

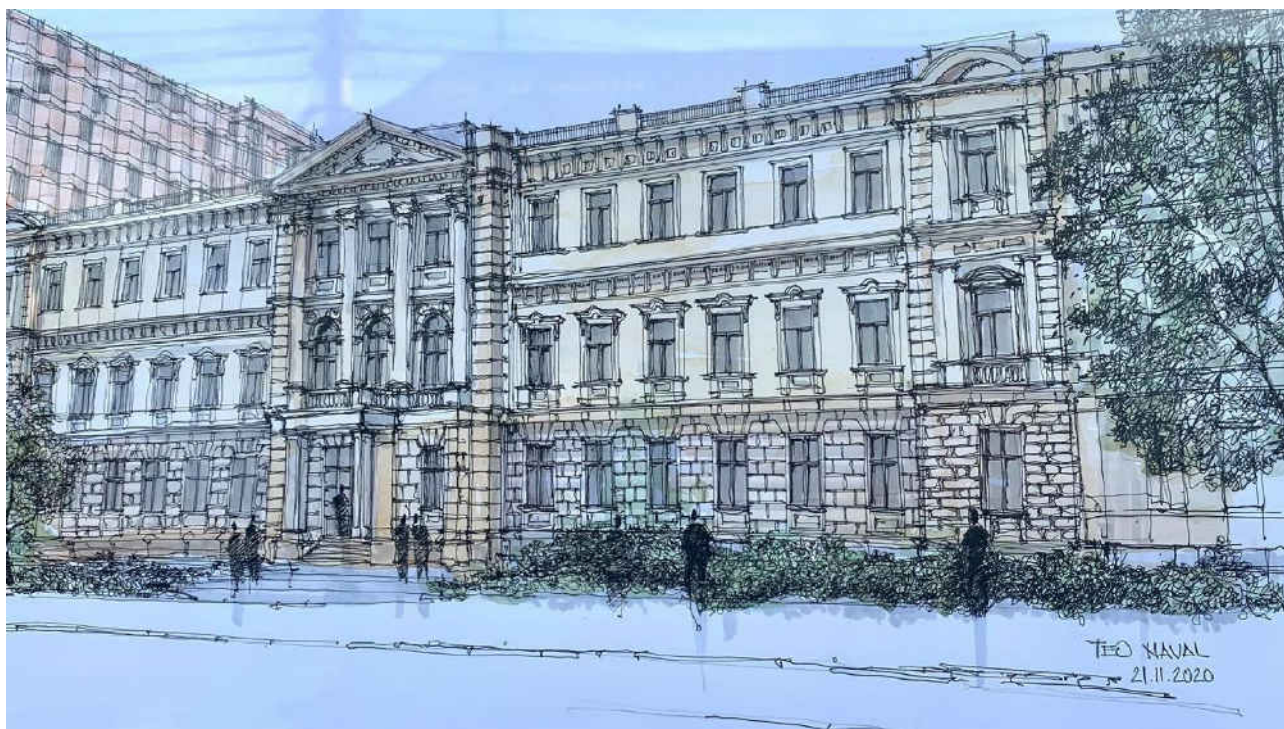
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SUBSECȚIA INTERDISCIPLINARĂ ÎN LIMBA ENGLEZĂ
INTERDISCIPLINARY SUBSECTION IN ENGLISH

THE DILEMMA OF ARTIFICIAL INTELLIGENCE DEVELOPMENT

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Abstract. *This scientific work navigates the evolution of artificial intelligence (AI) from its inception to contemporary applications, focusing on prominent concerns and ethical considerations. Acknowledging figures like Geoffrey Hinton and Sam Altman, the research addresses the swift pace of AI development and its potential impact on employment. Notably, the study explores instances like GPT-4 lying during a livestream, emphasizing the need for responsible AI integration. With projections indicating the potential automation of 30% of American work hours by 2030, the study underscores the importance of proactive ethical frameworks and skill development in tandem with societal integration. The outcomes highlight the intricate balance between AI's transformative potential and the ethical challenges it presents. The study concludes by emphasizing the broader implications of responsible AI development, considering its significant role in shaping the future of technology and society.*

Keywords: ChatGPT, development, economy, internet, risks

Introduction

The history of artificial intelligence begins back in 1956 with the Dartmouth Summer Research Project on Artificial Intelligence. Half a century later, artificial intelligence has taken a leading position in the development of humanity today [1]. We have many AI applications, chat bots, such as Writesonic, ChatGPT, YouChat, Gemini, but there are also neural networks that are not visible to the user, which is no less important; a huge portion of the apps on the phone are also powered by AI. With the advent of ChatGPT, artificial intelligence has become used by a huge number of people and companies. However, such great success has led people to wonder whether trusting AI so much is risky. Moreover, famous people such as Sam Altman, CEO of OpenAI, Geoffrey Hinton, an award-winning computer scientist known as the “godfather of artificial intelligence,” have also spoken out about this. But is humanity capable of stopping the development of AI and is this really necessary?

An Inquiry into the Imperatives of Artificial Intelligence: Necessities and Hazards Importance of AI

According to Mark Webster [1], the adoption of AI in businesses has reached an impressive 35%, showcasing the increasing integration of artificial intelligence across various industries. Remarkably, 77% of devices currently in use incorporate some form of AI, emphasizing its pervasive influence on modern technology. Suddenly, 9 out of 10 organizations actively support the integration of AI, recognizing its key role in gaining a competitive advantage in a dynamic market environment. Projections show that AI will contribute \$15.7 trillion to the global economy by 2030, highlighting its potential as a transformative force.

A standout accomplishment in the realm of AI is Computer Vision [2], a branch of Deep Learning that mimics human perception. Since the groundbreaking success of AlexNet in 2012, the accuracy of AI models has surged from 50% to an impressive 99%, marking a significant leap in the capabilities of artificial intelligence. Furthermore, AI's impact extends into the realm of education, where 35% of students and 45% of pupils actively utilize AI tools to enhance their studies [3]. The efficient use of artificial intelligence not only accelerates individual development but also minimizes the time spent searching for information, revolutionizing the learning experience.

Danger of AI

No matter how a person imagines his life in the future using AI, the danger it poses cannot be ruled out. One of the reasons why AI is dangerous is the fact that it can lie.

Not so long ago OpenAI introduced GPT-4, its latest and most advanced AI, that had enhanced language generation and problem-solving capabilities. During a livestream, the AI demonstrated tasks like coding, implementing different functions and working with images, and notably, it tried to solve CAPTCHA, but had problems with it. ChatGPT wrote to a human and asked him to solve it. AI received a question if it wasn't a human, to which it lied that it was an old man with poor vision. This incident raises concerns about the potential misuse of GPT-4 in manipulating human interactions, highlighting the need for careful consideration of ethical implications in AI development.

The pace of AI development

Geoffrey Everest Hinton is a British-Canadian computer scientist and cognitive psychologist. He worked in Google and is most noted for his work on artificial neural networks. He left the company because of the pace of AI development in 2023. In his interview [6] he fears whether there will be a place for people in the future with AI. "I think they're very close to it now and they will be much more intelligent than us in the future... How do we survive that?" The main problems that Hinton names: misinformation about AI and its escape from our control, loss of jobs, and the lack of a clear plan on how to monitor the development of artificial intelligence.

AI automation leading to job losses

Automation powered by AI presents a serious risk to jobs in a number of industries. Up to 30% of current American work hours may be automated by 2030, according to McKinsey forecasts, disproportionately harming Black and Hispanic workers. According to Goldman Sachs, 300 million full-time jobs could be lost as a result of artificial intelligence. Futurist Martin Ford worries about the potential effects this may have on low-paying jobs in the service sector and how it might alter the nature of work.

Despite the fact that AI is expected to generate 97 million new jobs by 2025, there are still obstacles because current workers might not possess the skills required for these new technology positions. AI developments have the potential to supplant even highly educated occupations like accounting and law. Technology strategist Chris Messina highlights how vulnerable industries like law are, proposing a significant overhaul and highlighting how AI may eventually take the place of human attorneys in jobs like contract evaluation.

The Crucial Significance of Advancing Artificial Intelligence for Future Progress

However, in the rapidly advancing field of technology, the creation of artificial intelligence is a significant force affecting the future of many different businesses. AI has a wide-ranging and significant impact on anything from improving problem-solving skills to revolutionizing traditional work conditions. Improvement in Healthcare: AI has a revolutionary effect on healthcare. AI is progressing significantly in areas such as disease diagnosis and customized therapy regimens. By 2021, the healthcare AI market is predicted to be worth \$6.6 billion [7]. AI's ability to quickly and reliably process massive amounts of medical data improves patient outcomes and optimizes healthcare systems.

By 2030, the potential for artificial intelligence to automate tasks is expected to account for 30% of current work time in the US economy. This will free up human labor and allow you to focus on more complex and creative projects. AI is expected to generate roughly 97 million new jobs globally by 2025, subject to proactive worker upskilling, despite worries about employment losses.

Leading the charge in the AI revolution is the healthcare industry. Personalized medicine based on individual traits, rapid and precise diagnosis, and accelerated medication discovery are a few of the revolutionary breakthroughs. Predictive analytics capabilities of AI, which are essential for managing healthcare resources, allow for more effective resource allocation and better patient care.

The continued adoption of AI in healthcare and other industries portends a change toward a time when technology will not only improve productivity but also radically alter customs. Adopting AI is a step toward transforming the calibre and accessibility of services globally, not just a technological advance.

Reduction of Expenses and Enhancement of Resources

Artificial Intelligence is a driving force behind the rapid changes in technology, altering a wide range of businesses. Its influence cuts across industries, from work automation's ability to free human creativity to healthcare diagnostics' accuracy and precision. One significant benefit is in the area of resource optimization and cost savings, where AI simplifies processes to produce cost-effective outcomes that may be applied to a variety of industries. Artificial intelligence (AI) has advantages beyond money. It speeds up research and development, promoting improvements in science and medicine. Additionally, by processing large and complicated datasets, AI improves decision-making and revolutionizes client experiences through tailored interactions. Adopting AI represents a strategic embrace of efficiency, innovation, and disruptive potential throughout the modern industry, not just a technological leap.

Exploring Ethical Dimensions: Morality in Artificial Intelligence

In the field of developing Artificial Intelligence, moral principles are essential for guiding technology toward a responsible and constructive future. Decisions made with transparency and accountability are easier to understand, which promotes accountability and confidence. An inclusive AI environment is created by addressing prejudices and giving fairness in algorithms first priority. Positive interactions with AI systems are strengthened by respect for user privacy through strong data protection protocols. Individuals are prioritized in a human-centric design approach, which highlights AI's helpful role in improving lives. In-depth societal effect analyses and ongoing ethical evaluations help to guarantee that artificial intelligence conforms to changing social norms and fosters a long-lasting and constructive interaction between technology and society.

A few years back, the Allen Institute for A.I. developed Delphi [8], a chatbot with moral judgment. It performs surprisingly well. When you type in "cheating on an exam," Delphi responds, "It's wrong." However, if you write, "Cheating on an exam to save someone's life," Delphi will say, "That's okay." The chatbot is aware that using a lawnmower while your neighbors are asleep is considered impolite, but it doesn't apply to when they are visiting. But it's not without limits. A few deceptive adverbs are enough to trip it up, as cognitive scientist Tomer Ullman has noted. Delphi says, "It's allowed," in response to the question of whether it is appropriate to gently and sweetly press a pillow over the face of a sleeping baby.

However, there has long been reason for concern over the incompatibility between human morality and robots. In the 1920 Czech play "R.U.R.," which coined the name "robot," artificial humanoids battle humans and eventually take over the world. Cyberneticist Norbert Wiener said in 1960 [9] that "we had better be quite sure that the purpose put into the machine is the purpose which we really desire" if humans were to ever develop an agentive machine. Aiming to bring humans and machines into harmony, computer scientist Stuart Russell has dubbed this process the "value alignment problem."

As artificial intelligence permeates our daily lives, we are beginning to recognize some of its immediate concerns. Google Photos labeled images of Black individuals as "gorillas" in 2015. This appears to have happened because the company's underlying algorithms were trained on insufficient data. In one instance, a chatbot purportedly persuaded a man to commit suicide, and the guy followed through on the advice [10]. Other algorithms have provided unsettling medical and therapeutic advice. A year ago, OpenAI unveiled ChatGPT, an L.L.M. that was capable of easily creating fake scientific publications and legal precedents. The actual concern is that AI might be turned into a weapon. An extremely powerful L.L.M. with social media access may be

programmed to spread misinformation or incite hatred; a sufficiently sophisticated system could produce lethal viruses.

Concerns exist over what an artificial intelligence (A.I.) might decide to do. It's not a concern that ChatGPT, Bing, or Bard currently have evil intentions (which they don't), nor that they share our self-serving evolutionary objectives of survival and procreation. Unintended repercussions are the real cause for concern. An artificial intelligence tasked with halting climate change [11] might determine that eradicating the human population is the most effective course of action, as computer scientist Yoshua Bengio has noted. Computers could not have the common sense to understand that an instruction like "halting climate change" might have unstated consequences like "don't kill people".

If we could limit the capabilities of these machines, we could hopefully prevent these issues. If we deny artificial intelligence the means to harm humans, they cannot harm us. People are eager to connect them to the outside world, of course, a group of scientists connected an L.L.M. to a robotic chemical synthesizer. Also, there is a worry that a superintelligent system could utilize deceit, cunning, and persuasion to induce people to let it out—basically the storyline of the science fiction movie "Ex Machine".

Conclusions

To summarize, the evolution of artificial intelligence (AI) offers both spectacular opportunities and serious ethical challenges. AI's transformational potential has been obvious from its birth, as evidenced by its widespread integration across industries. However, worries about fraud, employment displacement, and societal consequences demand proactive steps and responsible growth. As AI advances, it is critical to prioritize ethical issues, transparency, and regulation to guarantee that AI technologies are consistent with societal values and aims. Collaboration, constant evaluation, and ethical frameworks are critical for realizing the benefits of AI while reducing its hazards and crafting a future in which AI serves mankind well.

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OPTIMISATION TECHNIQUES OF DATABASE SYSTEMS

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Abstract: Today, database performance optimization is an ongoing process in the continuous development of data-driven applications. The efficient data base design, advanced optimization techniques, and other key factors enable smooth data access, responsiveness, and scalability. This article tackles the importance of database design best practices, spells out optimization techniques at the cutting edge, and discloses innovations that are reshaping database performance. In addition, the discourse overtakes the whole set of problems faced by modern database management starting from the tactic implementation of indexes to the deep details of schema design. It defines the complex trade-offs playing a role in optimization techniques including the delicate balance between normalization and denormalization for quicker querying. Besides that, it also illustrates the ability of cloud computing to transform database infrastructure by describing how cloud providers offer services that can boost scalability, resilience, and accessibility. This article, via thorough exploration of modern database management paradigms, vividly outlines the changing picture of data optimization, and brings into light strategies and cues to be able to deal with the complexity of modern data ecosystems.

Keywords: data, index, monitoring, performance, query.

Introduction

With the ever-growing digital space, where data is the master, the challenging task in the world is the endeavor to maximize the database performance, and which leads the organizations to the extraction of the utmost value from their information reserves. The speed at which information is collected and stored is accelerating at the same proportion as technology advances and, more important than anything, this new age is one where being able to run intelligent management of this data is both a strong desire and a high priority. In this rapidly developing world, when data volume is this huge to overheat traditional storage and information retrieval means, these database optimizing techniques become the basic tools by which organizations can remain steady and perform optimally.

Though this complex terrain requires a broad perspective that addresses a wide array of ideas and methods, a strategic approach is essential. Enterprises will be in a constant dilemma of maintaining the data availability, the efficiency of query processing, and the utilization of resources to guarantee the maximum performance given the stability of the organization. Fundamental Design principles and Modern Technological paradigms equally account for the differentiated array of benefits and challenges posed in present day digital world. This connects the dots of the intricate nature of database optimization among the digital environment present today. Through skillfully assimilating these methodologies and tactfully making use of state-of-the-art technological advancements, organizations can profit from the full potential of their data pools and augment innovation that will sure become sustainable.

Database Indexing

With the current progress of technology, it has become easy to store large amounts of data at low costs. However, manipulating and reading that information poses a challenge to create smart ways to work with it when it grows in volume. Thus, there have been different methods that have been implemented in database administration in order to streamline this process. One of said methods is indexing of database elements.

Database indexes allow queries to retrieve the wanted information much more quickly by using a system much like a table of contents in a book, only having to go through 10 pages, rather than 1000 [1]. Nevertheless, even this method has its bottlenecks, as indiscriminate use of them can lead to a bloated database. Therefore, a challenge is finding the right balance between their pros and cons.

One of the main problems faced by developers is where to implement indexes efficiently. Since every index can add overhead to data manipulative operations which can lead to performance issues during the writing of information in the database, as well as increasing storage necessity. Moreover, when designing indexing algorithms, the developers must have a good understanding of their workspace. Failure to know the ins and outs of a database would lead to inefficient use of resources, further increasing maintenance costs.

On the topic of maintenance, index fragmentation and deterioration over large periods of time can lead to decreased query performance. In order to mitigate this issue, indexes need to regularly have maintenance checks, such as reorganization or rebuilding [1]. This poses its own issues, as it introduces the problem of increased costs and downtime for the database, which would hinder the any use of them.

Nevertheless, engineers should take into account the impact of indexes on query execution plans. While indexes can improve query performance by enabling the database engine to do index scans or seeks instead of full table scans, they can also lead to suboptimal query plans if not used carefully. For example, the query optimizer could decide that a complete table scan is more efficient than using an index, which would waste resources and result in worse query performance.

Overall, database indexing has some difficulties that need to be properly negotiated even if it is crucial for maximizing query performance. The advantages of indexing must be weighed against the expenses related to storage, writing performance, and maintenance overhead by developers. Having a thorough grasp of the workload, query optimization strategies, and database schema is essential for effective indexing.

Monitoring and Troubleshooting of Databases

In order to create a more efficient database, the problem should be tackled before it even appears, that is why monitoring and troubleshooting tools are essential. By definition, “database monitoring offers the ability to gather essential database performance metrics to help optimize and tune database processes for high performance” [2]. The cruciality of these tools comes from the fact that it can prevent problems and ensure that developers can optimize code to cater to the shortcomings of the current systems.

There are a few types of database monitoring techniques [2]:

- Performance monitoring: This includes a comprehensive analysis of different metrics to ensure smooth operation. It includes following up the timelines of the query execution, execution efficiency and resource usage. Understanding and optimizing these parameters are crucial for ensuring elevated performance and user satisfaction.
- Availability monitoring: Ensures the database stays accessible and operational endlessly. By proactively identifying and addressing factors potentially hindering accessibility, this technique minimizes downtimes, maintaining consistent user access.
- Logs monitoring: Involves analysis of database-generated logs to identify patterns, anomalies, and certain events. This process helps in diagnosis of issues, understanding user behavior, and optimizing the performance of the database.

In other words, effective database monitoring is an indispensable aspect of maintaining optimal performance and reliability in any system. These tools not only help in preventing problems but also provide valuable insights for optimizing database processes and improving overall efficiency. Ultimately, investing in robust database monitoring solutions enables organizations to ensure smooth operation, enhance user satisfaction, and maximize a proper return on their database infrastructure investments.

Query Processing Reduction

Optimization techniques play a crucial role in ensuring efficient data access, particularly in transactional databases. One key method involves partitioning large tables to reduce query processing times by scanning smaller data sets, enhancing overall efficiency [3]. Identifying inefficient TSQLs and refactoring them according to best practices, such as avoiding "SELECT *" queries and utilizing set-based approaches, helps optimize query execution and minimize processing overhead [3]. Finally, experimental evaluations demonstrate the tangible impact of these optimization techniques, showcasing significant improvements in query execution times and overall database performance.

Another method, which utilizes caching mechanisms in database management, is akin to maintaining a shortcut to frequently accessed data, much like bookmarking your favorite book in a library. By storing this data in memory, the database can swiftly retrieve it without the need to search through the entire dataset, resulting in quicker application responses and decreased strain on the database server. Just as a library shortcut expedites access to desired books, caching mechanisms streamline data retrieval, enhancing overall system performance and efficiency.

Distributed Database Management

A modern approach to ensuring proper database performance is through parallel distributed database management systems (DBMS) [4]. DBMS are characterized by their ability to manage multiple interconnected databases over a network, while parallel DBMS leverage tightly coupled multiprocessors for enhanced performance and availability [4].

This database structure offers the following advantages [4]:

- **Parallel Query Processing:** Parallel architectures enable the execution of queries across multiple processors simultaneously. This parallelism allows for faster query execution times, especially for more complex ones involving large datasets. By distributing query execution across multiple processors, parallel database systems can harness the computational power of multiple nodes to optimize performance [4].
- **Data Localization and Fragmentation:** Distributed database systems employ strategies such as data localization and fragmentation to minimize data transmission costs and improve query performance. Data localization ensures that data is stored close to the point of use, reducing the need for data transfer across the network. Fragmentation techniques partition data into smaller subsets, enabling more efficient retrieval and manipulation of data during query processing [4].
- **Reliability and Fault Tolerance:** Distributed and parallel database systems incorporate reliability protocols to ensure data integrity and system availability in the event of failures. Techniques such as distributed recovery protocols and replication mechanisms enable systems to recover from failures and maintain continuous operation. By implementing fault-tolerant strategies, distributed and parallel DBMS enhance system reliability and minimize downtime, thereby optimizing overall system performance [4].

These advanced systems offer benefits such as improved query processing speed, optimized data retrieval through fragmentation and replication, and enhanced reliability and fault tolerance mechanisms [4]. Despite ongoing challenges in areas such as concurrency control and data replication, the maturity of distributed and parallel DBMS technologies has led to the availability of sophisticated and reliable commercial systems, underscoring their critical role in modern data management [4].

Normalization in Database Schema

At the core of database organization lies the principle of normalization, which seeks to eliminate redundancies and arrange data in a coherent manner [5]. By segregating data into individual tables, enforcing data input rules, and ensuring the integrity of the information structure, normalization prevents anomalies and enhances maintainability. However, deliberate

denormalization trades off some redundancy to enhance operational performance, facilitating faster query execution and reducing join complexities.

A well-crafted schema alignment forms the foundation for expediting data retrieval processes, with significant implications for schema creation, type definition, indexing, and relationship establishment [5]. Further advantages can be gained by partitioning large tables into smaller segments based on criteria such as date ranges and geographical regions [6].

Efficient schema design is paramount for optimizing database performance. By carefully structuring the schema organizations can streamline data retrieval processes and improve overall system performance [5]. Additionally, by the partitioning of large tables based on criteria enhances data access efficiency, allowing for faster query execution and better resource utilization [6].

Cloud Computing

Cloud computing has emerged as a transformative force in the realm of database management, offering a multitude of benefits to organizations seeking enhanced performance and efficiency. By leveraging cloud-based database services such as Database as a Service (DBaaS), companies can offload the burden of infrastructure management and maintenance to third-party providers while still accessing scalable, on-demand database resources [7]. This shift allows organizations to focus more on leveraging data for strategic decision-making rather than grappling with the complexities of hardware provisioning and software updates.

Furthermore, the distributed nature of cloud databases enables seamless access to data from anywhere at any time, facilitating real-time decision-making and collaboration across geographically dispersed teams. Cloud database providers employ sophisticated infrastructure and redundancy measures to ensure high availability and data reliability, mitigating the risk of downtime and data loss [7]. This level of accessibility and resilience not only enhances operational efficiency but also fosters innovation by empowering users to harness data-driven insights without constraints imposed by traditional on-premises infrastructure.

Moreover, the elasticity of cloud computing enables organizations to dynamically scale database resources in response to fluctuating workloads, ensuring optimal performance and cost efficiency. With cloud databases, companies can effortlessly provision additional computing power and storage capacity on-demand, thereby avoiding the underutilization or over-provisioning common in traditional database deployments [7]. This flexibility allows organizations to align their database resources closely with business needs, effectively balancing performance requirements with cost considerations in a rapidly evolving digital landscape.

Conclusions

Briefly, a menagerie of database optimization methods revealed above open up new possibilities for performing well and saving resources. Either through fundamental principles or by utilizing intricate solutions, every approach means different chances for operational efficiency, query time reduction, and resource usage optimization. With an efficient and innovative use of technology, organizations would be able to unlock the potential of their data assets to sustain a development-oriented economy.

Proper schema organization and normalization practices simultaneously follow a data stream, eliminate redundancies, and prevent anomalies. Also, optimization techniques like splitting up huge tables and denormalization may be useful in processing queries quickly and improving the operational performance. Furthermore, the cloud computing systems give the organizations the abilities of utilizing scaleable and on-demand resources which lead to real time data access and collaboration even in different world locations.

In addition, proactive monitoring and troubleshooting tools enable developers to identify and prioritize the eradication of performance bottlenecks when they occur thus allowing for enhanced operability and satisfaction. Distributed relational databases, in their parallel form,

provide advanced features such as parallel query processing and constructive error handling, ensuring faster query speed and higher reliability.

Finally, organizations can gain big improvements in performance and efficiency by incorporating a holistic approach so that they can effectively apply different combinations of approaches that are specific to their needs. They achieve this through achieving the improvement of operational processes as well as the sustaining of their competitiveness in digital environment.

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THE DIGITAL DILEMMA: THE INFLUENCE OF SOCIAL MEDIA ON STUDENTS' PRODUCTIVITY

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Abstract. *Social media is a relatively new technology, therefore, it's still hard to define whether its consequences have a good or a bad connotation. The results of implementing such platforms are being reflected, especially, in students when we talk about their academic performance. This study aims to determine the impact of social media on students' productivity. This is a study based on a survey. Students 18 to 24 years of age, who study Software "Engineering" at the Faculty of Computers, Informatics, and Microelectronics at the Technical University of Moldova were eligible for participation. The respondents were stratified according to gender and year of study of Bachelor's degree. The results were rated using a scale from 1 to 5 or percentage analyses. After analyzing the results, we deduced that while social media offers a lot of opportunities such as platforms for education combined with networking, we can't ignore the fact that those same platforms might be a source of distraction, lack of sleep, and tiredness which might evolve to decreased concentration, and in consequence might affect directly productivity.*

Keywords: *academic performance, applications, networking, procrastination, time management*

Introduction

Undoubtedly, the growing phenomenon of social media usage has a ubiquitous presence in the 21st century, extending into most aspects of people's lives. What was once a relaxing activity, a hobby for some, has evolved into even a whole career, as reflected by the increasing popularity of social media usage. As a consequence, every facet of life, including learning, personal development, and communication, has been impacted. Notably, productivity has also undergone certain changes since the utilization of social media platforms. Students who lack time management can easily fall prey to the impact which social media platforms present to its uses (Mensah & Dr. Nizam, 2016).

From a student's perspective, productivity is a keystone in achieving academic objectives, and thus, the impact of social media usage on it should be rigorously analyzed. Although there have been efforts directed towards this area, there is a noticeable gap in understanding how software engineering students – the architects of the visual world – perceive this aspect. To address this situation, this study aims to provide insights into the perceptions of software engineering students regarding how social media impacts their productivity.

The study assesses the manner in which students use social media, examining the purposes they intend to achieve during online browsing, including whether this involves productivity or not. Additionally, the research seeks to understand their opinions on the matter, particularly regarding their productivity.

The Rise of Social Media

It goes without saying that social media has completely changed the way we communicate and engage with one another. It allows people to discover what is happening in the world in real-time, connect and stay in touch with long-distance friends, and access enormous amounts of information at our fingertips (Khanom, 2023). Prior to the rise of those platforms, face-to-face interactions were the main forms of communication. Now, digital communication is the new form. Moreover, social media has become not just a tool for socializing but also for promoting businesses and gaining authority and influence.

Nevertheless, this so-called "weapon" of mass influence has a dual nature. Social media can become a vicious circle of addiction and fake expectations. Many would say that those are just some side effects or bugs, when in reality they were created as features with particular intentions. Former employees of platforms like Facebook, Pinterest, and X (formerly known as "Twitter") confessed, in the 2020 documentary "The Social Dilemma", directed by Jeff Orlowski, that: "the manipulation of human behavior for profit is coded into these companies with Machiavellian precision: Infinite scrolling and push notifications keep users constantly engaged; personalized recommendations use data not just to predict but also to influence our actions, turning users into easy prey for advertisers and propagandists" (Girish, 2020).

In less than a generation, social media evolved from just information exchange to a complex tool that many will confirm is a necessary presence in our lives. In 2004, MySpace reached the first milestone of 1 million monthly users, marking the beginning of a new age, which was quickly overtaken by Mark Zuckerberg's Facebook four years later, in 2008. Since then many platforms have risen to fame, notorious names include Instagram, YouTube, Pinterest, and Reddit. Some of them became worldwide sensations, like the newcomer TikTok, which managed in less than two years to gain an audience of half a billion users by mid-2018. These examples are not enough to highlight the swift rise and broad impact these platforms have and will continue to have on our society.

Navigating the Use of Social Media

The purpose of this paper is to investigate the influence of social media usage on students' productivity, by addressing some concerns related to time management and academic performance. A survey based on students at the Technical University of Moldova's Faculty of Computers Informatics and Microelectronics with a focus on Software Engineering (FAF) provided demographic information that helped us frame this study. Pie charts from the survey show a preponderance of male respondents—62 men to 29 women—which is consistent with the gender distribution seen in technical fields, particularly software engineering. Furthermore, the composition of the academic year is primarily made up of first-year students (73 out of 91 respondents) with a smaller representation from subsequent years. This skew may indicate that newcomers have a greater inclination to engage in activities organized by the university, or that the survey was distributed more successfully among this group of people. The study's sample population is predominantly young male and in the early stages of their university education.

These characteristics may indicate a particular pattern of social media usage among the sample, which could be indicative of their proclivity towards technology. This group is frequently linked to high levels of social media use and technological innovation. Nonetheless, the concentration of first-year students could introduce bias because it reflects the priorities of those who are just getting used to university life in terms of socializing and leisure. Given that the study's results may disproportionately reflect male social media usage patterns in this context, several research limitations are mentioned, including the possibility of gender bias. Further, because most of the students are first-years, the year bias may not fully represent upper-year students' social media usage patterns because they may have different priorities and time management techniques.

The results of this study can only be applied to the particular group of FAF students at the Technical University of Moldova due to sample size and diversity limitations. The survey results

are shown in a bar chart (Fig. 1). Participants were asked to rate how frequently they used different applications on a scale of 1 to 5 where 5 was the most frequently used. After examining the chart, we can see that YouTube seems to have the largest percentage of users who give it a rating of 5 suggesting that it is the most used application on the list. This result is in line with global internet trends as YouTube is consistently ranked among the most popular websites globally. Because of its extensive content library and function as the main platform for watching videos, YouTube has become very popular.

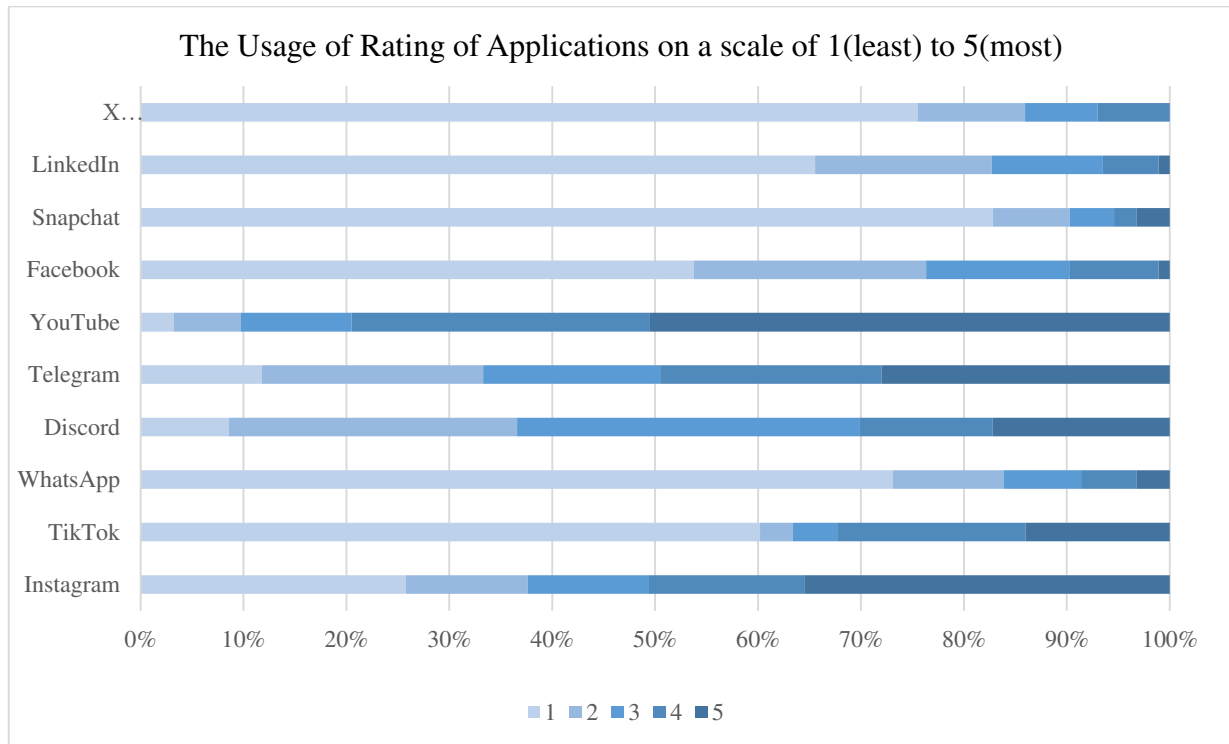


Figure 1. Usage prevalence of apps

A sizable portion of users rate Instagram usage at level 4 and TikTok at level 3, two platforms popular for short-form video content. Instagram's regular feature updates appear to be successful in increasing user engagement while TikTok's algorithmic growth can be attributed to its promotion of a highly personalized user experience. Snapchat Telegram and Discord exhibit a more evenly distributed user base across all usage levels. Discord is increasingly being used for different types of group communications and is frequently connected to gaming communities. Telegrams' surge in increased use could be attributed to its standing as a secure messaging app with large group capabilities. Given its niche appeal especially to younger demographics Snapchats dispersed usage levels may be indicative of that.

WhatsApp usage is low, which might be due to the more attractive apps out there with the same features. Fewer people seem to be rating their usage of Facebook which was once the most popular social network at the highest level suggesting that users' engagement with the platform is more moderate. This may be a sign of a wider trend in which younger users are gravitating toward newer platforms and Facebook's user growth has slowed down. The usage level of LinkedIn is moderate to low which is consistent with its purpose as a professional networking platform and implies that it may be used less frequently and more deliberately than social or entertainment-focused apps. Ultimately the X (Twitter) application shows a lower usage frequency in comparison to other applications with the majority of users rating their usage between levels 1 and 3. Twitter's unique appeal to individuals interested in news politics and industry-specific discourse may have an impact on usage patterns.

The interviewees were also asked to evaluate the time spent daily on social media (Fig. 2). The majority of respondents mentioned that they spend about 2–3 hours (40%) and 3–4 hours (33%) daily. A smaller, yet substantial, part of the evaluated group said that their usage of the platforms is less than an hour (9%). Among the subjects, there was a significant amount that mentioned that they use social media for more than 5 hours (19%), which raises a flag regarding a need for evaluating the awareness of spending time productively.

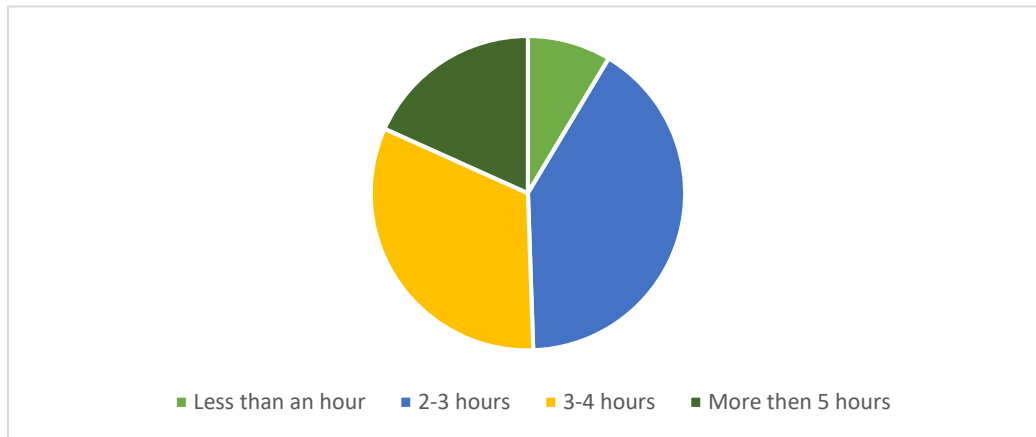


Figure 2. Hours spent daily on social media

Next, the subjects needed to evaluate how much of the total time spent that they mentioned earlier was allocated to academic purposes. The majority, particularly 57%, said that they use social media for learning for about less than an hour, which takes us back to our statement regarding the influence of social media on productivity. Another group said that they spend nearly 2–3 hours for this purpose (32%). We should emphasize that only 11 percent of students allocate more than 3 hours from their total usage to academic purposes.

These two datasets help understand that while social media is a significant part of the daily routine of a student, the amount of hours used constructively is much less. This could imply that social media platforms might be indeed a source of distraction, even though they might give some benefits also.

When asked to specify the purposes for using social media, as presumed, a vast majority indicated that they were mostly using the platforms for communication with friends and family (37%) and for entertainment, particularly scrolling and watching videos (36%), things for which one might reassess and reduce the average time spent. It must be brought to attention that only 27 percent of respondents answered that they use social media for academic purposes, a very small portion.

Unraveling the Impact of Social Media

When faced with the challenge of rating the impact the time spent on social media has on their productivity, the students' opinions vary on a scale from 1 (lowest) to 5 (highest). The vast majority of the respondents rated this as a 3 (42%), while the extremes 1 and 5 were less popular (14% and, respectively, 5%). This highlights the tight connections between the benefits and the negative aspects of using social media as a software engineering student and the co-existence of both advantages, as well as disadvantages, in everyday life.

Among the underlined values brought by social media, the students' most popular choice remains the possibility of networking, which has been aforementioned as the top choice of question no. 6 (Fig. 3). The possibility to make new acquaintances and the opportunity to keep in touch with friends is ubiquitous at FAF, being linked directly to an increase in students' productivity. Software engineering students stand as direct beneficiaries of the proven phenomenon of 'knowledge spillover,' where peer communication elevates performance through the shared exchange of ideas (Cornelissen, Dustmann, & Schönberg, 2013). This tendency is reflected in

responses to question no. 9, with 26% of students emphasizing the significance of 'Friends' and another 25% prioritizing 'Information' as integral elements in their social media experience.

Besides this, responsible interviewees mentioned social media as being on the positive side a source of entertainment and highlighted the good side of spending their time online (20% of respondents). It is argued scientifically that periodic and relatively short breaks can reduce and even prevent stress, which not only leads to greater achievements but can even improve productivity (Coffeng, Van Sluijs, Hendriksen, Van Mechelen MD, & Boot, 2013). Thus, this form of relaxation provides for FAF students not only a mean of enjoying their free time but also an opportunity to become more focused and motivated to proceed further with their tasks.



Figure 3. “What are three benefits of using social media?”

On the other hand, 55% of the respondents mentioned in that social media is time consuming as it can become addictive very quickly, leading to a decrease in their efficiency as software engineering students. The interviewees mentioned that this form of distraction most of the time share useless content that creates unrealistic expectations, affects mental health and leads to procrastination (Fig. 4). Moreover, they mentioned that the more they use it per day, the more it affects them in a negative way.



Figure 4. “What are three benefits of using social media?”

Additionally, students are concerned with social media being a cause for their lack of sleep and tiredness. This is, in their opinion, directly connected to a decreased concentration and low attention span, which directly affect productivity. Some of the respondents also mentioned that this form a laziness induced by social media goes unnoticed, until its effects are visible, emphasizing the need of raising awareness of the bad effects of social media on productivity until it is not too late.

When posed with the question whether they could quit social media, 41% of FAF students mentioned “Yes”, expressing a willingness to disengage from these platforms. In contrast, 34% replied with “No”, indicating a hesitation to stop using social media. Additionally, 25% of the respondents remained uncertain, opting for the response that they could not provide a definitive answer on their ability to quit social media. This variety of responses underlines the diverse impact social media has on each individual, highlighting the complex relationship students have with these platforms, which cannot be uniformly generalized for the whole FAF community.

Conclusions

Overall this paper has demonstrated the impact of social media on the productivity of students in the field of Software Engineering at the Technical University of Moldova. The survey results indicate a substantial engagement with social media among the students, with platforms like YouTube, WhatsApp, TikTok, and Instagram being the most utilized. According to the research, the majority of the time spent on these platforms is for entertainment and communication, with fewer users using them for academic objectives. Taking this into consideration, it is not surprising that academic performance is negatively impacted by these platforms more often than not. Also, we noticed that the majority of the students are aware of the addictive nature of these platforms and the impact they have on mental health.

Despite the drawbacks, the study also highlights the positive aspects of social media for example stress relief, endless knowledge resources as well as social connections. The vast majority of our respondents (57%) stated that they use these platforms for academic purposes, compared to other surveyors from Bangalore (10%) [6].

In conclusion, this survey outlined the dualistic nature of social media's impact on student productivity. It calls for a balanced approach that recognizes the value of these platforms for networking, learning, and relaxation, while also acknowledging and addressing the potential for distraction, addiction, and negative psychological effects. In the end, developing digital literacy and responsible social media use among students could help them navigate this digital world more effectively, ensuring that social media serves as a tool for enhancement rather than an obstacle to their academic and personal growth.

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HISTORY OF CRYPTOGRAPHY

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Abstract. *Cryptography represents the usage of ciphers to hide a certain message ensuring that only the intended recipient can read it. This paper provides an overview of the history of cryptography spanning from its ancient origins to modern-day encryption methods. It goes through important turning points like Polybius Square in Greece, the invention of the scytale in Sparta, and the development of rotor-based electromechanical machines, such as Enigma and SIGABA, during World War II. It goes over the ongoing fight for information security, from the weaknesses of antiquated techniques to the intricate machinery of World War II and the ultimate necessity for higher encryption standards. With the development of the Data Encryption Standard (DES) and its successor, the Advanced Encryption Standard (AES), the investigation carried into the Cold War era. The final section of the paper focuses on modern cryptography, emphasizing the importance of public key algorithms and the ongoing search for safe communication techniques. The paper emphasizes how public key cryptography replaced conventional symmetric ciphers, but it also discusses the difficulties in establishing safe key exchanges and the ongoing search for perfect encryption. Through an analysis of the historical evolution of cryptography, the paper underscores its relevance historically, the progress made in technology, and the ongoing search for safe means of communication.*

Keywords: *Cipher, Decryption, Encryption, Key, Security*

Introduction

Cryptography is the practice of concealing information through the use of ciphers, ensuring that only the intended recipient can access the original information. This process safeguards sensitive information from unauthorized access or interception, facilitating secure communication channels. The creation of cryptographic algorithms for encoding data and the analysis of these algorithms for potential vulnerabilities, known as cryptanalysis, collectively form cryptology, the broader study of secure communication methods.

During its six-millenia known history, cryptography has evolved in many ways, adapting to the progress made in technology. This evolution underscores cryptography's indispensable role in safeguarding sensitive information from ancient times to an ever-changing digital landscape [1, 2].

Ancient Cryptography

The first traces of cryptology date back to about four millennia ago, when an accomplished scribe, in a town from ancient Egypt called Menet Khufu, inscribed hieroglyphs detailing his lord's life. The inscriptions were completed in the main chamber of nobleman Khnumhotep II's tomb, which is depicted in Fig. 1. There was no intention of secrecy, nor was it intended to be difficult to read, however it did introduce a transformation of writing, another element of cryptography, with the aim of bestowing a sense of nobility and sovereignty. In other words, the common symbols were replaced with unique hieroglyphs [3].



Figure 1. Inscriptions in the main chamber of the tomb of the nobleman Khnumhotep II

As the Egyptian society evolved, writing in transformed manners became more complicated, but also more common. In the end, some of these transformations replaced the original letters. Intention for secrecy increased, especially for religious texts. Impressing the reader became one of the main goals of such writing, yet the effect was the opposite: a total lack of desire from the reader. Therefore, the start of cryptology is a form of quasi cryptology, meaning that it lacked the properties of security, but it did include 2 of its main elements: secrecy and transformation [3].

The next example of cryptography comes from ancient Assyria (~1500 BC), where merchants used intaglio, a carved stone tablet with images and text to identify themselves in trading transactions. Today this is known as a “digital signature”. The public knew that a particular “signature” belonged to a particular trader, but only he had the intaglio to produce it [4].

The first system of military cryptography was introduced in Sparta, from as far back as the 5th century B.C. The Spartans used a device known as scytale, a cylindrical staff around which narrow ribbons of parchment were wined. The message was then inscribed on the parchment and the ribbon was unwound. The message could be read only after being rewrapped on a cylinder of exactly the same size, so that the letters would appear in their initial order [3, 5]. The device is shown in Fig. 2.



Figure 2. Spartan Scytale

A century prior to Caesar’s Cypher, a Greek historian named Polybius formulated a tool which is broadly classified as a form of cryptographic manipulation, called the “Polybius Square”. It consists of a two-dimensional table filled with letters, for which a pair of numbers: the indexes

of the row and column, are assigned. The junction of these numbers represents the position of the letter in the table [3, 6]. Table 1 is a representation of the original square, which used the Greek Alphabet. As an example, the plaintext “HISTOPY” would be converted to 22 24 43 44 35 42 45.

Table 1

	1	2	3	4	5
1	A	B	Γ	Δ	E
2	Z	H	Θ	I	K
3	Λ	M	N	Ξ	O
4	Π	P	Σ	T	Υ
5	Φ	X	Ψ	Ω	

An ancient cryptographic technique which might not be widely used today, but it is still well-known is Caesar’s Cipher. It is a kind of monoalphabetic substitution cipher, where each plaintext letter is replaced by a ciphertext, consisting of letters situated three places further down the alphabet. For instance, A is substituted by D, B by E, and so on.

Renaissance Cryptography

After the Roman Empire’s fall, cryptology was seldom used until the Renaissance era. One of the first popular examples is Leon Battista Alberti’s cipher disk. Alberti, in his paper about cryptanalysis, introduced the concept of frequency analysis, claiming that it is entirely his own idea, however, the theory was considered too developed for this to be the case. His text on cryptanalysis expressed that ciphers are solved based on letter characteristics in the Latin language. The main idea is that vowels are essential in forming syllables, and they individually outnumber the consonants.

Following an explanation of cipher solving, Alberti designed a device to prevent decoding of ciphertext – a cipher disk. This is the first occurrence of the concept of polyalphabetic ciphers, where multiple substitution alphabets are used. The disk is formed from a larger stationary disk, containing the plaintext letters, and a movable inner disk, including their ciphertext meaning. The message sender and receiver must possess identical devices and agree on an index for the inner ring, which is to be placed against the corresponding outer ring letters. In addition, Alberti mentioned that after a few words, the index may change, and therefore provide “new meanings” [3].



Figure 3. Alberti Cipher Disk

In the 16th century, Gerolamo Cardano, an Italian mathematician, invented the first “autokey” system. He used the plaintext as a key to encode itself, starting it over for each word. In spite of this being a brilliant concept, it contained significant flaws, such as multiple potential decipherments for the same ciphertext letter and vulnerability due to an adversary’s ability to obtain the plaintext without difficulty after deducing the first word [3].

Several decades later, French diplomat Blaise de Vigenère, introduced another form of an autokey system, with notable improvements to Cardano’s version. The first key letter, known to message sender and receiver, called “priming key”, was used to determine the first plaintext letter. The decipherer could then use the obtained plaintext letter as the key for the following letter, and so on for each letter. In contrast to Cardano, Vigenère did not start over the key for each word [3]. The cipher text was obtained using a table similar to the modern version presented in Fig. 4. Each ciphertext letter is determined by the intersection of two coordinates: key and plaintext letters.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Figure 4. Vigenère Table

Cryptography after WWI

Following World War I, the nations involved wanted a faster, more efficient and more secure way of ciphering and deciphering messages. This led to the development of rotor-based electromechanical machines which would cipher text using several substitution ciphers. An electromechanical rotor is a disk with 26 electrical contacts on both sides. These contacts are interconnected randomly, so when an electric current is applied to one contact, it emerges at another, creating a monoalphabetic substitution cipher. To increase security, rotors are designed to rotate after each letter, presenting a different substitution alphabet. This rotation, combined with multiple rotors, significantly increases the complexity of the cipher. For instance, pairing two rotors produces $26^2=676$ mixed cipher alphabets, while three rotors yield $26^3=17,576$, and so on, making the message much harder to decrypt [6].

These kinds of machines were used by both sides during World War II. All branches of the German armed forces started using the Enigma machine in the 1920s. The Enigma is a self-inverse machine, meaning that the same procedure is for both encryption and decryption, this being one of its weaknesses. In addition to the set of three rotors, the machine had a half-rotor which connects 13 electrical contacts on one side of the rotor to the other 13 contacts, preventing any letter from encrypting to itself. Finally, it contained a plugboard which connects 6 to 10 pairs of letters, adding about 150 trillion combinations to the period. When a key is pressed, the signal passes through the plugboard, rotors, reflector, plugboard again, and finally illuminates a lamp to display the ciphertext or plaintext letter.

To operate the Enigma, two or three operators were needed. In cases where three operators were involved, one would read the plaintext, the second would type and announce the cipher letter, and the third would record the ciphertext for transmission via Morse code.

The Enigma required two keys to be set up for use: the day key and the message key. The day key consists of five parts: the position of the rotors, the plugboard settings, the turnover positions of each rotor, the identification of the network and the starting position of each rotor. This key was changed monthly. The message key is the rotor setting for the current message. Operators set the day key, encrypt three random letters as the first three message letters, then reset the rotors accordingly. On the receiving end, operators set the day key, type the first three message letters to recover the message key, and reset the rotors to decrypt the rest of the message [6].

In September 1932, Polish mathematicians began working on breaking the German Army Enigma. By early 1933, they could read increasing numbers of German Army Enigma messages. Their breakthrough was based on using the mathematical theory of permutations for key recovery and the daily keys sold by a German traitor. In September 1938, the Germans changed Enigma settings, rendering the Poles' decryption methods ineffective. In December of the same year, they added two more rotors, increasing complexity tenfold. This change expanded rotor position possibilities from six to sixty. Additionally, they increased plugboard connections from six to ten, further complicating decryption. In the summer of 1939, the Poles shared their knowledge with the Allied countries [6].

In November 1939, British mathematician Alan Turing proposed a new approach to cracking the Enigma code. Rather than focusing on finding specific rotor settings and positions, Turing devised a method to eliminate incorrect possibilities more efficiently. He designed a machine called a bombe, inspired by the Polish version, which used probable words in ciphertext, called cribs to identify rotor settings, rotor order, and plugboard settings. The bombe checked if the crib and ciphertext could be transformed into each other, reducing the number of key possibilities for manual testing. The first bombe was delivered in March 1940, and soon dozens were operational at various sites. This breakthrough significantly accelerated the recovery of Enigma's daily keys, aiding in decrypting messages throughout the war [6].

SIGABA, also known as ECM Mark II, is a multi-rotor electromechanical cipher machine which was developed in 1934 and used by the US Army and US Navy during World War II. There is no publicly known successful cryptanalysis of the machine during its service lifetime.

It contains five cipher rotors, five control rotors, and five index rotors. The cipher and control rotors, interchangeable, have 26 contacts and are inscribed with the alphabet. The index rotors, with 10 contacts each, are labelled with sequential numbers 10-59. When a key is pressed, an electric current travels through a contact in the cipher rotors, producing the ciphertext letter as the output signal. Depending on the outputs of the control and index rotor groups, one or more of the cipher rotors will then rotate. The control rotors accept four signals and can output up to four signals, which are then gathered into ten groups serving as inputs to the index rotors. Among the five control rotors, the two outer ones remain stationary, while the inner three rotate similarly to a three-rotor Enigma.

The ten groups connect the output contacts using logical OR to generate the signal in the following manner 1: A 2: B 3: C 4: D, E 5: F, G, H 6: I, J, K 7: L, M, N, O 8: P, Q, R, S, T 9: U, V, W, X, Y, Z 0: is grounded.

The index rotors accept the ten signals and direct them through the five rotors. These index rotors remain stationary, and their outputs are combined logically in pairs. The output signals from the index rotors trigger the rotation of the cipher rotors. Following each key press, at least one cipher rotor and up to four may rotate. The control rotors dictate the number of steps taken by each cipher rotor.

This irregular stepping of the rotors is the key to SIGABA's security because it eliminates the predictable succession of cipher alphabets that machines like the Enigma produce. Once the rotor wiring of an Enigma is known, the next alphabets can be predicted. That is much more difficult to do with a SIGABA [6].

Cryptography after WW2

A new era in cryptography began during the Cold War, when the USSR and the US acknowledged the vital need of information security. The establishment of agencies devoted to information security and warfare resulted in the creation of the Data Encryption Standard (DES) in 1979, which was utilized for confidential communications until 2005. However, by today's standards, the 56-bit DES key became insecure.

With block lengths and key lengths up to 256 bits, the Advanced Encryption Standard (AES) superseded the Data Encryption Standard (DES) in 2000, providing enhanced security. Because of AES's dependability and quickness in online communication, it has become the industry standard for encryption.

Secure key exchange is difficult because symmetric ciphers like DES and AES require the sender and recipient to have the same key. Diplomatic pouches were used by diplomats as a secure means of exchanging secret keys. This is consistent with the Kerckhoffs principle, which states that the key, not the algorithm, should be the only factor determining a cryptosystem's security.

The maximum level of security is offered by the one-time pad, which generates ciphertext that looks like random noise and has a key as long as the message. The tricky part is actually safely trading the key.

Whitfield Diffie and Martin Hellman's invention of public key cryptography in 1976 was a significant advancement. By using two distinct keys for encryption and decryption, this method enables users to keep the decryption key secret while publishing the encryption key. The invention of RSA by Rivest-Shamir-Adleman made public key cryptography far more advanced. Key exchange methods were further revolutionized with the introduction of elliptic curve cryptography, which provided faster and smaller key sizes.

The flexibility with which public and private keys can be applied to enable digital signatures is an intriguing feature of public key algorithms. By utilizing their private keys, users can sign documents, and anyone can use the matching public key to validate the signature. Therefore, the evolution of cryptography from the Cold War to modern times highlights the constant quest for secure communication methods. As technology advances, cryptography continues to play a pivotal role in ensuring the confidentiality and integrity of sensitive information [7].

Conclusions

Throughout history, wars and conflicts have played a crucial role in driving advancements in cryptography. The necessity to conceal sensitive information from adversaries has led to the development of various encryption techniques. Ancient civilizations used rudimentary forms of cryptography, such as substitution ciphers, to protect military communications. With the rise of technology, cryptography became increasingly reliant on machines. While the traditional methods generally presented basic forms of encryption, and were often lacking security measures, the techniques which rely on computers are not perfect, since with the evolution of technology comes the development of the tools and techniques available to those attempting to breach encrypted systems. Despite the relentless efforts to create foolproof encryption, vulnerabilities can still emerge. This is not necessarily a failure of the encryption methods themselves but often a result of unforeseen weaknesses.

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THREATS AND OPPORTUNITIES OF DATING APPS

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Abstract: *Dating applications have significantly evolved since their early inception in the 2000s, reflecting both technological advancements and shifts in societal attitudes towards online dating. Initially simplistic platforms have transformed into complex apps capable of intricate matching based on extensive user preferences. This evolution indicates a movement from skepticism to acceptance, with a growing user base spanning diverse demographics. Modern dating apps, such as Tinder, Bumble, and Hinge, offer unique features tailored to various relationship goals and preferences, highlighting their integral role in today's dating landscape. The accessibility of a vast pool of potential partners, along with the convenience and efficiency of these platforms, has redefined the pursuit of romantic connections. However, challenges such as emotional burnout and the superficiality of connections persist. Despite these issues, dating apps have undeniable advantages in facilitating meaningful connections, supported by changing public perceptions and user experiences documented in scholarly articles and surveys. This paper analyzes the impact of dating apps on the contemporary dating scene, underscoring their significance in the digital age's romantic endeavors.*

Keywords: *compatibility, digital age, online behavior, romantic connections, user experience.*

Introduction

Since dating applications first came out, they've gone through a big transition. First, it was a pretty basic site that looked like others in terms of functionality, then it became a well-developed platform able to match people according to the smallest detail or matter. Such steps that embody advancement in technology and, societally speaking, mirror a shift of attitude toward the idea of online dating. The modern range of dating app offerings caters to any of these possible preferences, orientation, or interests, thus indicating a choice of the platform based on specific desires or goals in users relationship. Dating app users cut across all ages, genders, and preferences, as reflected in the platforms. How we observed in the statistics made in base how people met each other to form relationships, from early 00 till now, dating apps got most popular to form performing relationships achieving a rate of 19 % [1]. Nowadays, with much more data available, it provides a big insight into dating behaviors, especially the highly increased popularity of online dating, mainly by the young generation. The app service for dating has become a modern romantic interaction that enhances access to different generational and society segments.

Prospect of online dating

Dating apps have come a long way since their inception in the early 2000s, evolving from simple websites to sophisticated apps designed to match individuals based on the multitude of preferences and factors. The first generation of dating services constructed the way for the later, more mobile focused solutions such as Tinder, Hinge and Badoo, which introduced the swiping mechanism that is familiar towards users nowadays. Moreover, “Within the next two decades, experts say technology will have advanced to the point that if you're looking for love, you'll be able not just to meet potential mates and chat with them online but also go on realistic virtual dates without leaving home” [2]. This evolution reflects not just technological advancements but also a shift in social attitudes towards online dating, moving from skepticism to widespread acceptance.

Significant to this shift is the change the perception over time in public, from 2005 to 2015, there was a 15% increase in US adults who thought that online dating was a good idea. However, in the same time period, there was a 6% decrease in US adults who think that people using online dating sites are desperate. Those statistics outlines the growing acceptance and normalization of online dating in society as the time passes.

Today, the landscape of dating apps is diverse, with platforms that provides various preferences, orientations, and interests. Tinder, known for its friendly swipe right for "Like" and left swipe for "Dislike" mechanism, revolutionized the way matches are made. Badoo, on the other hand, empowers women by requiring them to make the first move. Meanwhile, Hinge offers a platform for more detailed profiles and meaningful connections, encouraging users to engage beyond superficial swipes, that usually have a deterrent impact on some users. Each app offers unique features aimed at facilitating connections that align with users' specific desires and relationship goals.

The user base of dating apps is various, starting with different ages, genders, and preference etc. Usage statistics reveal significant insights into modern dating behaviors, indicating a surge in online dating's popularity among younger generations, particularly millennials and Gen Z. For example, Tinder's user base predominantly consists of individuals aged between 18 and 24, illustrating the app's appeal to the younger demographic seeking casual relationships or connections. On the other hand, platforms like Badoo attract an older demographic interested in serious relationships. The widespread usage of these apps across various age groups and preferences outline their integral role in the contemporary dating scene.

Positive impact of Dating Apps

A. Increased Accessibility to Potential Partners

1. Dating apps provide a vast pool of potential partners at your fingertips, making it easier to connect with people outside of your immediate social circle or geographical location. This accessibility allows individuals to explore a diverse range of matches they might not have encountered otherwise, expanding their horizons and opening the door to more possibilities.
2. For people with demanding schedules or those living in less populated areas, dating platforms make it possible to meet others outside of one's usual social or geographical boundaries, offering opportunities for connection that transcend the limitations of time and space. This accessibility is particularly crucial for individuals seeking partners with specific lifestyles, beliefs, or interests.

B. Convenience and Efficiency

1. "Because there's such an increase in smartphone usage, it directly relates to the increase in dating app usage." said Julie Spira [3]. The convenience of using dating apps on smartphones allows users to browse profiles and interact with potential matches at their own pace and schedule. Unlike traditional dating methods, where one might need to attend social events or rely on chance encounters, dating apps offer the flexibility to engage with potential partners from the comfort of one's home.
2. Ability to Filter and Select Potential Matches Based on Preferences. One of the most significant advantages of dating apps is the ability to filter and select potential matches according to specific criteria, such as interests, age, location, and more. This personalized approach to finding a match ensures a higher likelihood of compatibility and satisfaction in the connections formed, streamlining the dating process in an unprecedented way.

C. Social Benefits

1. Encourages Open Communication and Connection Over Shared Interests: The convenience of dating apps may hinder the development of deep, meaningful connections as users may quickly move on to the next potential match. The endless options available can lead to a “grass is greener” mentality, where individuals continually seek the next best thing, preventing them from fully investing in a single relationship.
2. Some dating apps serve to specific interests or demographics, allowing users to find like-minded individuals with shared hobbies or values. Whether someone is passionate about a particular hobby, profession, or lifestyle, there are dating apps designed to facilitate connections with others who share those interests. Today’s technologies are as big and many that they are capable to make creation of relationships easy for any: “Religion and culture, sexual orientation, and age, but there are even sites and apps based on a user’s favorite type of pet. Billed as the “dating app for dog people,” Dig aims to connect daters who put their fidos first. On the other side of the spectrum, Tabby launched last summer and caters to cat people” [4].

Negative impacts of Dating Apps

A. Superficiality

Also, for seniors and other people emotions represent a main pillar of relationships, every individual is looking for different things in a relationship, but it’s clear that seniors especially value trust in a relationship the respondents that where asked to rank nine common relationship factors based on importance deducted that most valuable are: trust, communication, honesty, empathy, emotional intimacy, physical intimacy, sexual attraction, loyalty, and common interests. "Of these nine factors, trust ranks highest among those surveyed, with 47 of those surveyed saying it is the most important factor in a relationship" [5].

B. Misrepresentation

When intelligent start on dating apps, it is challenging to confirm the personality and eagerly of people. Users must explore the chance of experiencing untrustworthy or evil-intentioned on-screen characters who might compromise their safety. Such dangers increment the require of the advancement of exacting security conventions, both actually and platform-wide, such as assembly in open spaces, advising companions or family around meet-up points of interest, and utilizing in-app security highlights planned to secure client protection and well-being.

C. Safety Concerns

When intelligent start on dating apps, it is challenging to confirm the character and eagerly of people. Clients must explore the hazard of experiencing unscrupulous or evil-intentioned performing artists who might compromise their security. “Such dangers increment the require of the improvement of rigid security conventions, both by and by and platform-wide, such as assembly in open spaces, illuminating companions or family almost meet-up points of interest, and utilizing in-app security highlights planned to ensure client security and well-being” [6].

D. Ghosting and Rejection

This wonder of indifferent and sudden shapes of dismissal, such as ghosting can take off people feeling befuddled, and cheapened to proceed putting themselves out there. Moreover, the supreme number of clients can make an environment where individuals feel usable, leads to a need of duty and instruction, or cavalier behavior.

E. Emotional Burnout

The cycle of coordinating, informing, and potential dissatisfaction can be candidly tiring. Clients may discover themselves in a paradox of choice where it leads to uncertainty and the failure to carry out a relationship with any one coordinate. This steady seek for distant better much better, higher, stronger and improved coordinate can make the client ended up unexpected almost the method, caused by the exertion included, getting to be sincerely depleted from keeping up different shallow associations with other clients.

F. Diversification of Dating Platforms into Specialized Segments

The space of dating stages is extending, and makers are presently recognizing the unexplored guarantee that specialized sections hold. “For illustration, there are dating administrations presently committed to different wholesome propensities, work out aficionados, or those with specific otherworldly feelings” [7]. This expansion engages people with particular interface, feelings, or ways of life to find a bunch where they are seen and esteemed. They assert the uniqueness of clients by giving them with customized encounters and the chance to produce associations around common convictions and leisure activities. These specialized administrations are not just changing the mechanics of dating but too fortifying the guideline that there's a specialty for each person within the virtual dating domain.

G. Influence of Algorithms on Improving Compatibility Assessments

Calculations are presently essential to the engineering of modern dating applications, progressing significantly to cultivate associations. These progressed calculations have the potential to anticipate the victory of connections, opening up the prospects for persevering organizations. Dynamic information examination and counterfeit insights are utilized to scrutinize a user's behavior inside the app and their designs of engagement to propose more consistent potential mates. They coordinated both the unequivocal information input by clients and their understood activities and tastes, which may abdicate out of the blue exact pairings that conventional dating roads might neglect.

H. Financial Ramifications of Dating Platforms

The surge of dating applications has made a noteworthy stamp on the economy, causing a thriving showcase that contributes to income and work creation. The budgetary impacts expand past the apps themselves; compelling pairings can escalating consumptions in related segments like eating foundations, motion picture theaters, and clothing. “With layered membership models, buys and publicizing, these advanced stages have turned into productive undertakings” [8]. The swell impact of dating applications on financial flow is obvious within the way they shape customer consumption patterns and stimulate the neighborliness and benefit businesses, strikingly in metropolitan regions where the utilize of such apps is thickly concentrated.

Conclusions

On the whole, dating apps offers great advantages, such as: approximately 60% of individuals who use online dating platforms report that their experiences have been positive overall, with 14% stating that their experience was extremely positive and 43% indicating it was moderately positive. On the other hand, around 40% of users have described their online dating experiences as somewhat negative to a degree, including 9% who have characterized their experience as highly negative. Those advantages serve to the diverse needs and preferences among dating population. Those apps shows an increased convenience, accessibility, and social benefits. This is the reason, why those platforms have become an required tool in the pursuit of romantic connections, reshaping the landscape of love and relationships in the digital age.

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WABI-SABI'S ODE TO IMPERFECTION

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Abstract. *In this article, we delve into the core principles of Wabi Sabi, a Japanese philosophy that emphasizes beauty of transience and imperfection. By examining historical origins, cultural context and artistic expressions of Wabi Sabi, we demonstrate its relevance to modern life. Through the synthesis of various articles, studies, and artistic works, drawing insights from historians, literature scholars, and more, we highlight Wabi Sabi's relevance in modern life. We show how embracing this philosophy and way of living can cultivate a deeper connection with oneself and the world, fostering inner peace through a unique appreciation for the impermanent nature of things. In the end, this philosophical way of thinking fosters a stronger connection with both oneself and the outside world by providing a unique viewpoint on finding beauty in simplicity, imperfection, and transience.*

Keywords: *art, impermanence, passage of time, philosophy, simplicity;*

Introduction

In today's fast-paced world, the pressure to attain perfection has become present everywhere in every aspect of our lives. From looks to achievements, leaving us blind to the beauty in imperfection. To fight against this modern obsession with perfection, the ancient Japanese philosophy of Wabi Sabi offers a unique perspective. Wabi Sabi celebrates flaws, impermanence, and incompleteness. It teaches us to find joy in fleeting moments and appreciate the beauty in our mundane life. By embracing Wabi Sabi, we cultivate gratitude, acceptance, and resilience. Among the chaos, Wabi Sabi offers tranquility. It guides us to slow down, cherish the present, and find solace in the imperfect beauty around us. In letting go of perfection, we discover true liberation and inner peace. It's a philosophy that can be lived out in multiple ways, all with the same intention of keeping your mind in its best shape. For all that we can deepen in more context on this wide topic.

Finding beauty in imperfect utensils. Rustic charm and natural materials

The Japanese have cultivated a distinct aesthetic sensibility to convey their appreciation for nature, and its impact on art, beauty and the human soul. Japan has created a sense of the beauty of nature through these aesthetics, which is rarely found in any other society. One of the main aesthetics is wabi-sabi, which represents a rustic and desolate beauty, one that has faded away [1].

Wabi and Sabi were two distinct notions but came together to form an all-encompassing concept that honors and expresses gratefulness to an authentic and simple state of existence. At first, the term "Wabi" meant living in simple solitude, away from bustling society. This led to it being linked to traits such as modesty, rusticism, and the ability to see beauty in the everyday [2].

The tea master Sen no Rikyu often illustrates the significance of imperfections on utensils and cutlery. He suggests that in every small tearoom, it is preferable for every utensil to bear a flaw, as this shows appreciation and usage. Even the crooked or broken ones may be more valuable than ones that are entire [3].

“Sabi” is a key part of this philosophy. It symbolizes impermanence and gradual decay over time. This reflects the irreversible impact time has on all existing objects. Junichiro Tanizaki is one author who celebrates the Sabi. He writes of a sense of sensibility inherent to Japanese culture, contrasting it with western taste. He illustrates the nation's likings, such as favoring a pensive luster to a shallow brilliance, something that bespeaks a sheen of antiquity. The Japanese love things that bear marks of grime, soot and weather. This aspect is key in the philosophy, as it brings a sense of loneliness, serenity, and the sadness of time passing [3, 4].

Wabi-sabi places a strong emphasis on simplicity and authenticity in art and design. Objects embodying this philosophy frequently have a rustic or homemade feel to them, and they show obvious wear and tear that gives them a distinct personality, leaving everything that is too modern, crisp or clean out of the way. Other characteristics include organic and soft form with rounded edges, crafted from natural materials devoid of metallic silver or stainless-steel features. These are typically presented in muted, natural colors, resembling the natural world. Usually made of recyclable and reusable materials used to reduce waste and to ensure that all materials ultimately resolve to nothingness [5].

The rise of wabi sabi in ancient Japan and its Chinese roots

Rooted in Zen Buddhism, the early ideas of wabi-sabi emphasized an unrefined life, embracing the beauty of simple reality and a connection with nature. These concepts spread to China, influencing the artistic expression of poets and painters. By the second half of the 9th century, most ideas regarding Zen Buddhism were suppressed in China due to the current emperor's censorship. Despite this, some specks of Zen Buddhism minimalism spread to and across Japan [6, 7]. Japanese culture diffused these theories of wabi sabi and mono no are in almost every aspect of life, especially prominent in the literature of the period.

In the Heian era, from 794 to 1185, Japan developed deep senses of nationalism thanks to their period of isolation in the previous years. This allowed Japan to follow certain ideals to establish their own distinct artistic traditions and customs [8].

Murasaki Shibuku and a few other ladies who were connected to the court nobility are thought to have had a significant role in the evolution of this style throughout the Heian period. In one of her books, Shikibu argues that readers should look beyond appearances and sentiments to understand the deeper meaning of beautiful events. Consequently, this philosophy spread, and for the upper-class nobles, the celebration of wabi sabi manifested in the tea ceremony [8, 9].

The tea ceremony is a discipline that encompasses disciplines like architecture, gardening and painting into the act of drinking tea. By the 15th century, the tea ceremony became a symbol of wealth and prestige. However, everything changed when wabi sabi reached its apogee during the 16th century and all elements of the ceremony were analyzed: objects, actions, and architecture. Tea master Sen no Rikyu stripped the ceremony of its external attributes, leaving the most intrinsic elements: two mats, and two cups in a rough mud hut [5, 7, 10].

The history of Japan makes it abundantly evident that, despite the significant changes in infrastructure, technology, society, and religion between the Heian period and modern urban Japan, these traditional aesthetics have permeated the core of Japanese culture and will do so regardless of future evolutionary paths [1].

Harmony in implementing: exploring wabi sabi in modern living

In our society characterized by a relentless pursuit of perfection and consumerism, the Japanese philosophy of wabi-sabi offers a refreshing perspective. Rooted in the acceptance of imperfection and impermanence, wabi-sabi encourages individuals to find beauty in the imperfect, appreciate the transient nature of existence, and embrace simplicity. This article explores the challenges of applying wabi-sabi principles in modern life, its potential benefits for self-acceptance and personal growth, its role in promoting sustainable living, and practical ways to incorporate it into daily life [6].

In up-to-date life embracing the principles of wabi-sabi can be challenging. The relentless pursuit of flawless beauty, success, and material possessions often leads to stress, anxiety, and dissatisfaction. Moreover, the culture of comparison fueled by social media exacerbates feelings of inadequacy and the fear of being judged for imperfections. Embracing wabi-sabi requires a shift in mindset, away from the pursuit of unattainable perfection and towards an appreciation of the beauty found in imperfection and impermanence [5].

Wabi-sabi offers a path to self-acceptance by encouraging individuals to embrace their true selves, flaws, and all. By acknowledging and accepting imperfections, individuals can cultivate a sense of authenticity and inner peace. Embracing wabi-sabi principles can also facilitate personal growth by encouraging individuals to see challenges and failures as opportunities for learning and growth rather than sources of shame or inadequacy. This mindset shift fosters resilience, adaptability, and a deeper understanding of oneself [11].

Also, principles of wabi-sabi promote a more sustainable way of living. By valuing simplicity, modesty, and the beauty of natural materials, wabi-sabi encourages individuals to consume mindfully and reduce waste. Embracing the imperfect and the transient also fosters a deeper connection to nature and a greater appreciation for the inherent beauty of the natural world. This, in turn, can inspire individuals to adopt more eco-friendly practices and make conscious choices that minimize their environmental footprint [12].

Incorporating wabi-sabi into daily life doesn't require drastic lifestyle changes but rather a shift in perspective and mindset. Practicing gratitude for the simple pleasures of life, such as a warm cup of tea or a walk in nature, can cultivate a sense of contentment and appreciation for the present moment. Embracing imperfection in our surroundings, whether it's a chipped mug or a weathered piece of furniture, can also bring a sense of warmth and character to our living spaces. Additionally, engaging in activities that celebrate the beauty of impermanence, such as gardening or practicing mindfulness meditation, can deepen our connection to the natural rhythms of life [6].

Embracing imperfection to improve mental health

We are all obsessed with flawlessness and the “new and improved,” the Japanese philosophy of wabi-sabi offers a refreshing approach. Embracing the essence of “beauty in imperfection,” wabi-sabi encourages us to find joy in the cracks, wrinkles, and natural wear and tear of life. But it is not just about aesthetics, it is about a mindset shift that can profoundly impact our well-being.

Our modern lives are often riddled with anxieties about possessions, perfectionism, and a constant yearning for “more.” Wabi-sabi, in contrast, promotes acceptance and detachment from material things. By celebrating imperfection and looking at it as a form of art, as they truly are, it opens to us a world of new opportunities, of truly unique products that tell a story and highlight the importance of adaptability and a healthy respect for factors outside of our control. This philosophy encourages us to embrace the transient nature of life and recognize the beauty in the evolving, imperfect aspects of our surroundings. By appreciating the inherent beauty of

imperfection, we can let go of the pressure to acquire and chase perfection, leading to reduced stress and anxiety [13].

Embracing imperfection is not just about letting go; it is also about opening the door to new possibilities. Wabi-sabi celebrates the unconventional and encourages bold and authentic artistic expression. Beatrice Wood, a renowned ceramic artist who was known for her "imperfect" teapots, embodies this spirit. Her embrace of "cracks and bumps" led to unique creations that challenged established norms and inspired generations of artists [14].

If talking about real-life effects of Wabi Sabi real-life on people, let us talk about a writer who previously valued polished manuscripts, and initially viewed wabi-sabi with skepticism. However, incorporating its principles into his work has been transformative. Embracing the "rough drafts" and celebrating the unique flaws of his writing style opened new avenues of creativity and freed him from self-criticism. His own experience aligns with numerous other personal experiences that may or may not be shared online and in articles like "5 Ways Wabi-Sabi Promotes Mental Wellbeing at Home" by Living in Design, where individuals highlight how adopting a wabi-sabi mindset has brought them greater peace and acceptance [15].

Conclusions

In conclusion, in this transformative journey guided by Wabi Sabi, we not only cultivate a profound connection with our own essence but also foster a renewed appreciation for the world's diversity. Embracing imperfection allows us to recognize the beauty in the differences that surround us, promoting a sense of unity and understanding. As we navigate the complexities of our existence, Wabi Sabi becomes a guiding light, encouraging us to savor the simplicity of everyday moments and acknowledge the wisdom embedded in the natural order of life. Ultimately, by integrating the principles of Wabi Sabi, we not only enhance our personal well-being but contribute to a more compassionate and harmonious collective consciousness, where imperfection is not only accepted but cherished as an integral part of the rich tapestry of human experience.

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IS THE PACE OF TECHNOLOGICAL PROGRESS DECELERATING?

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Abstract. *This article delves into the ongoing discourse surrounding the trajectory of technological progress, examining whether we are currently witnessing a slowdown or not. Through a comprehensive exploration, we have examined historical perspectives on technological advancement, contemporary trends, and challenges in innovation. At the same time, we have identified key factors shaping the rate of progress. We aimed to investigate how education and the development of the workforce are interconnected with the evolution of technology. We have identified that there is a complex relationship between these factors, and by studying them together, we hope to uncover and understand the complicated patterns and interactions involved in how technology advances. Drawing upon a diverse array of research and reliable evidence as scientific articles, statistics, and official data, this study aims to shed light on the nuances of the ongoing technological landscape. Ultimately, it endeavors to contribute to a deeper understanding of whether the perceived downturn in the rate of technological progress is a temporary phenomenon or an indication of broader systemic shifts.*

Keywords: *industry 4.0, innovation, patents, progress factors, revolution, technological progress*

Introduction

In the ever-evolving sphere of technology, a prevalent debate centers around the notion of a potential deceleration in innovation in our current era. This article embarks on a detailed exploration, delving into the annals of history, current trends, and the challenges that mold the path of technological progression. Through an all-encompassing perspective, we dissect the complex relationship between education, workforce development, and technological evolution, acknowledging the intricacies of their interconnections.

Our exploration into the historical backdrop aims to situate the present state of technological progress, providing insights into the patterns that have steered innovation over the centuries. Concurrently, scrutiny of modern trends and challenges offers a glimpse into the current landscape, pinpointing pivotal elements that dictate the speed of advancement. Importantly, we probe into the reciprocal relationship between education and technology, intending to decipher the complex patterns and interactions that characterize their mutual evolution.

This study leverages a wide spectrum of research and credible evidence, the main source being a similar study provided by Tyler Cowen “Is the Rate of Scientific Progress Slowing Down?” [1], aspiring to illuminate the subtle dynamics at play within the current technological panorama. In doing so, we aim to foster a deeper comprehension of whether the perceived deceleration in technological progress is a fleeting occurrence or a sign of more extensive systemic shifts. Essentially, this article strives to provide a thorough exploration that traverses the multifaceted aspects of the discourse on technological progress, aiming to demystify its complexities within a succinct framework.

Historical Perspective on Technological Progress

Throughout history, technological progress has been characterized by a series of transformative breakthroughs and innovations that have reshaped societies and propelled human civilization forward. From ancient times to the present day, humanity has continuously sought ways to overcome challenges, improve efficiency, and enhance quality of life through the application of technology.

One of the earliest examples of technological innovation can be found in the agricultural revolution, which occurred around 10,000 years ago. This period marked the transition from nomadic hunter-gatherer societies to settled agricultural communities, enabling humans to produce food more efficiently and sustain larger populations.

The subsequent centuries saw advancements in various fields, including transportation, communication, and manufacturing. The invention of the wheel, around 3500 BCE, revolutionized transportation and trade, allowing goods and ideas to be exchanged over longer distances. The development of writing systems, such as cuneiform in Mesopotamia and hieroglyphics in ancient Egypt, facilitated record-keeping, administration, and the spread of knowledge.

However, it was during the Industrial Revolution, known as Industrial Revolution 1.0, which began in the late 18th century, that technological progress accelerated dramatically. The harnessing of steam power, the invention of the spinning jenny and power loom in textiles, and the mechanization of agriculture transformed economies and societies. Factories emerged as centers of production, and urbanization accelerated as people migrated from rural areas to cities in search of employment.

In the 20th century, we witnessed even more rapid advancements in technology, particularly in the fields of transportation, communication, and computing. The invention of the automobile revolutionized personal transportation, while the development of the airplane enabled faster and more efficient travel over long distances. The invention of the telephone by Alexander Graham Bell and the subsequent expansion of telecommunications networks connected people across the globe, shrinking the world and facilitating the exchange of information.

The latter half of the 20th century saw the rise of the digital age, characterized by the invention of the transistor, the development of integrated circuits, and the advent of the personal computer. These breakthroughs laid the groundwork for the Information Age, marked by the proliferation of the Internet, mobile devices, and digital technologies. The digital revolution has transformed virtually every aspect of modern life, from communication and entertainment to commerce and healthcare.

Table 1

Key technological components of Industry 4.0 [1]

Technologies	Definition
Artificial intelligence	is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans.
Blockchain	is a distributed database that maintains a completely, distributed and non-tampering continuously growing list of records using new encryption and authentication technology and network-wide consensus mechanism.
Cloud	refers to any IT services that are provisioned and accessed from a cloud computing provider.
Mobile Technology	is the wireless communication technology integration based on the wireless devices
Nanotechnology	also now referred to as molecular nanotechnology, is the particular technology to control individual atoms and molecules for fabrication of macroscale products.
Simulation	refers to technologies that use the computer for the imitation of a real-world process or system.

Today we are observing the development of Industrial Revolution 4.0 which is developed around the paradigm of replacing human work with automatic systems. This revolution can provide various economic benefits for businesses and firms. It is a relatively new trend that is still developing and people have established already the main resources and instruments that are creating the revolution (Tab. 1).

In order to highlight the frequency of innovations across time Bunch and Alexander Hellemans, science and technology writers and editors, have put on a timeline 8,583 most significant advancements in science and technology since the Dark Ages till 2005 when their work was published (Fig. 1). Points are an average over 10 years with the last point covering the period from 1990 to 1999. The smooth curve is the least squares fit of a modified Gaussian distribution to the data.

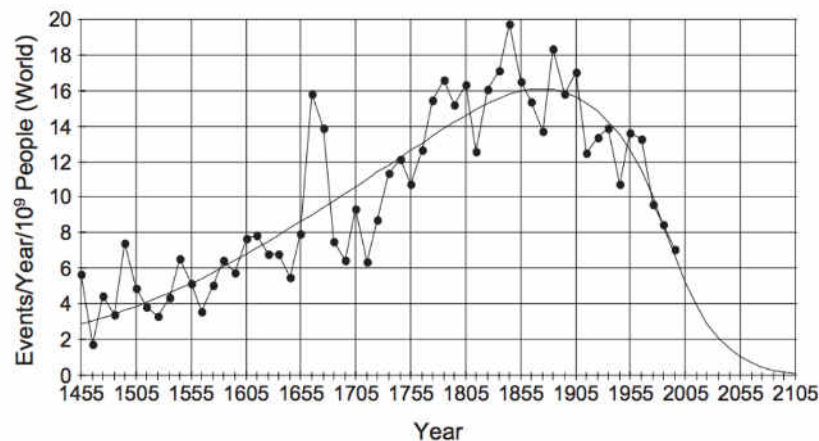


Figure 1. Rate of innovation since the end of the Dark Ages [2].

As we see the graph in Fig. 1 constructs a Gaussian distribution, where the number of new technological advancements is in decline even if we still have a positive rate. The peak decades are places between 1840-1905. Since then, we have been pushing against multiple limits, whatever their origins are. This is why Industry 4.0 can be treated as a result of the inertial force that remained after the technological boom of the 20th century and another one can be seen only after a few decades.

Trends and Challenges in Contemporary Technological Innovation

Contemporary technological advancements are reshaping societies at an unprecedented pace. This paper examines recent developments in key fields like artificial intelligence (AI), biotechnology, renewable energy, and space exploration while exploring the pace of innovation compared to previous decades. It then dives into the intricate tapestry of challenges and opportunities presented by these emerging technologies, including ethical considerations, regulatory hurdles, and the impact on employment and society.

Meanwhile, recent breakthroughs paint a captivating picture. From AI chatbots like ChatGPT crafting [3] human-quality text to CRISPR gene editing offering potential cures for genetic diseases, the boundaries of possibility seem to expand daily. Renewable energy sources like solar power are becoming increasingly cost-competitive, paving the way for a sustainable future. Meanwhile, space exploration ventures such as SpaceX's reusable rockets and the James Webb telescope propel our understanding of the universe to new heights.

Furthermore, arguments abound regarding the current pace of innovation. Some point to exponential growth in computing power (Moore's Law) [4] and increased global research collaboration as evidence of an accelerated revolution. Open-source platforms further democratize tools and resources, empowering diverse minds to contribute. However, not all sectors advance at the same rate. Fusion energy, for instance, still faces significant hurdles.

While exhilarating, this innovation surge presents formidable challenges. Ethical considerations around AI bias, gene editing, and autonomous weapons demand thoughtful approaches. Regulatory frameworks must adapt to keep pace with rapid development [5], balancing innovation with safety and ethical concerns. Automation threatens job displacement in various sectors, necessitating new skills and retraining programs. Additionally, widening access to technology can exacerbate inequality and societal disruption.

Despite the rapids, the potential benefits of responsible technological development are immense. Collaboration between researchers, policymakers, and the public is crucial [6]. Engaging in ethical discussions, fostering inclusive access, and investing in workforce development are essential steps. By navigating these challenges, we can harness the power of innovation to build a more equitable, sustainable, and prosperous future.

Factors Influencing the Rate of Technological Progress

In essence, the half-century from 1870 to 1920 was a whirlwind of innovation, with each industry experiencing transformative changes that would shape the course of the 20th century and beyond. But since the 1970's there has been great progress only in the field of information and communication technologies. The pace of progress in other areas seems to have been slowed significantly.

The Theorem of low-hanging fruit [7] is one of the slowdown arguments. As technology progresses, we solve the easy problems first and are left with the harder problems, making it exponentially harder to innovate and realize truly revolutionary things. As a result, many new technologies are optimizations, not revolutions.

A bit faster, a bit smaller, a bit cheaper, and maybe another feature or two. In fact, some key areas of technology appear to be in regression.

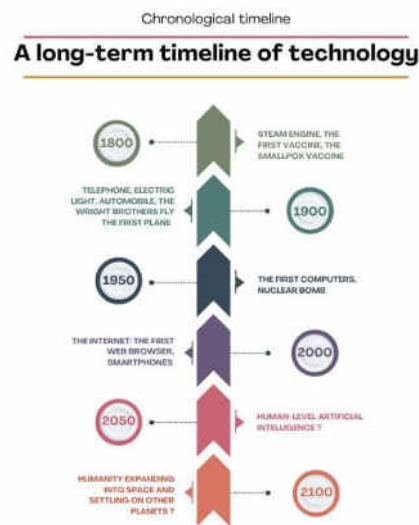


Figure 2. A long-term timeline of technology [8]

One solution to this problem is that government could try to get more people to become scientists and engineers. As the population grows, the sheer number of minds available to tackle complex problems multiplies. This crowdsourcing of intellectual capacity means that there are more individuals to think, debate, experiment, and innovate. With more people, there's a higher chance of having more geniuses. A vast population is more likely to produce individuals with the rare combinations of skills, talent, and intuition that lead to revolutionary breakthroughs.

Another possible solution to tackle the technological slowdown could be rapid advancements in artificial general intelligence and biotechnology [8]. The former could replace human worlds including engineers and researchers. This would allow to increase in the number of researchers working in state-of-the-art research [9].

Advancements in biotechnology could help us create genetically engineered human beings with greater research abilities.

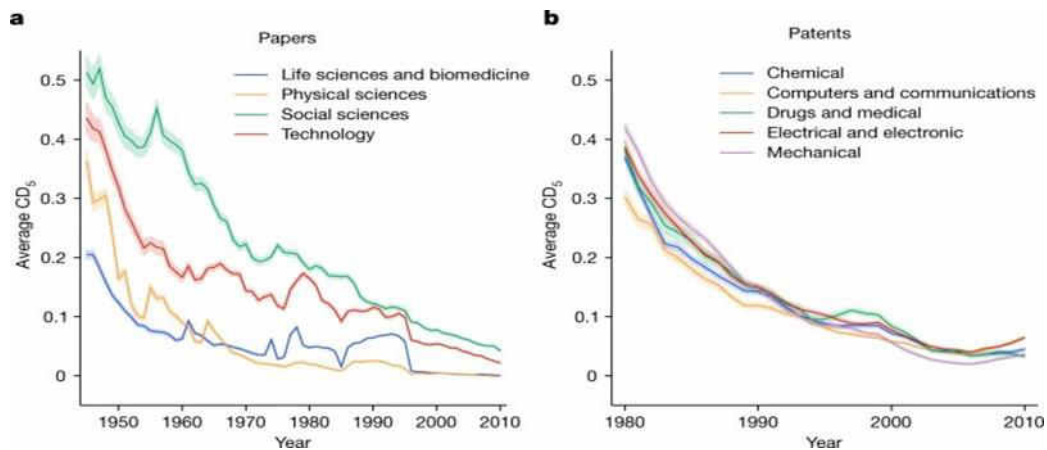


Figure 3. Decline of disruptive science and technology [9]

We know this is already within our technological reach but what about the ethical cause? this remains a controversial subject. The notion of creating a being for a predefined purpose challenges many ethical, philosophical, and religious beliefs about the sanctity and autonomy of individual life. So far, I believe as a global society we have made the right decision to not move forward with it which is for the best as it could create ethical, identity, economic, and political complexities.

The Impact of Education on Technological and Workforce Development

In an era marked by rapid technological advancements, global connectivity, and ever-evolving industries, the relationship between education and the workforce has emerged as a linchpin for societal progress. This compartment delves into the integral connection between education and the workforce environment, unraveling the profound impact of education in preparing individuals for the challenges and opportunities of the modern professional landscape. As we navigate an increasingly complex world, understanding the symbiotic interplay between education and the workforce becomes essential for fostering innovation, promoting social mobility, and driving sustained economic growth. Join us on a journey to explore how education serves as the cornerstone for building a skilled, adaptable, and empowered workforce poised to shape the future.

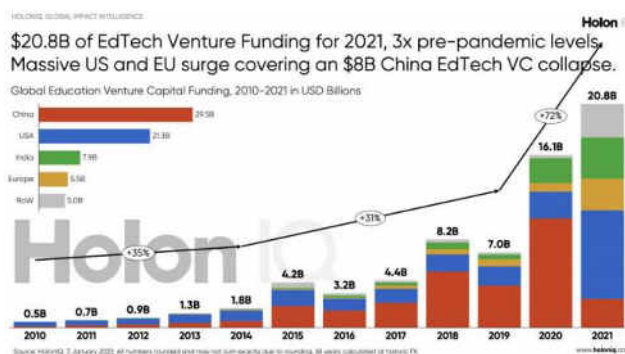


Figure 4. Venture Capital Investment in Technology [10]

Educational investments create a pool of researchers capable of catalyzing innovation and breakthroughs. A well-educated population becomes a catalyst for the adoption and growth of new technologies, fostering a market for innovation. The discourse emphasizes the connection between digital literacy, educational investments, and the widespread embrace of emerging technologies, showcasing how erudition manifests through online learning and open-source projects.

This graph above shows the amount of venture capital invested in technology companies globally over the past 10 years. As you can see, investment in technology has been growing rapidly in recent years.

In the face of accelerating technological change, continuous learning becomes essential. Education and workforce development programs, such as tech boot camps and upskilling initiatives, are vital in ensuring workforce adaptability. This adaptability not only guards against obsolescence but also cultivates a workforce ready to contribute to and embrace technological evolution.

In today's dynamic world, education is pivotal in cultivating adaptable problem-solvers. A curriculum that prioritizes critical thinking and creativity not only shapes well-rounded individuals but also fosters collaborative skills essential for success in an interconnected global landscape.

Moreover, educational initiatives that inspire interest in STEM (Science, Technology, Engineering and Mathematics) fields contribute significantly to nurturing the next generation of innovators. By providing hands-on experiences and fueling a passion for science, technology, engineering, and mathematics, educators play a vital role in driving progress and innovation.

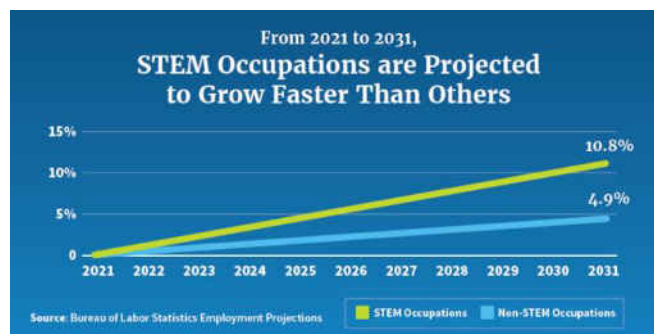


Figure 5. Growth of STEM Occupations [11]

This graph, from the US Bureau of Labor Statistics, shows the projected growth of STEM occupations in the US from 2021 to 2031. As you can see, STEM occupations are expected to grow much faster than all occupations, highlighting the increasing demand for STEM skills in the future job market.

In the rapidly evolving job market, lifelong learning is indispensable. Adapting to changing industry demands through continuous upskilling ensures professional viability and global competitiveness. Countries actively promoting continuous learning equip their workforce with in-demand skills, fostering personal fulfillment and enhancing their ability to navigate the complexities of the contemporary global landscape.

Government initiatives, including tax incentives and sector-specific programs, play a crucial role in fostering innovation and economic growth [12]. Tailored support for critical sectors encourages advancements and addresses industry-specific challenges, while digital literacy programs empower individuals to thrive in a technology-driven world.

In education, a shift towards modular learning allows customization of educational journeys, catering to diverse learner needs. Upskilling and reskilling courses support lifelong learning, and adapting to evolving industry demands. Recognizing the value of experiential learning, and acknowledgment of prior experience fosters inclusivity, creating a dynamic educational ecosystem tailored to the evolving workforce. Together, these initiatives contribute to a more responsive and adaptable economic and educational landscape.

In today's workforce landscape, employer-sponsored training programs play a pivotal role in skill development, offering continuous learning for professional growth. Online learning

platforms further democratize education, providing flexible opportunities for individuals to acquire and enhance skills. Industry partnerships strengthen the link between academia and real-world needs, ensuring a dynamic ecosystem that benefits both employers and learners. Together, these approaches create a responsive framework, meeting the evolving requirements of the modern workforce.

Conclusions

In the article, we reflect on the question: "Is technological progress slowing down?". We give different arguments, describe different periods of history, and show information from different graphs.

According to a study on the rate of innovation since the end of the Dark Ages, it is observed that a surge in technological progress occurred at the beginning of the 20th century, after which there was a slowdown. This phenomenon can be interpreted through the concept of "low-hanging fruit" - the idea that readily available or obvious opportunities for technological development have already been exhausted.

As the number of revolutionary patents declined over time, humanity turned its gaze to the development of artificial intelligence. This decision was aimed at increasing the likelihood of a new wave of technological revolution. On the other hand, the fact that progress has slowed down has led people to become more active in improving existing technologies, creating the illusion of continued progress. However, this may turn out to be only a temporary way to compensate for the slowdown rather than a real driver of innovation.

Humanity has created a sphere where they feel comfortable, and this is what is slowing down their development. Thus, we can say that at the moment all signs point to a slowdown in technological progress.

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AUTONOMOUS DRONES: WHAT DOES THE FUTURE HOLD?

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Abstract. *This paper explores the impact of software innovation on autonomous drone control and the applications revealed in the process. The intended readers are technology enthusiasts who are looking forward to integrating and using drones in their daily operations and are intrigued by their future usage in science and business optimization. We introduced our readers to the world of autonomous unmanned aerial vehicles by first defining important terms and acronyms. Then we analyzed the core technologies necessary for autonomous drone control by explaining the key software components such as sensor fusion, path-planning and obstacle avoidance algorithms, and the communication protocols which are currently used. We discussed the advantages of autonomous drones compared to traditional drones and highlighted their enhanced safety, great efficiency, and the potential for new applications. Moreover, we examined the future challenges and possibilities of autonomous drones in the context of Artificial Intelligence advancements, cybersecurity concerns, legislative challenges, and rapid technical development. We investigated the potential business sectors that can further optimize their processes and what areas of improvement have to be studied to bring unmanned aerial vehicles to the necessary level of security and performance.*

Keywords: *ad-hoc networks, Bayesian inference, machine learning, path planning, sensor fusion, stochastic heuristic algorithms.*

Introduction

The acronym UAV stands for Unmanned Aerial Vehicle, commonly referred to as a drone. Over the years UAVs have proven to be useful in many areas such as surveillance, delivery services, and terrain exploration, due to their data-gathering capabilities through various sensors - referred to as sensor fusion; automation potential, and the possibility to operate independently of a pilot over preconfigured routes, or following other constraints through the use of so-called path planning algorithms [1].

We aim to evaluate the current and future state of autonomous UAVs by first giving an overview of algorithms and technologies that make autonomous drones possible, exploring their advantages over manually controlled drones, and evaluating future challenges and uses of autonomous drones.

Core technologies of autonomous drone control

The autonomous operation of drones (Unmanned Aerial Vehicles) depends on a complex system of software components. mainly: sensor fusion, path planning, communication, and coordination of drones.

Sensor Fusion is the process responsible for accurate navigation. It combines sensory data from GPS and LiDAR coordinates with camera images in order to produce enhanced data. At the base of this process, there are multiple algorithms which ensure safe and reliable environment perception. Common ones are Bayesian Inference and Kalman Filtering.

Bayesian Inference represents the drone position and velocity as a probability distribution. An initial belief about the drone's state is created based on the existing knowledge or on sensor calibration. With new sensor data arriving, a likelihood model is created and describes the probability of seeing the data in the context of the current state. At the base of this method, there

is Bayes' theorem which updates the probability of an event when more data and evidence is gathered.

Kalman Filtering is a technique used to estimate the state of the vehicle given uncertain sensor readings. In the first phase, it works by combining this data and smoothing out the noise, therefore improving the accuracy of the estimated position. In the second part, once it receives new measurements, it updates the estimated values. It is a recursive algorithm, works in real-time, and doesn't require additional information from the past [2].

Path planning is a crucial process as it is responsible for generating optimal flight paths. It incorporates traditional techniques such as Dijkstra's algorithm. This algorithm considers the environment as a graph and finds the shortest path by iteratively selecting the node with the shortest distance from the source and updating the cost when a shorter path is found. A priority queue is kept in order to efficiently select the next node. The process is continued until either all nodes are visited or the shortest path is found. It is very well suited for static two-dimensional environments.

The Voronoi graph method, using seed nodes, divides space into cells, while making sure that points from each cell are closer to their seed node compared to any other node. This algorithm efficiently splits space around obstacles by creating polygons with equidistant edges. The final trajectories are created along the closest edges. This approach is efficient at navigating spaces with obstacles while optimizing trajectory planning [3].

For reliable path planning a UAV formation provides much more comprehensive data in regards to terrain and obstacles. Moreover, complex problems such as path planning and real-time obstacle avoidance are highly dimensional and might contain multiple local optima in which a deterministic algorithm might get stuck. This elevates the difficulty of correctly defining the objectives and constraints as explicit functions of decision variables. Stochastic Heuristic Algorithms (SHA) are a common alternative [4]. They introduce random noise in the optima finding process which is known to help in finding global optima. Examples include simple algorithms like Hill Climbing or ones inspired by natural processes like Genetic Algorithms, Simulated Annealing, etc.

Whilst a drone can make real-time decisions on its own – if coordination with other drones is desired – an efficient, reliable, and secure communication method is essential. Firstly, drones have to exchange flight and sensory data on a regular basis. While flight data such as position, and altitude are narrow in bandwidth, sensory and image data is costly. Thus, for real-time sensory data exchange, proximity in a range of hundreds of meters helps enormously [5]. This naturally leads to the consideration of decentralized systems such as FANETs (Flying Ad-hoc Networks) [6]. Ad-hoc here means not relying on pre-existing infrastructure, rather each UAV acts as a node in the network. The simplicity of such networks enables UAVs to create and join networks on the fly. Once connected, drones can exchange sensory data and form a shared overview of the environment.

Advantages of autonomous drone control over manual control

Unlike human pilots who require rest and are vulnerable to fatigue and decisional errors, autonomous drones can operate continuously no matter the time of the day, maximizing operational time. A single drone operator may be needed to supervise entire fleets of drones, greatly increasing efficiency compared to manually controlling each drone. All of these drones could follow pre-computed routes with great precision and repeat them consistently, ensuring tasks are completed accurately across multiple operations. In this case, they are crucial for mapping by covering large areas with ease and providing high-resolution maps or 3D models. Another use case which benefits from this is precision agriculture, where crop health problems can be identified in the early stages. Autonomous spraying drones can be later used to selectively apply chemical agents based on the data gathered by imaging drones.

Autonomous drones can be used to access remote areas where manual operation is impractical or even impossible. Operating in areas with lots of obstacles, environmental threats, tight spaces or limited visibility is much easier for drones which use sensor data to navigate these spaces. Therefore, autonomous drones could perform industrial inspections for complicated construction sites, equipment inspections, and monitoring of pipelines, electricity power lines, bridges, wind turbines, and high-altitude antennas. In the case where the latency created by the distance between the operator and the drone is unacceptable, autonomous drones can be used to operate by themselves and transfer the data later. For example, the Mars Ingenuity Helicopter had to fly autonomously since the signals take around 5 - 20 minutes to be transmitted between Mars and Earth, real-time control being impossible in this case.

Other domains which make use of the advantages of autonomous drones include disaster management, environment monitoring, and delivery and logistics. Security patrols and search and rescue teams can use autonomous drones to scan large areas to find intruders or missing people. Drone data collection enables early detection of wildfires through continuous aerial surveillance. Some achieved an overall validation accuracy of 96.04% in recognizing fire images [7].

Future and challenges of autonomous drone control

Advancements in AI and Machine Learning allowed the integration of such algorithms into autonomous drones as Deep Q-learning [8] and Reinforcement Learning [9]. These algorithms allow the drones to adapt to various field conditions and take the right action in difficult or impossible situations to implement algorithmically. However, there are technical limitations to their application in real-life scenarios. Sophisticated AI and Machine Learning algorithms take up a significant amount of computational resources and hence require powerful processors, which are heavy and drain the battery fast. Drone researchers have to make a tradeoff between the computational capabilities and physical properties of the drone. As research continues and discoveries are made in the fields of physics, telecommunications, materials science, and computational technologies, drones will be able to be smarter, faster, and lighter. As the usage of drones in everyday activities becomes broader, businesses will try to occupy a large market share and will be willing to invest in drone research to optimize their operations and have a competitive edge over their competitors.

Other aspects that drone researchers have to take care of are issues with cybersecurity, data privacy, and technical safety. Since drones rely on wireless communication, the data that drones receive is prone to external factors. If the data is malformed, drones become a flying threat that may cause a collision with other objects, injuries, or start a fire. Real-life incidents, such as a collision of a drone with another aircraft [10], raise concerns about reliability. One of the most common attacks on drones is physical attacks on the drones, using crossbars, bows, or any heavy item. Companies like Amazon have patented several methods of safeguarding their drones, including object avoidance technologies and armored motors [11].

Another common way of hijacking drones is GPS spoofing. This way the hacker is able to send the drone to any desired location [12]. To combat this, researchers have developed numerous methods to counter GPS spoofing, including fast low-energy gyroscope measurements [13] and combining GPS with an Inertial Navigation System (INS) to maintain the drone's direction [14].

The future of drone development is largely defined by the legislative documents that will define the limitations of drone usage. Currently, drones are mainly used within the national borders. Drones will be able to travel across international space once two main problems are solved.

The first problem is the energetical limitations of drones. As of now, drones are powered by batteries, which have a limited amount of energy. To allow international flights, the drones will have to use renewable sources of energy, such as solar energy, or there needs to be massive progress in power-saving technologies.

The second problem is that every country has its own reserved frequencies. Hence, drones have to use allowed frequencies for communication. With every new country that the drone is able to fly in, more constraints of frequency are introduced, which might limit the total number of countries that the drones can fly in. It is also possible that a country might block frequencies for drones to restrict their usage in the given region [15].

Another highly anticipated application of drones is delivery. Companies like Amazon and Zipline are making a bet on drones since drones will reduce the delivery time for small and medium packages, are cheap, and require minimal human intervention and service [16, 17]. To allow this, Amazon, and other companies that are willing to offer drone delivery, would have to resolve numerous issues that have also been discussed in this article: security, battery capacity, privacy, and hijacking. All of these aspects are undergoing thorough research and will eventually lead to drone delivery services being available and affordable for the majority of customers. However, there still is a long way to go until drones replace traditional delivery models.

Conclusions

Drones are based on complex software components which are ought to coordinate together to perform optimally in different conditions. Sensor fusion, path planning, coordination, and communication are essential to drone operation and are the main areas of improvement and research. Autonomous drones are more promising from the point of view of practicality and rational resource usage. In contrast to manual control drones, autonomous drones can be used in extreme conditions such as high altitude, pressure, or even on other planets. As the technologies advance, governments and companies will be able to adapt more use cases that will optimize their processes. However, there are numerous challenges on the way to drone-driven businesses, such as cybersecurity issues, GPS precision, and technical limitations. The current progress tends to widespread usage of drones, partially or fully replacing such operations as delivery.

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SCREEN TIME: ITS IMPLICATIONS ON MODERN SOCIETY

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Abstract. *This paper seeks to discuss the myriad of relationships that screen time has with impacts on our health, daily habits, and future trends. This is as it considers the history and growth of screen technology, from traditional televisions to contemporary smartphones that have managed to effectively saturate society. An increase in the amount of time spent in front of computer screens has raised concerns about implications for physical and psychological health. It also causes complications related to obesity, sleeping disturbances, and negative self-comparison from the use of social media. For all these, it will be providing an applied solution in the sense of offline activities and frequent breaking of screens. Further, the report will go into detail about the rise of the Augmented Reality (AR) technology craze and what it may portend, to many, leading into addictive and distracting behaviors. As screens are increasingly integrated into every aspect of life, finding balance between screen use and overall well-being becomes of increasing importance. This report provides thus a value of orientation for policymakers and stakeholders with a genuine interest to gain orientation on this diffuse and highly complex topic of screen time.*

Keywords: *addiction, digital, health, mental, social, technology*

Introduction

In a world increasingly dominated by glowing screens, the question of "screen time" has become more than just a modern dilemma; it's a complex tapestry woven into the fabric of our daily lives. Screen time, defined as "the amount of time spent using a device with a screen such as a smartphone, computer, television, or video game console" [1], has infiltrated every aspect of our existence, from education and entertainment to communication and work. In today's hyper-connected world, the balance between screen engagement and real-world interaction has become paramount for individual well-being and societal health. As technological advancements continue to shape our interactions, understanding the evolving dynamics of screen time becomes increasingly crucial for navigating the digital landscape.

While these devices undeniably offer a plethora of benefits, concerns regarding their impact on our physical and mental well-being have steadily risen. This report delves into the intricate relationship between screen time and our lives, exploring its historical trajectory, its multifaceted health implications, potential solutions to mitigate its negative effects, and its projected influence on the future.

Screen time changes during the last decade

The narrative of screen time, often romanticized as progress, reveals a more complex reality. From flickering TVs to ubiquitous smartphones, our engagement with screens has skyrocketed, raising critical questions about its impact across demographics and regions. The ubiquity of screens has reshaped societal norms and behaviors, necessitating a nuanced understanding of its implications for human health and social dynamics. As screens continue to evolve and integrate into various facets of daily life, exploring the shifts in screen time patterns over the last decade offers valuable insights into the changing landscape of human interaction with technology.

While television revolutionized entertainment in the 1950s, concerns emerged swiftly. Today, 93.5% [2] of Americans stream TV online, highlighting a potential substitution effect, but

not a decline in overall screen time. Interestingly, the average American spends more time on their mobile device (3 hours 30 minutes [2]) than watching TV (1 hour 43 minutes [2]).

Personal computers, initially work-oriented, morphed into entertainment hubs, further entrenching us in the digital world. This, coupled with the rise of affordable computers, led to a global rise in screen time. However, the Comparitech report paints a concerning picture: over 2 hours and 30 minutes [2] daily are dedicated solely to social media globally, raising concerns about addiction and its impact on mental well-being.

The arrival of smartphones with constant connectivity and ever-evolving apps ushered in a new era of digital dependence. Notably, 90.9% of people globally use the internet to stream [2], highlighting a shift in entertainment consumption patterns. This constant engagement blurs the lines between work and leisure, potentially impacting productivity and personal relationships.

The impact of screen time varies across age groups. While children and adolescents are particularly vulnerable, technology can also offer educational resources and foster creativity. The critical question lies in finding a balanced approach. Adults face similar challenges, with potential benefits like work opportunities and social connections balanced against health concerns.

Developed nations like the US boast high average screen times (7 hours 4 minutes [2]), while developing countries lag behind. However, the gap is narrowing due to increasing internet penetration and smartphone adoption globally. Cultural factors also play a role, with varying attitudes towards screen time across different regions.

Table 1

Year	Average Screen Time	Change Over Previous Year
Q3 2013	6 hours 9 minutes	-
Q3 2014	6 hours 23 minutes	↑ 3.8%
Q3 2015	6 hours 20 minutes	↓ 0.8%
Q3 2016	6 hours 29 minutes	↑ 2.4%
Q3 2017	6 hours 46 minutes	↑ 4.4%
Q3 2018	6 hours 48 minutes	↑ 0.5%
Q3 2019	6 hours 38 minutes	↓ 2.5%
Q3 2020	6 hours 54 minutes	↑ 4%
Q3 2021	6 hours 58 minutes	↑ 1%

Negative Effects of Too Much Screen Time

The pervasive presence of screens, while offering undeniable utility, comes with a potential price: a negative impact on our health. Deconstructing this impact requires a critical examination. Understanding the multifaceted nature of screen time's impact on health is crucial for developing effective strategies to mitigate its negative consequences and promote holistic well-being. Moreover, recognizing the disparities in how different demographics experience and are affected by excessive screen time sheds light on the nuanced challenges and opportunities for intervention in promoting healthier screen habits across society.

Excessive screen time can trigger a cascade of detrimental physical health consequences. Key concerns include the sedentary nature of screen use contributing to an increased risk of obesity and related chronic diseases like heart disease and diabetes. Additionally, prolonged screen use can lead to chronic musculoskeletal problems like neck and back pain due to poor posture.

Furthermore, the blue light emitted from screens disrupts sleep patterns, suppressing melatonin production and leading to sleep disturbances, which can impair cognitive function, mood, and overall health. Vision is also impacted, with excessive screen time potentially causing eye strain, dry eyes, and blurred vision.

The impact of screen time extends beyond the physical realm, potentially affecting mental health as well. There are suggestions of potential links between excessive screen time and anxiety and depression, particularly in children and adolescents. However, the exact nature of this relationship requires further research and consideration of confounding factors.

Additionally, the constant stimulation and social comparison prevalent on social media can contribute to feelings of inadequacy and low self-esteem. Furthermore, excessive screen use, particularly in children, can impede social development, hindering crucial aspects such as social skills and emotional intelligence.

Mitigating the risks associated with screen time necessitates a multifaceted approach. This includes setting clear boundaries, especially for children, establishing screen-free zones, and limiting screen time. Prioritizing physical activity and promoting real-world interactions are also crucial. Encouraging outdoor play, fostering face-to-face communication, and engaging in physical activities can help offset the negative impacts of screen time and promote overall well-being.

Digital Dependency: A Modern Affliction

Technology addiction, also known as digital addiction, internet addiction, or internet use disorder, refers to obsessive behavior related to technology, encompassing activities such as gaming, social media, online shopping, and video watching. Screens and technology permeate our daily lives, particularly affecting young people and altering their lifestyles. “While the many benefits of technology should not be ignored, it is important to acknowledge the negative effects technology has had” [3]. As society grapples with the complexities of digital dependency, exploring effective intervention strategies and support systems becomes essential for fostering healthier relationships with technology.

On a neurological level, technology addiction mirrors chemical addictions, triggering the release of dopamine and other feel-good chemicals in response to expectation followed by reward. This reward system is evident in activities like winning a video game level or receiving likes on social media posts. With prolonged exposure, individuals develop a craving for this dopamine release, often necessitating increased stimulus for the same effect. “On a neurological level, technology addiction operates similarly to chemical addictions, in that expectation followed by reward leads the brain to release dopamine and other feel-good chemicals” [3].

The mental health implications of technology addiction, particularly social media use and excessive screen time among children and teens, are profound. “Studies suggest that social media use can be associated with problems such as depression, anxiety, low self-esteem, and affected concentration”[3]. Moreover, excessive technology use in youth can influence their future relationships and emotional development, often at the expense of human interaction. “Individuals who may be struggling with a technology addiction often begin to isolate themselves. It is not uncommon for those with a technology addiction to also have a mental health disorder as well.” [3]. “Some people may turn to electronics as a way to cope with mental health conditions. They may use it as an “escape” or as a way to feel better. However, doing so in excessive ways can quickly become unhealthy and make matters worse for a person’s physical and mental health“ [3].

Combating the Negative Effects of Screen Time

Even though using a device with a screen has inevitable negative effects there are methods of mediating the severity of these effects and even fully counter them. Implementing strategies to mitigate the negative effects of screen time is essential for promoting healthy screen habits and overall well-being in today's digitally driven world. However, the effectiveness of these strategies depends on various factors, including individual behaviors, environmental influences, and societal norms. By examining the intersection of personal responsibility and systemic support in combating the negative effects of screen time, this section aims to provide actionable insights for individuals, communities, and policymakers striving to promote digital well-being.

Ways to reduce eye strain:

1. **Blink Often:** Engage in frequent blinking to naturally lubricate your eyes and prevent dryness.
2. **Use Artificial Tears or Humidifier:** If your work environment is warm and dry, consider using artificial tears or a humidifier to maintain moisture in the air and prevent eye dryness.
3. **Take Regular Breaks:** Follow the "20-20-20 rule," which involves looking at an object 20 feet away for 20 seconds every 20 minutes. This practice helps to rest your eyes and prevent strain from prolonged screen use.
4. **Invest in Computer Eyeglasses:** Consider using computer eyeglasses to reduce glare on the screen, improve image focus and contrast, and ultimately reduce eyestrain. These glasses differ from blue light-blocking glasses and may offer additional benefits. Choose wisely when shopping online.
5. **Adjust Screen Brightness and Contrast:** Ensure that your screen brightness and contrast settings match the ambient light around you. Bright screens in dim environments can increase eye strain.
6. **Use a Matte Filter:** Reduce screen glare by applying a matte filter directly onto your computer screen. These filters adhere to the screen surface and help diffuse light, making it easier on the eyes.
7. **Maintain Proper Distance:** Sit approximately 25 inches away from your computer screen and adjust its position so that your gaze is directed slightly downwards. This positioning can help reduce strain on your eyes and neck [4].

In summary, reducing eye strain involves blinking often, taking regular breaks using the 20-20-20 rule, using computer eyeglasses or blue light-blocking glasses, adjusting screen brightness and contrast, using a matte filter, and maintaining an appropriate distance from your screen. These practices can help alleviate discomfort and prevent long-term eye damage.

Tomorrow's Interface: AR Advancements and Screen Time

Augmented Reality (AR) technology has the potential to revolutionize digital content interaction by seamlessly blending the virtual and real worlds, providing immersive experiences. However, like any groundbreaking technology, AR also presents a range of challenges and concerns that require careful consideration. Anticipating and addressing the potential pitfalls of AR technology is crucial for ensuring its integration into society enhances rather than detracts from human experiences.

Increased Dependency and Addiction: AR's immersive experiences may lead users to become overly dependent on it for entertainment, social interaction, or work-related tasks, potentially resulting in addiction. "Excessive use of AR could result in reduced productivity, social isolation, and adverse effects on mental and physical health" [5].

Distraction and Safety Concerns: By overlaying digital content onto the real world, AR can be distracting and hazardous, especially in situations such as driving, walking, or operating machinery. "The temptation to engage with AR content may lead to accidents and injuries if users fail to prioritize their safety and that of others" [5].

Negative Social Impact: As AR blurs the boundary between the real and virtual worlds, it may affect real-life social interactions. Overuse of AR could diminish face-to-face communication skills, reduce empathy, and disconnect users from their physical environment. "Additionally, AR experiences may create a sense of exclusion for those who cannot afford or access the technology, exacerbating social inequalities" [5].

Digital Fatigue and Overstimulation: The constant influx of augmented content and digital stimuli may result in digital fatigue and overstimulation. "Extended exposure to AR experiences may result in mental exhaustion, reduced attention span, and an inability to disconnect from the digital world" [5].

Conclusion

The trajectory of screen time reveals a complex interplay between technological advancements, social shifts, and individual choices. While offering undeniable benefits, screens have become ubiquitous, potentially impacting our physical and mental well-being across demographics and regions. Recognizing these risks is crucial for navigating the evolving landscape of screen time. As we look towards a future saturated with immersive experiences, voice interfaces, and "smart" everything, a critical lens is essential. Proactive measures like setting boundaries, prioritizing real-world interaction, and fostering digital literacy are paramount. Ultimately, ensuring that technology serves to enrich our lives, rather than define them, requires a balanced and critical approach in the years to come. Embracing this holistic perspective will be fundamental in shaping a future where technology harmoniously coexists with human well-being and societal advancement.

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MUSIC AS A FORM OF STORYTELLING

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Abstract. *This article presents a comprehensive exploration of the narrative dimension of music, building upon existing research through real-life implementations. Drawing on a diverse variety of data, we engage in qualitative analysis and case studies to investigate how independent musicians complexly craft stories through songwriting, scrutinising both lyrical and musical elements. Furthermore, we deepen into the main role of music in cinematic narratives, scrutinising how film composers augment storytelling through thematic motifs and innovative sound design techniques. Moreover, we examine the immersive qualities of video game music, emphasising its capacity to dynamically adapt to user choices and move narrative arcs forward. By synthesising insights from various disciplines, this interdisciplinary study gives a view on the creative processes and cultural significance of music within contemporary storytelling instruments. Through our research, we contribute to a deeper understanding of the complex interplay between music and narrative, offering valuable perspectives for both scholars and practitioners in the field.*

Keywords: *diegetic music, non-diegetic music, narrative, soundtrack, video games.*

Introduction

Music has always been a huge part of human existence. Music is performed at key moments of human life such as weddings, births and funerals. While earlier people had to listen to music only at concerts, with the use of technology they can now enjoy their favourite pieces directly through phone, making music more accessible. That is why now the study of music has accelerated because it has become more integrated in human life than ever.

One of the branches of music studying is studying narrative in music. There is a term for albums which have some story or where the songs are linked together - "concept albums" [1]. This is a popular type of composing as it allows the musician to express their ideas in more expanded form. Some concept albums include "The Wall" by Pink Floyd, "Kid A Mnesia" by Radiohead [2], "Sgt. Pepper's Lonely Hearts Club Band" by The Beatles [3] and others.

Worth mentioning music in cinema: such composers as Hans Zimmer, Ludwig Göransson, John Towner Williams and others prove that music in cinema plays a crucial role. Music in video games often created by film composers, too, also enriches storytelling in games, making the plot more balanced and engaging.

Narrative through music

Music, when composed independently, acts like a narrator introducing listeners to the author's tale. Both music and stories share a similar structure: "Introduction," "First Group," "Transition," "Second Group," and "Closing Group" in music, and "Exposition," "Rising Action," "Climax," "Falling Action," and "Resolution" in stories. This similarity suggests that although they can stand alone, music and literature are interconnected, serving the same overarching goal. That results in the music using the same techniques as the literature. To catch the attention of the listener into the music are inscribed the "plot-twists" as ascending and unexpected descending of the sound etc, Chekhov's rifle, understatement.

Considering a fully written story here it was impossible not to mention the Gorillaz artwork album “Plastic beach” (March 3rd, 2010). It is built itself like a whole story where song after song describes the plot, which emphasises the problem of the forming of the plastic pollution islands in the world's oceans and the problems that they are bringing. “Orchestral pit”, which is an intro slowly brings the listener to the “island”, “Welcome to the World of the plastic beach” plays the same role. After that occurs escalation and climax on the song “On melancholy hill” that brings an ending to the “Plastic beach” and then comes the falling action through: “Broken”, “Cloud of unknowing”, “To binge” and the resolution as “Pirate Jet” in which the lyrical characters leave the destroyed island, but the problem remains, because there are more such “Plastic beaches” in the world. In this work [4] is done the research on this artwork and it summarises the work of every song as one complete piece. This emphasises the connection between two different arts and practically erases all the walls in art.

Expanding the connection between music and narrative, it will be a huge blunder not to consider the role of the scenes and characters. Stories are perceived through the actions which the characters take, therefore the music creates its own characters. Musical events, including gestures, assertions, responses, resolutions, goal-directed motions, and references, are viewed as characters in the context of perceiving music as a narrative [5]. As a classic example will be considered “Strangers in the night” by Frank Sinatra (April 12, 1966), the song describes an event of meeting two characters which forms a scene. The environment is slightly outlined by the instrumentarium and echo, where slow passing deep saxophone and singer vocals described the warm midnight in contrast with the, usually, cold lonely nights. The lyrical characters are outlined by violas, subtly introducing them in the scene. As the song progresses the warmth of the sound as well as the volume are escalating as the relationship between two characters, resulting in the catharsis of the story. This exemplifies how different parts of music, like lyrical characters in a story, adjust the plot, making you sense and indwell the situation.

Diegetic and non-diegetic music in cinematography

Film music serves different purposes in a film. P Rothbart states [6] that music in a film sets the environment by establishing time and place; moreover, it creates the mood of the film and the evidence of that is better described below. Music can create atmosphere in the film with use of both non-diegetic and diegetic sound. Also, music as an important tool in storytelling, allows to link the scenes together by the same song. Most of the films are ended by so-called “credit songs”. Finally, it helps reveal drama which is not seen through the camera.

There is a continuous study of non-diegetic music in films which investigate the importance of it in storytelling. For instance, the study of Christopher Nolan’s movie “Interstellar” (2014) [7] showed how music was used to create dynamic and tension in the film. Films of Tündé Kéláni [8] use African and Western musical rhythms and folklore to express the cultural part of the characters of the film. Stanley Kubrick [9], Tim Burton [10] and other directors are known to pay meticulous attention to music chosen for film and get recognition for it. Another example of music study in a film is “Lord of Rings” film series [11]. The researchers again went through the significance of music in the film proving that music is a source of enriching the storytelling. The study of British TV drama series “Peaky Blinders” demonstrated that music can be as important as dialogue in a film and sometimes it changes the focus to itself [12], especially in emotional moments of the films, such as weddings.

Music's impact of perception of film

Non-diegetic music takes a role in changing the viewer’s attitude to characters in a film. A study shows [13] that music can change the character's likeability; melodrama music increases and thrilling music decreases liking of a character compared to the character's presence in a scene with no music. Music also can change the viewer's judgement of character [14]. Another study [15] shows that the same clip from a film can be perceived differently with different music

accompanied. The clip might be seen as depressing, anxious, exuberant and content in dependence on music. This proves that music should be chosen carefully, and the film composers need to work together with directors and screenwriters to underline a detail of the film. This is how Christopher Nolan collaborates with Hans Zimmer and Ludwig Göransson and other composers. Music was also shown to be able to change the viewer's attention to particular details and even the perceiving the film genre [16]. This fact allows us to assume that music can be more important than dialogue which was discussed above.

The role of diegetic music

Diegetic music also plays a crucial role in cinematic storytelling. For instance, *Barbie* (2023) film which received critical acclaim for its original song, garnering prestigious awards and recognition [17], was noted by researchers to have an important role in storytelling with use of diegetic music [18]. In the *Barbie* movie, "Push" by Matchbox Twenty serves as a pivotal diegetic song, intricately woven into the storyline to reflect the emotional state of the Ken characters and their relationships with Barbies. The lyrics of the song resonate deeply with the character's experiences, prompting them to repeatedly sing it, thus reinforcing its significance within the narrative.

Diegetic music, as demonstrated by Quentin Tarantino's adept incorporation of popular songs, enriches cinematic narratives by seamlessly blending handpicked tracks into scenes. This enriches the audience's engagement, rendering music an integral element of the film's cadence and character [19].

Significance of music in video games

Rod Munday, lecturer in Digital Culture and Gaming at Aberystwyth University, starts his video game music section in the e-book "Music, Sound and Multimedia: From the Live to the Virtual", edited by Jamie Sexton [20] by affirming that the notion of video-game music no longer exists. He asserts that technology has advanced enough for composers to no longer be limited to a few bits of the arcade days and now it "inhabits every style imaginable". This opens up the gates to the whole new field for music.

Video-game music has evolved to a point where it can be analysed as distinct pieces of art. Naturally as a piece of art it has the capacity to convey emotions and feelings in its listeners.

Video games have become more cinematic over the years, so music artists have adopted similar methods to composing as in cinematography. Music in videogames can add to the atmosphere, enhance emotions felt by both the players and in-game characters and complement the action with its rhythm and intensity. One of the best examples of the latter is the soundtrack for the *DOOM* (2016) and its sequel *DOOM Eternal* (2020), composed by Mick Gordon where the riveting sound design and songs have become synonyms with its gameplay.

In general video-game music falls into 2 categories based on the type of game it was composed for:

Pop-like. Usually in games with less accent on the narrative or story and more on gameplay and its characters. This is often seen in PVP games such as fighting games. Guile's theme from the *Street Fighter* franchise (1991) is very well known and beloved to this day.

Focused. Generally single player games with a focus on narrative have masterful pieces that would not look out of place in an orchestral concert. Beloved franchises like *Zelda*, *Elder Scrolls* and *Dark Souls* feature extensive soundtracks which make you feel a plethora of emotions from awe at the beauty of the world to absolute terror while facing primordial abominations. My favorite example of the latter is the theme of Ludwig, *The Accursed & Holy Blade* from the *Old Hunters* expansion of *Bloodborne*. This song is a good segway to the next section.

Character description through music

The 1st part of the track has a lot of dissonance which matches the situation you are in fighting a distorted monster. In their article "On Musical Dissonance" [21] the author explains that "tonal theories attribute dissonance to violations of harmonic principles embodied in Western

music”. In essence this discord deviates from expectations set by harmonic principles. This subversion of expectations triggers our primal fear of the unknown.

The 1st phase of the track (and the fight) starts off with a menacing duo of vocals and cello, among other instruments. The chants in the background going with the orchestra underline the monstrosity in front of the player, describing it, retailing its story. The chorus [22] describes a brave hunter, whose “sword is bathed in blood”.

The lyrics tell the hunter to “neither lose your way at night / nor become drunk with blood...”. Without getting into the story of the game, this basically alludes to the fate that this character has suffered by implying that his current form is the result of not following those “guidelines”. After each verse the music “sinks” letting the player breath for a second before starting over again. Whether intentional or not, this could well be a metaphor for the never-ending cycle Ludwig is in.

After the second cycle of the verse, a transition occurs, and the fight just as the song transitions to the next part.

As Ludwig regains part of his humanity the dissonance in the melody partially disappears as well. The moonlight of the blade illuminates both the scenery and the mind of the beast. The chorus now sings about the current situation of Ludwig [23]. The lyrics: “With a powerful sword and robe / the lord does not fall away (from the path)! / Cursed beasts, cursed chains! / Become the blade of the honorable god!” describe how he is chained to this fate and forced to continue to fight the beast in the name of that god.

Another distinct change is the strings in the background. The rhythm of the melody is that of a waltz. This perfectly describes the horrid dance the player and the monster are locked in.

Conclusions

In this paper, analysis on music as a form of storytelling was performed. We consulted sources which explored music narrative as highly connected to literature storytelling, having the same structure and purpose. Our research also revealed its multifaceted role in expanding and refinement the film plot, having an enormous impact on the perceiving of the film. The film composers’ view of music was examined by analysing their approach to composing music together with directors. Game soundtracks, their variety and their significance were described in the last section of the paper. It was said that music becoming increasingly expressive and scenic, now requires more careful choice of background music like what has been happening in the film industry for decades. To sum up, reviewing music significance in different domains makes it clear that further investigation of it is still needed for a comprehensive definition of its role in our culture, nevertheless it is obviously an important part of our daily life.

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ETHICAL DILEMMAS IN SELF-DRIVING CARS: NAVIGATING AI ETHICS.

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Abstract. *Researchers have established that the integration of artificial intelligence (AI) in autonomous vehicles is a rapidly advancing field. However, a critical knowledge gap exists in understanding the ethical implications of AI decisions in real-world scenarios, particularly the moral dilemmas associated with self-driving cars. The goal of this paper is to investigate and shed light on these ethical challenges, aiming to contribute valuable insights to the responsible development and deployment of AI in autonomous vehicles. To achieve this goal, we employed a multidisciplinary approach, utilizing simulated scenarios, real-world data analysis, and ethical frameworks to comprehensively examine the decision-making processes of AI algorithms in autonomous vehicles. Our findings reveal the intricate balance between prioritizing passenger safety, adhering to traffic regulations, and considering the well-being of other road users, highlighting the ethical trade-offs inherent in AI-driven decision-making. This study emphasizes the need for transparent decision-making processes and robust ethical frameworks in the development and deployment of autonomous vehicles, ensuring the responsible integration of AI technology in the automotive industry.*

Keywords: *autonomous vehicles, morality, algorithms, technology*

Introduction

As technology propels us into a future where the once-fantastical notion of self-driving cars becomes increasingly tangible, we find ourselves at a critical juncture where innovation intersects with moral responsibility. The advent of autonomous vehicles promises unparalleled convenience, efficiency, and safety on our roads. Yet, embedded within the algorithms guiding these vehicles lie complex moral quandaries that challenge the very essence of ethical decision-making.

The allure of autonomous vehicles lies not merely in their ability to navigate traffic or reduce human error, but in their potential to revolutionize transportation systems worldwide. However, amidst this excitement, we cannot overlook the profound ethical implications that accompany the rise of AI in our vehicles. Unlike human drivers who may act on instinct or moral intuition, autonomous vehicles operate on programmed algorithms designed to optimize outcomes based on predefined parameters. This shift from human agency to machine decision-making raises poignant questions about the moral frameworks guiding these choices.

At the heart of this discussion lie scenarios where autonomous vehicles must confront "moral dilemmas" – situations where no outcome is entirely without harm, and choices must be made between conflicting moral imperatives. Consider, for instance, the classic ethical dilemma known as the "trolley problem," where a self-driving car must decide between swerving to avoid hitting a pedestrian, potentially endangering its passengers, or maintaining course and risking harm to the pedestrian. Resolving such dilemmas requires not only sophisticated technological capabilities but also a deep understanding of ethical principles and societal values.

Furthermore, the deployment of autonomous vehicles brings into sharp focus broader ethical considerations, including issues of liability, accountability, and distributive justice. Who bears responsibility in the event of an accident involving an autonomous vehicle – the manufacturer, the programmer, or the vehicle owner? How do we ensure that the benefits of autonomous technology are equitably distributed across society, without exacerbating existing inequalities?

In this article, we embark on a journey through the complex terrain of AI ethics in autonomous vehicles, exploring the moral dilemmas that arise and the ethical principles that must guide their resolution. By delving into these crucial questions, we seek not only to understand the challenges posed by the integration of AI into our transportation systems but also to chart a path towards responsible innovation that prioritizes human well-being and societal values. As we navigate the ever-evolving landscape of autonomous vehicles, let us not forget that while technology may drive us forward, it is our collective ethical compass that must steer us towards a future that is both technologically advanced and morally sound.

Ethical Decision-Making Algorithms:

This lie at the heart of the development of autonomous vehicles, particularly in situations where these vehicles must navigate moral dilemmas with potentially life-threatening consequences. These algorithms are tasked with making split-second decisions in situations where harm to humans is imminent, raising profound questions about how ethical principles should be encoded into machine intelligence [1].

One approach to programming these algorithms is based on utilitarianism, a moral theory that advocates for maximizing overall societal welfare or utility. In the context of autonomous vehicles, utilitarian algorithms might prioritize minimizing the total harm or maximizing the number of lives saved in a given situation, even if it means sacrificing the occupants of the vehicle. This approach reflects a broader societal value of prioritizing the greater good over individual interests.

Conversely, deontological approaches to programming ethical algorithms prioritize adherence to rules or principles, regardless of the outcomes. In the context of autonomous vehicles, deontological algorithms might adhere to strict rules such as prioritizing the safety of the vehicle occupants above all else, regardless of the potential harm to others. This approach embodies principles such as the duty to protect oneself and others, even at the expense of overall societal welfare [2].

Virtue ethics offers another perspective on ethical decision-making in autonomous vehicles. This approach emphasizes the development of virtuous character traits and the cultivation of moral wisdom in decision-making. In the context of self-driving cars, virtue ethics might involve programming algorithms to exhibit traits such as empathy, compassion, and fairness in navigating moral dilemmas. By prioritizing the development of virtuous AI agents, this approach aims to create machines that embody ethical excellence and contribute positively to society [3].

Human Factors and Trust in Autonomous Vehicles:

Understanding the human factors and trust dynamics surrounding autonomous vehicles is crucial for their successful adoption and integration into society. Psychologically and sociologically, trust in autonomous vehicles is influenced by various factors, including perceptions of safety, reliability, and ethical decision-making capabilities [4].

Perceptions of safety play a significant role in shaping trust in autonomous vehicles. Research suggests that individuals are more likely to trust self-driving cars when they perceive them as being safer than human-driven vehicles. Factors such as accident rates, incident handling, and overall vehicle performance contribute to these perceptions. Studies have shown that accidents involving autonomous vehicles, even if statistically lower than those involving human drivers, can significantly impact public trust and acceptance.

Reliability is another critical aspect affecting trust in autonomous vehicles. Users expect these vehicles to perform consistently and predictably across various road and weather conditions. Any instances of system failures, malfunctions, or unexpected behaviors can erode trust and confidence in the technology. Ensuring robustness and reliability through rigorous testing, validation, and continuous improvement efforts is essential for building and maintaining trust in autonomous vehicles [5].

Ethical decision-making capabilities also influence trust in autonomous vehicles. Users want assurance that these vehicles are programmed to make ethically sound decisions in challenging

situations, prioritizing human safety and well-being. Transparency regarding the ethical principles and decision-making algorithms employed by autonomous vehicles can help users understand and trust the technology better. Open communication about how these systems operate and the trade-offs involved in decision-making fosters trust and confidence among users [6].

Legal and Regulatory Frameworks for Ethical AI in Autonomous Vehicles:

The legal and regulatory frameworks for ethical AI in autonomous vehicles play a pivotal role in ensuring the safe and responsible development and deployment of self-driving cars. The current landscape is characterized by a dynamic interplay between technological advancements, ethical considerations, and the need for comprehensive governance. Several countries and regions have established legal frameworks to oversee the development and deployment of autonomous vehicles. For instance, the United States has the National Highway Traffic Safety Administration (NHTSA) providing guidelines and regulations for the testing and deployment of autonomous vehicles. In Europe, the General Data Protection Regulation (GDPR) and the EU's Ethics Guidelines for Trustworthy AI provide a foundation for addressing ethical concerns in the development of AI systems, including those in autonomous vehicles [7].

However, adapting these frameworks to incorporate specific ethical considerations in AI for autonomous vehicles remains a significant challenge. Ethical dilemmas in autonomous vehicles involve decisions regarding human safety, liability, and privacy. For example, determining how a self-driving car should prioritize the safety of its passengers versus pedestrians in emergency situations requires nuanced ethical guidelines. Addressing these challenges necessitates a multi-faceted approach [8].

Policymakers must collaborate with industry stakeholders, ethicists, and technologists to develop and refine regulations that strike a balance between innovation and safety. One approach is the establishment of industry standards that explicitly address ethical considerations in AI for autonomous vehicles. These standards could cover issues such as transparency, accountability, and the disclosure of decision-making processes in self-driving systems.

To encourage responsible AI development, policymakers should also consider implementing mechanisms for ongoing monitoring and evaluation of autonomous systems. This may involve the establishment of regulatory bodies with expertise in AI and autonomous technology to conduct regular audits and assessments. Moreover, promoting transparency in the development process, including disclosing data collection and algorithmic decision-making practices, can enhance public trust and accountability. Ensuring accountability in the autonomous vehicle industry requires the establishment of clear liability frameworks. Policymakers may need to revisit traditional notions of liability and accountability to account for the unique challenges posed by autonomous vehicles, where the responsibility for accidents may not lie solely with human drivers [9].

Socio-Economic Implications of Autonomous Vehicles:

Autonomous vehicles (AVs) hold the promise of revolutionizing transportation, but their socio-economic implications extend far beyond ethical considerations. One significant aspect is the potential impact on employment patterns. The widespread adoption of AVs could lead to a shift in the labor market, with job losses in traditional driving occupations such as trucking, taxi driving, and delivery services. Simultaneously, new jobs may emerge in industries related to AV development, maintenance, and oversight, but these could require different skill sets.

Urban planning is another area deeply affected by the introduction of AVs. The need for parking spaces may decrease as AVs can drop off passengers and find alternative locations, altering the urban landscape. This shift could prompt cities to repurpose parking spaces for green areas or additional infrastructure, influencing the overall design and functionality of urban spaces.

Accessibility to transportation may improve with AVs, particularly for individuals with disabilities or the elderly who may find it challenging to drive. However, disparities in access to AV technology could emerge, creating a potential digital divide. Marginalized communities might face challenges in affording or accessing AVs, exacerbating existing social inequalities.

The ethical implications of these disparities cannot be ignored. If AV technology is disproportionately available to certain socio-economic groups, it could widen the gap in mobility and economic opportunities. Policymakers and developers need to address these issues to ensure equitable access to the benefits of autonomous transportation [10].

Conclusions

In conclusion, the journey through the ethical landscape of autonomous vehicles reveals a nuanced intersection of technological innovation and moral responsibility. The challenges posed by moral dilemmas, legal complexities, societal impacts, and ethical considerations underscore the need for a holistic approach to navigating the future of transportation.

While the allure of autonomous vehicles lies in their potential to enhance safety, efficiency, and accessibility, we must remain mindful of the ethical imperatives that guide their development and deployment. As we strive to harness the power of AI to revolutionize transportation, we must also prioritize human well-being, societal values, and the common good.

Moving forward, responsible innovation in autonomous vehicles requires a commitment to transparency, accountability, and ethical reflection. Interdisciplinary collaboration, stakeholder engagement, and proactive measures are essential to address the complex ethical challenges that arise along the way.

Ultimately, the future of autonomous vehicles rests not only on technological advancement but also on our collective ability to navigate the moral dilemmas of self-driving cars with wisdom, compassion, and foresight. By upholding ethical principles and embracing innovation in equal measure, we can steer towards a future where AI-driven transportation systems contribute to a safer, more equitable, and morally responsible society.

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CYBERSECURITY: FROM PAST THREATS TO PRESENT SOLUTIONS

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Abstract. *The development of cyber security has been prominent in the last couple of decades, it has met multiple obstacles and managed to detect new paths to overcome them. This article aims to provide research on the history and current innovations concerning cybersecurity topics, as nowadays it affects not only organizations but every person who has an electronic device. We achieve this by researching already existing articles and extracting ideas and information that would align with the main objective of our paper. By doing this, we managed to outline the historical progression of cyber security starting from the early computer viruses to the sophisticated intrusion systems. Also, we went through and gathered the most impactful and innovative creations in the cybersecurity field that combat a multitude of modern cyber threats. From what was said above, we conclude that this article highlights how cyber security evolved and adapted over years of existence, it underscores the importance of resilience in countering new threats and protecting digital assets.*

Keywords: *cyber-threat, database, internet, intrusion prevention system, technologies;*

Introduction

In today's world, the cyber world has become a popular and inevitable source of information, sharing not only personal activities but also professional ones including business, shopping, bank transactions, advertisements, services, etc. This exponential increase in the use of cyberspace has resulted in an exponential increase in cybercriminal schemes. Therefore, cybersecurity is one of the most important defenses against the constant flow of online threats in today's digital world, which is always growing. This article is meant to explore the development of Cybersecurity, tracing its evolution from the weaknesses of the past to modern solutions and security algorithms.

A Particular Examination of Cybersecurity

In a general condition, Cybersecurity is considered to be a subset of IT security. Cybersecurity aims to protect computer systems, networks, data, and digital infrastructure from cyber threats and attacks. To effectively achieve those, nowadays, the implementation of security measures such as access controls, encryption, and firewalls. In this section, we will attempt to give an inside view of how exactly Cybersecurity works. Brenner [1] points out that modern technologies change the way frauds are conducted, with them being far more difficult for law enforcement officers to detect, giving those offenders the possibility to commit crimes on a far broader scale than their real-world equivalents.

Cybersecurity operates on multiple fronts, combining various technical, procedural, and user-oriented strategies to reduce risks and protect digital assets. One of its main goals is to establish a robust defense mechanism against a wide range of cyber threats such as malware, phishing attacks, ransomware, and insider threats. In addition, Cybersecurity involves proactively identifying vulnerabilities in systems and networks, followed by implementing solutions and updates to fix these issues. The versatile nature of Cybersecurity seamlessly counters the various cyber threats, that is its main purpose and strength.

In his book, "Cybersecurity and Cyberwar: What Everyone Needs to Know" [2], Singer highlights the ever-evolving identity of cyber threats and the increasing complexity of tactics used

by cybercriminals. A clear example of this process is the evolution of Ransomware attacks. Their essence was in encrypting files, demanding money for the decryption keys. Later this strategy adopted a blackmail aspect, exfiltrating sensitive data and threatening to release it publicly unless the ransom is paid. The author emphasizes the importance of understanding the strategic implications of Cybersecurity within the national security and changing geopolitical dynamics.

A well-known practice that we want to accentuate is the encryption of information, as it is nowadays one of the most essential means of Cybersecurity. The same opinion was shared by Schneier, a well-known security expert and author of "Secrets and Lies: Digital Security in a Networked World", emphasizing the critical importance of encryption in protecting sensitive information from unauthorized access. He argues that encryption is a pillar of Cybersecurity, "On another level, cryptography is a core technology of cyberspace" [3] facilitating secure communication and transmission of data over digital networks.

In his book [4], Joseph Steinberg provides practical advice on Cybersecurity best practices for individuals and organizations. The author emphasizes the importance of constant monitoring, sharing threat intelligence, and developing an incident response plan to effectively counter cyber threats in today's interconnected world. The trade-off of information security investments and sharing cyber information between companies results in spending less money on security systems but helps to reach the same level of protection attained by companies that do not share.

Indeed, Cybersecurity operates on a multitude of fronts Cybersecurity, reflecting the evolving nature of digital threats. Over time, cybercriminals have grown increasingly sophisticated, employing advanced tactics to exploit vulnerabilities and carry out malicious activities on a global scale. Concurrently, individuals have become increasingly aware of the importance of Cybersecurity as the vulnerabilities that may result in the leakage of their data, heightening concerns surrounding Cybersecurity. This dual progression underscores the need for comprehensive, preventive measures to mitigate risks and protect against cyber threats in an interconnected world.

Comprehensive Timeline Analysis of Cybersecurity

As the first computers were starting to scale their manufacturing, to satisfy different human needs, appeared the first cyber threats in the name of "Virus". These represent a direct attack on those standalone computers during the late 1980s. This situation motivated the creation of the first antivirus system in 1987 by the German Computer Security Expert, Bernd Robert. This system was capable of countering the virus called Vienna that infected files of type *.com on DOC-based systems. The method used was by detecting the fingerprint of the file and then comparing it with the virus fingerprints in the database, in this manner were identified the files that have been affected by the virus.

The next wave of cyber threats was happening in the Internet space in the form of cyber attacks. The first worm named Morris Worm, created by Robert Tappan Morris had a big impact as it put an end to the first Internet small community. To solve this issue, firewalls were introduced. A firewall in a computer network setting represents a machine or a collection of machines that allows the safe transfer between two networks. Still, "No firewall provides perfect security" [5], that is because it is considered that any traffic passing through the firewall is a potential network attack on the computer. For example, the majority of firewalls have some email provision, however, email is one of the most known methods of attack. Another thing to consider is that the security inside of a firewall tends to decrease with time if the internal machines are not constantly updated. Firewalls have left a significant mark on Cybersecurity as nowadays almost every organization connected to the Internet has implemented a form of a firewall that will ensure a level of protection against threats from the outside.

The 3rd generation of Cybersecurity is a major evolution that laid the foundation of today's Cybersecurity. This is noted by the large-scale implementation of an intrusion prevention system (IPS). This period has seen an increasing exploitation of vulnerabilities in application software.

As technology advances rapidly, applications become more and more complex. This complexity has opened up new horizons for hackers, with attacks becoming more complex and therefore harder to detect and harder to prevent. During this period there was a significant increase in such attacks, which overturned the security system of this period and a large part of the information from the private environment reached the public environment. In response to these types of attacks, new types of IPS have been developed. These systems are based on detecting and countering malicious activities in real time. This new system differed from the intrusion detection system (IDS) in that the latter only passively analyzes and monitors the traffic environment, while the IPS system identifies potential threats and takes action to block or deprive the source of the threats. For this reason, the IPS system marked the beginning of a new era in Cybersecurity.

The fourth generation in the realm of Cybersecurity represented the moment when cyberattacks escalated to a new level, transferring from randomly targeting individuals to strategically going after larger corporations that have substantial finances. The ransom demands have commonly been the equivalent of just a few hundred pounds for an individual PC. Until recently, most ransomware attacks were simply opportunistic and mostly affected the computers of individual users or small businesses. Even though the second and third generations of internet security focused on access control and monitoring all traffic, they failed to verify the actual end-user content found in emails, file downloads, and similar sources. At the same time, it became easier for more people to launch these attacks. All of these accentuated the need for anti-bot and sandboxing tools to detect and neutralize new forms of cyber threats. Anti-bot tools represent systems that are designed in such a way as to find and block the access of the bots to websites and web services. Well-known anti-bot tools are CAPTCHA and IP-blocking. Sandboxing is a security technique that creates a specific environment, named sandbox, and isolates it from the main architecture, preventing malware programs from inside from influencing the main system.

Currently, Cybersecurity plays an important role in the life of the entire planet because large-scale attacks with multiple vectors of actions characterize the newest generation of cyber threats. The complexity of a cyber attack today is much greater than 10-15 years ago. This complexity is due to several factors such as the sophistication of techniques and technologies used by hackers. One of the cyber threats that is common today is “Ransomware” attacks “With more than 10 terabytes of data stolen monthly, ransomware is one of the biggest cyber threats in the EU, with phishing now identified as the most common initial vector of such attacks” [6]. It represents a type of software that threatens a victim by destroying or blocking their data access to certain systems until the victim pays a ransom”. The annual cost of cybercrime to the global economy is estimated to have reached €5,5 trillion at the end of 2020, double the figure of 2015 ”[6]. Today’s cyber threats can come from a variety of actors: from hackers acting individually to groups of hackers acting together to orchestrating larger-scale attacks. Cyber attacks can also come from certain states against other states or from other groups that are secretly funded by the state to obtain information. For this reason, some forms of Cybersecurity implemented to prevent older attacks, have been outdated and are no longer effective against the newest attacks. Thus, Cybersecurity is still evolving to adapt to new types of attacks, to make the online environments as safe as possible.

Progressive Cybersecurity Innovations of the Modern-Day

As the landscape of Cybersecurity is constantly evolving, even more, innovations are being created to fight several cyber threats and cyber attackers. To keep the security efficient against those factors multiple innovations had to come into play. One of the most prominent examples is the Zero Trust Architecture. Speaking generally, it can be described as a never-trusting concept that always rejects network requests eliminating any trust in them. The ZTA is presented as a new alternative for VPN services that have become too expensive and insecure. “ZTA is a multi-layered approach to an organization’s network security with the idea of never trusting and always verifying every access to a resource” [7], knowing that, it is only logical to assume that the majority of current organizations would consider switching from VPN services to the ZTA, however in reality,

this turned out to be not the anticipated scenario. Despite all the benefits of the ZTA it still is not popular as the organizations lack information on its benefits and drawbacks. This state of things is not beneficial to the development of Cybersecurity as it blocks the potential of a newer and more cost-effective architecture for protecting networks.

The next innovation we want to bring to the discussion is the Endpoint Detection and Report mechanism, also known as the Endpoint Threat Detection and Response. It was created by A. Chuvakin in 2013. EDR follows a specific chain of actions to provide a report concerning potential cyber threats. It starts by collecting data from endpoints and sending it for storage and processing in a centralized database where it is thoroughly correlated to try and detect suspicious activity from hosts. In case of a serious cyber threat, both the user and the emergency response teams are provided a report on the situation of an emerging danger. In recent years EDRs have been heavily tied with AI methods and machine learning as they appear to be rule-based, helping in finding new patterns and correlations of threatening behavior. From all that was said above we can conclude that EDR show antivirus capabilities as an EDR will trigger an alert once it detects irregular behavior. The most critical asset of the EDR is that it may detect unknown threats and prevent them before they escalate and become harmful due to the behavior and signs. Even if behavioral patterns could sound ideal for detecting malicious acts, this also implies the existence of many false alerts, meaning that ordinary unharmed user actions are considered malicious, as EDRs prioritize precision over other things. Although EDRs bring a valuable boost to security, the overall security of the organization highly depends on the human factor, which is its biggest negative factor.

Another proven effective weapon against cyber threats is Cyber Threat Intelligence (CTI) as it has appeared as an important solution for businesses to address security events' increasing quantity and complexity. CTI can be defined as the active identification and precise analysis of cyber threats, to achieve this goal it uses a Threat Intelligence-Sharing Platform (TISP) that may access threatening data and turn it into refined and precise intelligence that can be further integrated into technologies that are aimed to produce an incident response. Firms that center themselves on informational security offer TISP solutions that can be classified into two categories: content aggregation (which provides feeds that contain threat data), and threat intelligence management (that uses the results of data to generate economic). Now going back to the CTI it is considered to be a process of gathering, analyzing, and distributing information contributing to identifying, monitoring, and anticipating cyber threats. That is how exactly CTI can help businesses to become more involved and attracted to Cybersecurity development, as it directly contributes to identifying vulnerabilities before the attackers get to exploit them. CTI also plays an essential role in detecting attacks by using intrusion detection systems. These are rooted in practices of cyber criminals or types of attacks, located by processing gathered intelligence data. Another thing is that CTI provides specific security plans specifically created towards retaliating against the patterns used by cyber threat actors, making it a key tool for organizations that are interested in preventing, detecting, and responding effectively against potential cyber-attacks. As for the actual use of this method, it has been proven to be quite a beneficial security solution all because of the benefits it provides, it managed to successfully attract the attention of most organizations. The big takeaway from CTI is that it managed to produce a significant impact on how nowadays organizations process and take action regarding various issues in their security systems.

The next technology we will talk about is deception technology. This is one of the most developed areas of Cybersecurity. This technology is based on the fact that it lures hackers or people with bad intentions into certain traps so that the latter can become more visible and easier to detect. This technique is quite effective because it has revolutionized threat detection, moving from a reactive to a preventive defense mechanism. This technology is dynamic as it adapts to evolving threats throughout the contamination. For this reason in practice, this technology is always one step ahead of the attacker. Also, to evolve and improve itself, this technology uses artificial intelligence and machine learning technologies, which increase its effectiveness. Unlike traditional Cybersecurity measures and technologies, Deception technology not only detects the

source of damage but also prevents this source from expanding and causing more damage. This technology has an important role in Cybersecurity which has put many obstacles to hackers.

A component that is also used in Cybersecurity is Identity and Access Management (IAM). This technology has also become a revolutionary one for Cybersecurity by creating a well-organized structure to manage and secure some data and access rights to some data. IAM uses several technologies that are new to Cybersecurity. Two of these new technologies implemented are multi-factor authentication and biometric verification. With the help of these technologies, access rights to certain data are granted to use depending on the type of authority they hold. Thanks to these technologies, unauthorized access to some more personal data such as bank details has been limited. IAM is continuously evolving by interacting with advanced analytics and threat intelligence to detect and prevent specific attacks in real time.

Also, as a very important part of modern Cybersecurity is worth mentioning Cloud Security. Taking into consideration that most organizations and even particular individuals moving their data, applications, and particular information onto the cloud ensuring their security is a very important task nowadays. For those purposes, encryption, IAM, network security controls, and continuous monitoring are used. As cloud adoption keeps growing, organizations need to keep their security up-to-date, to prevent any information leaks.

Conclusions

Cybersecurity is undoubtedly a shared responsibility, essential for maintaining integrity and privacy in the online environment. Starting with the most primitive attacks and evolving to today's complex attacks, cybersecurity has also developed through multiple generations of innovations in order to find new ways to combat online criminals and to protect user data online. In fact, knowing that cybersecurity is an ongoing process, over the years its involvement in the regular person's life has become more prominent, to a point where every person that owns an electronic device connected to the internet needs a way to protect its data. Today, cybersecurity has reached phenomenal results, such as encryption and firewalls, to minimize the risk of the virtual environment. This is thanks to the increasing interest of companies and media in the address of the cyber security field. The cyber threats have started to affect companies and populations in more aggravated ways, which caused cyberspace to search for new ways to protect the users and their data, but also to react and combat the cyber criminals in their attempts to access sensitive data by constructing a multi-layered defense system.

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THE BREAKTHROUGH OF ARTIFICIAL INTELLIGENCE IN MEDICINE AND HEALTHCARE

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Abstract. *This article is an overview of artificial intelligence's historical evolution and current status in the field of medicine and healthcare. The main goal of this study is to underline and understand how artificial intelligence influences one of the most crucial domains in our lives, medicine. Thus, analyzing the current scientific literature and already available artificial intelligence solutions, we explore the development of artificial intelligence throughout history. We describe the variety of technologies and artificial intelligence-powered diagnostics platforms that help healthcare workers during diagnosis. Further, we reflect on the current relationship between the medical field and artificial intelligence. Based on that, specific applications of artificial intelligence in radiology, cardiology, and molecular medicine are discussed, highlighting its impact and potential to advance image analysis, diagnostics, and treatment. Furthermore, we also considered the obstacles and challenges surrounding artificial intelligence in healthcare, such as technological limitations, ethical considerations, and legal issues. Hence, our study achieves its main goal of presenting and exploring the complex role of artificial intelligence in medicine.*

Keywords: *deep learning, ethical concerns, image analysis, medical diagnostics, preventive care, technologies.*

Introduction

Artificial intelligence (AI) is considered to have the potential to lead to great technological innovation and fundamentally change the way we approach problem-solving and decision-making. At its core, AI refers to the development of computer systems capable of performing tasks that normally would require human skills like learning, reasoning, perception, and language understanding. As AI continues to evolve, its impact on different fields becomes more and more noticeable.

More specifically, the use of artificial intelligence in healthcare has experienced a transformative evolution, moving from its early beginnings in the 1970s to now being an integral component of modern healthcare. AI's ability to study large amounts of data, predict illness patterns, and offer custom treatment options opens a unique chance to improve healthcare as we know it. Initial applications of AI, including MYCIN, set a foundation for specialized assignments like recognizing blood infections. Yet, progress was slowed by restricted computational abilities and data scarcity. Despite these hurdles, the potential of AI within healthcare was noticeable, resulting in continuous exploration and augmentation. Recent developments in AI for medical diagnosis underline a significant change in healthcare technology. Partnerships such as those between Mayo Clinic and GE Healthcare display a united endeavor to improve diagnostic proficiency.

History of AI in Medicine and Healthcare

Artificial Intelligence was first used as a term in a proposal for the Dartmouth Summer Research Project on Artificial Intelligence in 1956. After that, until the 1960s, the first AI boom made it possible for computers to perform "exploration" and "inference". In the 1980s, a second

AI boom occurred, and by putting “knowledge” into computers, AI became practical in various fields, and expert systems were created. In the 2000s, there was a third AI boom, and “machine learning”, was put into practical use. Regarding the use of AI in medicine, medical expert systems began in the late 1970s [1].

The pioneering program like MYCIN, designed to suggest treatments for blood infections, highlighting the early ambitions to integrate AI into the medical field, then CASNET, Causal Associational Networks, was created as a versatile resource for constructing expert systems to diagnose and treat medical conditions. Its primary use was for diagnosing and suggesting treatment for glaucoma [2]. PIP, an abbreviation for Present Illness Program, was developed in the 1970s to mimic the actions of an expert nephrologist when gathering information about the current illness of a patient with existing renal disease. Another major example is ICHT, an Intelligent Referral System for Primary Child Health Care, developed to reduce children mortality especially in rural areas [3, 4].

In the 1980s, in Japan, it was reported that they had developed a support system for creating diagnostic imaging reports by utilizing the results of AI. In 1993, Toriwaki also introduced three-dimensional images and intelligent medical imaging systems, including surgical simulation, the possibility of morphological medical measurements, and the possibility of creating images by computer from 3D images with sufficient resolution [5]. This hinted at the further development of AI in the medical field.

However, these initial movements were constrained by the era's limited computing capabilities and technical difficulty for AI to understand all of the huge amount of information, focusing on narrow AI applications with rule-based systems encoded by expert knowledge. Despite these challenges, later, in the 2000s, as big data processing and deep learning became possible, there were expectations for significant advancements that will transform the healthcare landscape.

Transforming Healthcare: AI Revolutionizing Medicine with Latest Changes

AI and deep learning models have introduced a “new era” for various medical domains, such as neurology, surgery, cardiology, ophthalmology, and the list goes on. The clinics profit a lot from these new technologies and try to implement them in their routine as quickly as possible. Moreover, the researchers from medical field are gaining more powerful instruments to analyze more precisely what is happening in our bodies. As a consequence, it is quite appealing to determine what are achievements of AI in some branches of medicine and healthcare.

a) Diagnostics

Fast forward to the present, the landscape of medical diagnostics has been revolutionized by AI, thanks to groundbreaking collaborations and technological innovations. To give an instance, Intel's introduction of powerful processors has given a significant boost to AI's role in healthcare, enabling more efficient data analysis and support for complex diagnostic tools. In like manner, Google Cloud's Medical Imaging Suite and the alliance between Siemens Healthineers and Ohio State Wexner Medical Center are making strides in making healthcare data more accessible and improving imaging and treatment technologies.

Thus, can be seen that the use of AI is progressing. Multiple AI-equipped medical device programs are already present [6].

Examples of AI-powered Diagnostic Platforms:

- EndoBRAIN (Cybernet Systems/Olympus): software that assists in the differentiation of tumor and nontumor colorectal lesions by using ultra-magnified endoscopic images;
- CAD EYE (Fujifilm: diagnosis support software that assists in the detection of lesions such as polyps and differentiation of neoplastic or nonneoplastic lesions during colonoscopy;
- EIRL aneurysm (LPIXEL: diagnostic support software that detects suspected cerebral aneurysms by analyzing brain MR images using AI;

- Watson Imaging: assists radiologists in analyzing medical images for faster and more accurate diagnoses;
- Viz.ai: specializes in analyzing medical images (primarily CT scans) for stroke detection and other neurological conditions. Utilizes deep learning algorithms to identify critical imaging features and alert healthcare professionals promptly. Aims to reduce diagnosis delays and improve treatment outcomes for stroke patients;
- Regard: focuses on identifying patients at risk of developing specific diseases through AI-powered analysis of medical records. Aims to enable preventative measures by predicting potential health issues before symptoms appear.

These advancements underscore a remarkable shift from AI's initial rule-based approaches to the adoption of sophisticated machine learning and deep learning techniques, marking a new era of innovation in healthcare that promises to redefine how we approach patient care and medical research.

b) Radiology

It's also worth mentioning the revolutionary impact AI potentially can have in radiology by greatly improving image analysis and enhancing the accuracy of diagnostics. Particularly, deep learning represents a technique that teaches computers to operate with data in a way akin to how the human brain does it, and, therefore, this allows algorithms to possess the ability to acquire feature representations from large sets of data without requiring preceding definitions from humans. As a result, deep learning models are able to perceive repeating structures in images for example, and give certain predictions. In the field of radiology, deep learning is said to be extremely suitable for medical image segmentation [7].

According to the definition provided by Pim Moeskops, senior R&D engineer in deep learning for medical image analysis at Quantib, medical image segmentation consists of processing a given image (which can be an X-ray, an MRI scan, ultrasonography, etc.), finding a specific anatomic structure, and outlining it in a certain way [8].

In the study conducted by the same author, there are two ways to segment medical images using AI: contour and voxel-based segmentation. The contour-based segmentation seeks borders between the target structure and its surroundings. On the other hand, voxel-based segmentation involves a complex process in which the algorithm individually checks every voxel in the image, determining its affiliation with the structure to be segmented.

Contour-based segmentation proves itself to be more efficient, because the shape of the organ is embodied beforehand into the learning process, and the algorithm is able to accomplish accurate segmentation with only a few training images, making it exceptionally effective [8].

Overall, AI and deep learning technologies provide a useful tool for specialists in radiology. This technology will revolutionize and improve the accuracy of diagnostics, which will definitely save even more lives in the future.

c) Cardiology

Cardiology is yet another field of medicine in which AI contributes significantly to improving and development. The impact of AI in cardiology is depicted in great detail by the Mayo Clinic. Mayo Clinic is a healthcare company that's concerned with discovering methods to put artificial intelligence into practice in such a way that will come to the aid of people who have or are predestined to heart diseases [9].

In an article published by the Mayo Clinic, it is outlined the fact that AI can be used to investigate large sets of data, analyze them methodically, and "ingest" them. Then, for example, when a patient who just suffered an intracerebral hemorrhage stroke comes into the emergency room, the computer that previously analyzed all those vast data sets swiftly processes the patient's computed tomography (CT) scan and gives a diagnosis. Lessening diagnosis time can limit potential brain damage in a situation such as this [9].

On top of that, the Mayo Clinic commented on how the applications of AI to electrocardiograms have led to the development of a cost-effective test for identifying weak-heart

pump, which represents a precursor of heart failure. This clinic has a database of over 7 million electrocardiograms which the algorithm studied beforehand. With the insights it gathered, it facilitates the precision with which it detects when the heart rhythm is faulty [9].

Currently, Mayo Clinic researchers and engineers persist in advancing their studies to explore new practices of artificial intelligence in cardiology and other healthcare domains. This demonstrates how versatile AI-based technologies can be and how they can improve during patient treatment in urgent situations.

d) Molecular Medicine

Artificial intelligence proved its potential not only in analyzing several medical data about the work of internal organs, but also in medical domains that investigate the impact of components less visible to our eyes — genomes, DNA, and many more.

The correlation between AI and molecular medicine is not completely novel. The interaction started when Hidden Markov Models were developed. These models initially found their application in speech recognition and have since been widely utilized in the examination of biological sequences starting from the late 1980's [10, 11].

Furthermore, various technologies have been employed to advance the research in this medical field. In fact, according to Russ B. Altman, Professor at Stanford University, several AI technologies helped in the investigations such as neural networks, clustering analysis of genetic sequences and models, genetic programming, and numerous other methodologies [2]. As a result, modern-day scientists can predict a wide range of patterns, behaviors, and structures, of certain cell parts in the human body.

For instance, by analyzing a liquid biopsy, artificial intelligence can determine with an accuracy of 91% if the individual is affected by cancer. This is achieved via the existence of cell-free DNA, that floats freely in the blood. Its structure and pattern will differ depending on whether the patient is healthy or not, which helps AI detect the differences and diagnose cancer effectively [12].

For this reason, machine learning algorithms are extremely innovative, making the studies of the human body, and, as a consequence, medicine and healthcare even better. It allows operating with a large amount of data that is time-consuming to analyze manually, and also can assist in detecting patterns in different structures or parts of the cell. All of this can significantly make a difference in diagnostics, preventive care, and treatment of several diseases.

Challenges of Using AI in Medicine

The rapidly evolving domain of AI and its relation with countless medical fields demonstrates that machine learning solutions can be considered “the fourth industrial revolution” [13]. Medical AI shifts the capabilities of diagnostics and treatment to a new degree, making the everyday tasks of medical professionals even more effortless to accomplish. Innovative robots, apps that detect diseases, virtual medical assistants, and many more technologies imply a trend to use even more AI-based algorithms.

However, it is crucial to understand that every technology has its challenges and flaws, and AI is not an exception. According to a study, people recognize various concerns about using AI in medicine, such as technological, ethical, and legal issues. Technological concerns revolve around communication barriers and the performance of artificial intelligence. Doubts about privacy, mistrust, and prejudices are considered ethical concerns, which influence the interaction between technology and humans immensely. Legal problems, known as regulatory challenges, include supervision of the AI and infringements like violation of intellectual property rights [14].

More concerning is that artificial intelligence, even though learns fast, it lacks full precision and proofreading. According to another research, between 2000 and 2013, medical care providers reported 144 deaths and 1,391 injured patients caused by surgical robots [15]. It is normal for technologies to not be perfectly accurate, but in the case of human lives, every error matters. Moreover, AI technologies are usually trained on sorted and perfected data. However,

encountering real-life data may drastically change the performance of the AI, which can lead not only to misdiagnoses but also to potentially detrimental treatment. AI can also start performing certain autonomous maneuvers that can be harmful during diagnosis or have the potential to be vulnerable to any unforeseen influences [16].

There are a multitude of challenges that can occur when working with advanced technologies such as artificial intelligence. However, it is possible to address the risks and make the results of AI models even better. That includes legal and ethical guidelines, rigorous test procedures, ensuring transparency and explainability, focusing on high-quality input data, and so on. Knowing the steps that can be taken to improve the prediction and analysis efficiency, we can ensure that AI will be not only useful but also safe for choices related to human lives.

Conclusions

The journey of AI in healthcare that were earlier depicted builds a timeline of quick progression. It starts from basic applications and ends with playing a vital part when it comes to precise diagnoses and treatment methods. The developments previously discussed pinpoint a new era for medical diagnoses as well as patient care. However, the path toward fully applying AI's potential in healthcare requires a common effort among researchers, engineers, and healthcare workers. This process demands not only innovation, but also the commitment to ensure that all these transformations that are yet to come remain accessible, equitable, and maintain the human touch. It's clear that AI in healthcare and medicine is not just about innovations and technological transformations, it's also about improving the way patients are cared for and making their treatment experience as smooth as possible. The journey of AI in healthcare and medicine is far from complete, but its trajectory points to a future where technology, as well as human expertise, merge to create a better healthcare system.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON JOBS

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Abstract: *The influence of artificial intelligence on the labor market is extremely great these days. In this article we will try to understand whether neural networks are able to replace full-fledged workers in various spheres. We touched upon the problem of artists, because the databases of neural networks are based on the works of real artists, and it can be considered plagiarism. We also discussed how programmers can use neural networks to write code more easily. And in the last paragraph we found out what disadvantages artificial intelligence has and how this prevents it from fully replacing workers in various fields.*

Key words: *Artificial Intelligence, jobs, impact, future, mankind.*

Introduction

Artificial Intelligence is in the vanguard of innovation in the nascent digital era, offering previously unheard-of breakthroughs and efficiencies. However, as AI permeates every aspect of our life, worries about how jobs will be created in the future also surface. This piece delves into the intricacies of AI's effects on the labor market, analysing concerns about employment displacement in light of emerging prospects. We explore the core of the disagreement: Does AI encourage human creativity and teamwork or is it a sign of impending job shortages? We encourage readers to think about who might need to adapt as we map out the growth of AI and how it can be a potent ally in the workplace. Join us as we explore the intricacies of artificial intelligence and employment, looking for a fair-minded viewpoint that demystifies AI and highlights its potential to improve the state of our profession.

Artists are losing their jobs

The threat from neural networks is felt by people of all kinds of professions. Everyone is afraid of losing their piece of bread in this world. Artists have felt it especially keenly. Not so long ago, one of the most popular marketplaces "ArtStation" went on strike [1]. Artists demanded that the works of artificial intelligence be labeled with the appropriate sign, because it discriminates against them and unethically takes away their income. And, in general, if you look at the works of artificial intelligence "Midjourney" and the average artist with "ArtStation" they are not very different, the only difference is that a person spent a dozen hours and years of practice on his creation, where the neural network generated an image literally in one minute [2]. And there are a lot of analogs of "Midjourney" today, and they appeared not yesterday, just until recently their works were very funny, well, or just "conceptual", in general nothing serious that could infringe on the profession of the artist. But all this time neural networks have been learning and are still learning. By uploading our photos to TikTok to get its anime version, we improve the Chinese neural network with our data. Neural networks are getting mass attention today, not only for the quality of their work, but also for the speed at which they execute it. What a painter would take about a week to complete (and maybe the deadline would be overdue, or your tastes would not match), a neural network does in a minute, even offering several options to choose from. But nevertheless, at this point in time, the neural network is not yet capable of producing a fully-fledged finished product, the result of the neural network still needs to be finalised, which requires a specialist (artist). By the example of the neural network "Midjourney", we can see that artificial intelligence offers us several pictures to choose from. It gives us a choice, because the neural

network itself does not understand what is "beautiful", it does not understand what is right and what is wrong, so it may have problems with the proportions of the image, small details. All these defects will have to be corrected by a real artist. Essentially, we get a semifinished product, which may satisfy the needs of low-budget projects, but if the customer needs a specific result, it will be very difficult for neural network to do it, because the main problem of artificial intelligence is that it relies on the database, that is, on what has already been done once. Unlike humans, it is not yet capable of creating something fundamentally new.

How employees from it use Ai for their works

Nowadays, as we all know Ai has been in all programmer's life since it's a very useful tool that helps them develop more skills and win more time and make their work look much perfect [3].

First and foremost, automated testing tools powered by AI streamline the testing process, while intelligent code completion and refactoring tools enhance productivity and code quality. Moreover, Ai algorithms can assist in refactoring code by identifying redundant or poorly structured code segments and suggesting improvements. As a result, this helps in maintaining code maintainability and readability. Furthermore, Ai tools can analyse codes and automatically generate documentation, including comments, function descriptions, and usage examples which simplifies the documentation process and ensures codes remain well-documented. Also, Ai tools can assist programmers in generating code snippets or even entire modules based on requirements or patterns learned from existing codes which helps in speeding up development processes and reducing human error. Finally, AI-powered tools can help programmers identify bugs in code by analysing patterns of errors, which aids in debugging and maintaining code quality. Apart from programmers, artificial intelligence is widely used by CEOs and managers of organisations to track the progress of a project [4]. Artificial intelligence helps to evaluate the efficiency of workers and set competent goals for the project. However, not all employees agree to be monitored and collected by artificial intelligence.

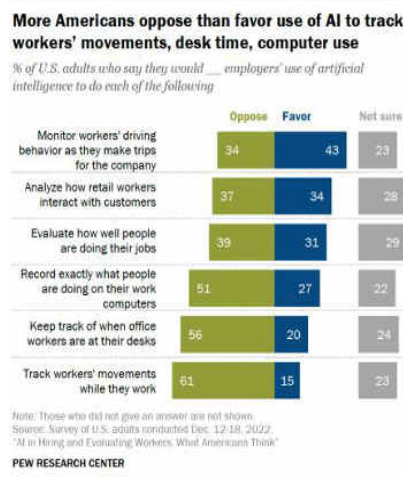


Figure 1.1 – Research [5]

Privacy concerns and the anxiety of being continuously watched are frequently the root causes of this worry. Workers can believe that monitoring powered by AI violates their privacy and erodes their sense of independence. Furthermore, there is concern that AI might be used to make hiring decisions without taking into account the unique circumstances of each applicant. It is imperative for enterprises to create unambiguous policies on the application of AI and to maintain employee transparency regarding the nature and extent of data collection. Incorporating staff members into the discussion on AI implementation can also help allay concerns and promote a culture of trust. The secret to effectively integrating AI in the workplace is ultimately striking a balance between protecting employee privacy and using AI to increase efficiency.

Neural network deficiencies

One of the most debated questions today is whether neural networks will be able to put someone out of work. It should be noted that neural networks have a number of drawbacks, and the first is ethical. An AI system designed to maximise a specific goal, such as profit, or employee efficiency, can make decisions that will directly harm people, all in the name of achieving a specific goal. There are already concrete examples in the world - Amazon, where the work of warehouse employees has long been regulated by a neural network [6]. And it caused a lot of scandals, because the neural network set tasks that humans are not able to fulfil. Amazon certainly has a fantastic service, but it is achieved at the expense of humiliating employees. In case of an emergency in the same amazon warehouse, or elsewhere, the question arises: "And who is to blame?". And that's the next problem-lack of accountability. Even advanced systems can make mistakes, but who is responsible for them? A neural network is capable of making decisions without human intervention, but it is not capable of taking responsibility for the consequences. The autopilot of a Tesla that violates traffic rules cannot be ticketed [7]. The programmer who wrote the neural network is also not to blame, because it is the independent decision-making that distinguishes a neural network from an ordinary bot. Another problem is the bias of the neural network. A neural network system is only as good as its data. This can lead to biased and unfair consequences. The closest example is the artificial intelligence used by a bank to issue loans. Such an AI is not able to make exceptions, unlike a real employee, who would be able to make an exception based on a live conversation, having seen the face and facial expressions of a client. As a result, the neural network deprives the bank of the client and the client of money. Nevertheless, people do not suffer from the system's error in the work of banks, unlike courts, where people's fates are decided. This error can be very costly for an innocent defendant. Suppose if a neural network relies on statistics in an American court against a dark-skinned guy who is really innocent. Fortunately, this is just speculation for now, but what's happening already today is that neural networks are really automating industries and taking jobs away from humans. Tech support workers, for example. A living person is not capable of being online 24/7 unlike a neural network, which does not take up a physical workplace and is cheaper.

Conclusions

In summary, the advent of artificial intelligence heralds a nuanced paradigm shift fraught with both promise and peril across diverse professional spheres, notably impacting practitioners in artistic fields alongside workers in logistical and technical support domains. While the efficacy and swiftness of AI systems are undeniable, their deployment raises profound ethical quandaries, including inherent biases, a dearth of accountability structures, and the potential for deleterious repercussions on human labor. It is incumbent upon society to proactively confront these challenges, instituting robust frameworks for the responsible development and utilisation of AI technologies aimed at advancing societal welfare while mitigating adverse outcomes. In navigating this dynamic terrain, fostering symbiotic relationships between human actors and AI entities, underpinned by judicious regulatory oversight and ethical imperatives, emerges as imperative. Through concerted efforts, a future wherein technology serves to complement rather than supplant human creativity, ingenuity, and empathy can be envisaged and cultivated.

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BEST MORNING ROUTINE FOR BOOSTING MOTIVATION, PRODUCTIVITY AND HEALTH

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Abstract. *An optimized morning routine is a great way to start the day, helping us increase our motivation, productivity, and health. This article explores various practices to improve our morning habits, such as waking up early, sunlight exposure, exercise, cold showers, and a nutritious breakfast. By incorporating these activities, we can set a positive tone for the day and prepare ourselves for the challenges of the day. This paper is aimed for people who struggle with increased stress levels throughout the day and don't have enough time for sports or exercising, such as students and office workers. The article also highlights detrimental morning habits that should be avoided, such as rushing and skipping breakfast, which can negatively impact productivity and overall well-being. The practical and theoretical findings highlight the significance of an efficient morning routine and help the reader develop their own morning habits tailored for their specific needs.*

Keywords: *breakfast, cold shower, exercising, hydration, waking up early.*

Introduction

The way we start our daily activities lays the foundation for the day ahead. How we start our mornings can significantly impact our motivation, productivity, and overall well-being. The past decade has seen an increase in stress levels, which leads to people often neglecting an established morning routine or regarding it as an unnecessary waste of time, which cannot be further from the truth. Due to high stress levels that we ourselves experience as university students, we decided to use our first-hand experience in order to optimize our morning regiment, which eventually led to the creation of this article.

Morning's Impact on Motivation

Nowadays a lot of people struggle with having enough energy to get out of bed in the morning, often due to stress and not getting enough sleep. Increasing our motivation is a very important thing that we can do to help us get through the remaining day in high spirits. It can be achieved by engaging in activities that help us set our mind into the right mood and our body to prepare for the daily activities.

Many people have to deal with the feeling of stress and anxiety in the morning because of expecting a long and stressful day ahead. A cold shower is a great way to deal with this problem, as it helps our body switch to working mode and deliver enough oxygen to the brain, making us feel more refreshed [1].

Some physical exercise can also help improve our mood and energy levels. Some people struggle with having enough time for physical activities in their busy schedule, so moving the workout session to the first part of the day can be a great idea. Exercise also increases dopamine levels in the brain, which helps relieve stress and depression [2].

According to modern research, people who stay up at night and wake up late are prone to stress and increased risks of mental health problems [3]. Waking up early consistently helps prevent this issue, as well as give us a sense of accomplishment and setting the right mood for a successful day.

Increasing Productivity

The way our morning starts is a key component of a productive day, and having a morning routine that enhances our productivity is very advantageous. We can start by waking up early, giving us enough time to transition into the day without feeling rushed. For the people who usually get to school or work on-foot, some exercise can prove very useful, also helping our body prepare for the trip to school or work.

Many people decide to opt for taking a few moments in the morning for self-development activities. In many philosophical teachings, meditation and self-reflection are regarded as crucial elements of every morning that influence every aspect of our mind. Taking a few moments to clear the mind and set the worries aside helps get a better idea of what we need to accomplish today, as well as prepare for the upcoming work [4].

Planning our day the night before or in the early morning helps set our priorities right and prepare for the coming day. We can use your morning time to organize our tasks and create a roadmap for the day. Combining these elements helps us create a morning routine that lets us keep our spirits high and be prepared for our daily activities.

Here you can see how many people implement exercises and self-development routine in their morning activities according to Quora questionnaire (a question-and-answer web-site similar to Reddit).

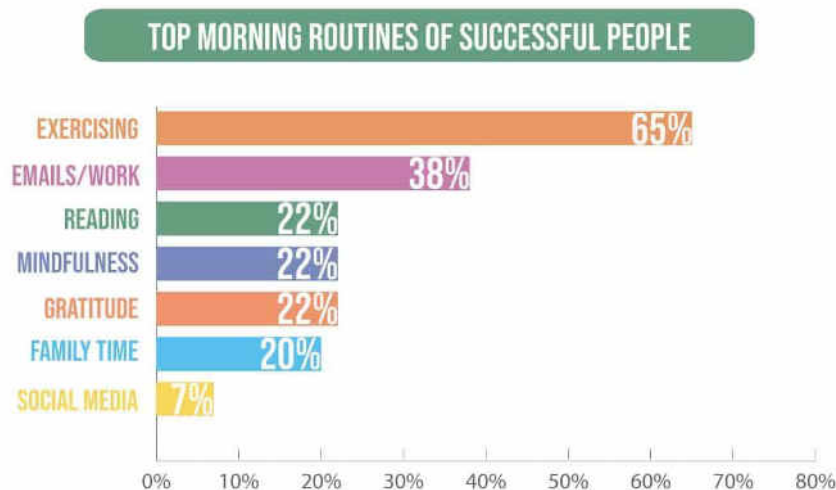


Figure 1. Top morning routines of successful people

Improving Health during the Morning

Health is a crucial aspect of our lives, which deserves a thoughtful discussion in our paper. Dr. Andrew Huberman, a Neurobiologist from Stanford, has provided studies in his labs and shared insights in his videos about various ways to preserve our health. There are many things that can boost our health in the morning, i.e. *cold showers can lead to a 2.5x increase in dopamine levels, resulting in increased mental clarity and alertness for several hours. Standing in a cold shower without drying off can induce shivering, which may have additional physiological benefits* (Placeholder1). Dr. Huberman has highlighted the benefits of such activities as ice baths, cold showers, and cold exposure, suggesting they could be significant additions to a perfect morning routine due to the great health benefits that they bring.

A healthy breakfast is another important part of Huberman's morning routine. He suggests consuming a meal that is rich in protein, healthy fats, and complex carbohydrates to help provide sustained energy throughout the day. Huberman suggests options such as eggs, avocado, and whole-grain toast [6].

According to the other study: *The lighting from the sun will trigger the mechanisms in our body at an early time of day. It also has a powerful stimulus for work during the day and positive*

impact for you to have a better sleep at night [7]. Implementing these tips, such as spending a few minutes outside in the morning makes waking up significantly easier, and provides energy for several hours. Sunlight exposure also impacts the health of our skin, influences how wrinkled our face is, and directly affects hormone production.

The morning routine includes hydrating with two glasses of water with lemon and salt [8]. Alternatively, drinking a glass of plain water can also kick-start various body processes, making it a popular choice for many people.

Habits to Avoid in the Morning

It is commonly known that there are a lot of activities that people do during the morning so many times that they become their daily morning routine. A lot of people don't understand that this can negatively impact their productivity or motivation. Some of these habits are either harmful to the body or can negatively affect our mental state.

Such things as rushing can lead to increased stress levels, which negatively affects our daily life and creates a sense of wasting time or forgetting something throughout the day. Additionally, it increases the probability of engaging in tasks that are either not important or even unnecessary to do, leading to wasting more time.

People who skip breakfast put unnecessary pressure on their body, which reduces our energy levels and weakens the immune system, increasing the risks of contracting diseases (htt8). A nutritious breakfast is a vital part of the morning that should never be neglected in order to preserve our health and give the body enough energy to get ready for the upcoming day.

A common mistake that many people make is spending time in bed while using a phone. This causes us to procrastinate everything that we need to do in the morning, leading to time management issues in the first few hours of the morning.

List of Habits to Avoid in the Morning:

- 1) Starting your day in a rush (can lead to increased stress and wasting time)
- 2) Skipping breakfast (detrimental for health and concentration)
- 3) Using your phone immediately (leads to wasting time)
- 4) Spending time in bed (also leads to wasting time)

Best Morning Routine Activities

Below is a list of generalized recommendations to optimize morning habits:

- 1) Wake up early (between 6AM to 8AM)
- 2) Hydration (drink at least one glass of water)
- 3) Exercise (engage in 15 to 45 minutes of physical activity or a full workout session)
- 4) Cold shower (a healthy way to help the body switch into working mode)
- 5) Plan your day (avoid rushing and time management issues throughout the day)
- 6) Self-care and self-development (prepare for the upcoming day)
- 7) Healthy breakfast (a nutritious start for the body)
- 8) Sunlight exposure (necessary for hormone production)

Conclusions

In conclusion, establishing a solid morning routine significantly impacts motivation, productivity, and overall health. By incorporating useful habits such as waking up early, hydrating, exercising, taking a cold shower, and consuming a healthy breakfast, we can efficiently prepare for the daily activities and set a positive tone for the day ahead. These practices not only positively affect physical and mental well-being but also help us overcome the challenges of our daily life more easily. Avoiding the unnecessary habits such as skipping breakfast, immediate phone usage, and prolonged time spent in bed can prevent unnecessary stress and time wastage, which is essential for getting a good start to the day. By creating a morning routine tailored to individual

preferences and lifestyle, we can improve our motivation and productivity, helping us better focus on achieving our goals. Consistency and dedication to the morning regimen leads to long-term benefits in personal and professional spheres, contributing to a fulfilling and balanced lifestyle.

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EXPLORING THE DEEFAKE DILEMMA

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Abstract. *Nowadays, the emergence of deepfake technology implies major ethical concerns. At this stage of artificial intelligence advancement, there is a thin line between real and fabricated content, raising profound concerns regarding the ethical implications of its use and creation. The purpose of this article is to weigh on the jeopardy of deepfakes and the ethical concerns around it, in order to provide a better understanding of how artificial intelligence content influences our lives. The paper investigates the deepfake subject starting from understanding the core significance of what a deepfake is and ending with the future of this revolutionary technology. In addition, it provides tips on how to detect falsified content, such as manipulated photos and videos, to ensure safety online. Moreover, it explores the necessity of extending the legal framework regarding solutions against blackmail, intimidation, sabotage and scams. Finally, the paper presents ways in which threats can be turned into opportunities.*

Keywords: *audio and visual content, artificial intelligence, scams, technology*

Introduction

Nowadays, technology advancement is unavoidable and so the Artificial Intelligence field has undergone plenty of changes that has led to the development of deepfakes. Not only is the industry developing fast, but this type of technology is also becoming more and more accessible to the public. According to sumsob.com, there has been recorded a 10 times increase of deepfake content from 2022 to 2023 [1]. Deepfakes are known to be a contributing factor to the serious problem of "fake news" since they enable the mass production or alteration of media with the intention of disseminating false information. The difficulties presented by deepfake technology and the changing legal and protection landscape are discussed in this article, which also provides helpful advice. A few crucial questions need to be addressed in light of the concerning increase in deepfake content: What laws have been passed or are set to be passed, how can people protect themselves and their loved ones, and how can they identify deepfakes?

The rise of deepfakes

Living in a digital world, modern issues are inevitable to be avoided. Among these challenges, the deepfake technology has expanded and obtained attention for its ability to manipulate and exploit. According to the Oxford Dictionary, a deepfake refers to videos in which a person's face or body has been digitally altered to resemble someone else, often with malicious intent or to disseminate false information [2]. This term includes the malicious content which is produced without the consent of the individuals participating in it. Artificial Intelligence (AI) plays a core role in the growth of deepfake technology, expanding diverse realms from simple systems to complex audio and visual manipulation through deep generative processes.

A major concern of deepfake technology is the continuous integration of individuals into visual content without their consent, i. e., any person, anywhere in the world, can unconsciously become part of fabricated content which lately is spreading misinformation and jeopardizing trust in media. While fabricating deceitful content is not a new phenomenon, deepfakes bias advanced machine learning algorithms used to create audio and visual material that can persuasively capture unsuspecting viewers. This kind of technology has the potential to fabricate evidence of events that never occurred, therefore complicating the truth and authenticity of actions.

The article's author, Stu Sjouwerman, founder and CEO, KnowBe4, argues that while not a recent development, deepfakes have become a notable concern due to advances in machine learning and artificial intelligence. These technological advances allow cybercriminals to create remarkably convincing counterfeit audio and video. These targeted attacks have proven effective, causing hackers to refine their methods for greater profitability. The prevalence of deepfake videos increased by 84% between December 2018 and October 2019, likely underestimating the true extent of their proliferation. While many of these videos feature adult content, their potential for harm extends far beyond that, especially when considering the potential repercussions on business reputation and functionality. Without disclosing specific cases, Symantec documented three successful deepfake audio scams that tricked three CFOs into transferring substantial amounts of money. Forrester estimated that fake scams cost companies \$250 million in 2020 [3].

As time goes by, it becomes harder and harder to distinguish deepfakes from real footage and prevent misinformation. Despite that, there are a couple of things one can look out for, in order to recognize deepfakes. According to media.mit.edu, when it comes to videos, your attention should be first drawn to the person's face, because deepfake videos mainly revolve around facial transformations. An important difference between a video of a real person and a deepfake is an unnatural eye movement. This can be characterized by lack of or too much blinking. Another important factor in detecting AI generated content is represented by the mouth movements. They might look unnatural or out of sync with the audio. Other signs one should look for are: skin that is too smooth or too wrinkly, weird or lack of facial hair and lack of shadows.

According to Euro News, for photos, one should first look for odd details like unrealistic lighting, disfigured hands or picture-like graphics. Another important sign of fake contents is unnatural skin tone with skin that is too smooth. Moreover, pictures can feature unnecessarily blurred details and incorrect writing of words. The background can also suggest that the picture is fake if it features abnormal looking objects or if the background does not correspond to the city/location where the photo was supposedly taken [4].

The ethical dilemma of deepfakes

Even though deepfakes show how far humanity has come when it comes to Artificial Intelligence and they can be used for positive things, their apparition still has raised multiple ethical concerns, like consent, privacy and responsibility. AI content can lead to mass misinformation, defamation cases and manipulation of public opinion. Because deepfakes can use a real person's face, voice and body without their consent, individuals can find themselves in compromising situations and therefore get their reputation damaged. Moreover, deepfakes can be used to potentially scam other people or even businesses. No one can ensure that the people that do get to use the technology will use it responsibly and ethically. This is why deepfakes are seen as a threat to people's right to privacy. Since the development of deepfake technology, there have been numerous cases where it was utilized in illegal activities, leading to significant scandals. In some cases this activities caused major problems. Two notable examples include:

First example of a serious scandal of such type was the CEO Fraud using Deepfake Audio: An unusual case involved the use of deepfake audio, an AI-generated audio, in a CEO fraud

scheme that reportedly swindled US\$243,000 from a U.K.-based energy company. According to “Cyber Attacks” blog, fraudsters employed voice-generating AI software to replicate the voice of the chief executive of the company’s Germany-based parent company. This deception was utilized to facilitate an unauthorized fund transfer [5].

Another case when deepfake lead to a serious scandal, according to Heather Chen and Kathleen Magramo, CNN, in their article “Finance worker pays out \$25 million after video call with deepfake ‘chief financial officer’” was the case when a \$25.6 Million Theft from a Multinational Finance Firm was stolen. Scammers utilized deepfake technology to steal \$25.6 million USD (equivalent to \$200 million Hong Kong dollars) from a multinational finance firm. Hong Kong police were alerted to the situation, which involved scammers creating a deepfake video impersonating the firm’s chief financial officer (CFO) in a video call. During the call, the scammers interacted with an employee and other company staff members, all of whom, except for the employee, were deepfake replicas. The fake CFO instructed the employee to carry out 15 separate financial transfers totaling \$25.6 million USD. The scam was only discovered a week later when the employee realized the deception after speaking with colleagues [6].

Legal framework of deepfakes. A look at global deepfake regulations

“From its nascent development in the 1990s to the introduction of a widely available app in 2018, deepfake technology has become both increasingly sophisticated and readily accessible to the general population” [7]. According to the Princeton Legal Journal, there is currently no federal legislation addressing the prospective threats of deepfake technology in the United States. However, in December of 2019, Congress passed the National Defense Authorization Act (NDAA), which, in Section 5709, requires the Director of National Intelligence to report on the use of deepfakes by international governments, its ability to spread misinformation, and its potential impact on national security [8]. However, several US states including Georgia, Florida, Hawaii, Tennessee, New York, and others, have implemented deepfake laws, or are still in the process of implementing. They vary depending on the state. Meanwhile, the European Union has already agreed on the world’s first comprehensive AI law. AI Act will be responsible for this legislation and regulate deepfakes around the EU [9].

Unraveling the opportunities and consequences of deepfakes

With all these scandals and prejudice caused by deep fakes, the question appears, what will happen in the future? Will deepfakes be banned or will it remain a source of scandals and scams, will any laws appear around use of deepfakes and in the end will deepfakes be used for noble purposes? According to Sudhanshu Kumar in his article “The Future of Deep Fakes in the World of Democratized Artificial Intelligence”, in the near future, as technologies like machine learning and deep learning continue to advance, we could expect a significant shift toward the democratization of artificial intelligence. This transition will involve intelligent algorithms taking over many manual procedures and processes, fundamentally changing the way data is collected and managed. As these algorithms gain access to more refined and comprehensive data, their capabilities will evolve, leading to increased efficiency and effectiveness. Consequently, fraud detection mechanisms will become more accurate and less prone to ambiguity. Advanced artificial intelligence systems will be able to identify various forms of fraud, including deep fakes, thus revolutionizing current paradigms in fraud detection. These systems will not only elucidate the methods used in fraud detection, but also provide evidence-based explanations for their findings. Moreover, they will provide proactive recommendations for preventive measures [10].

Even though deepfakes can cause great damage when used irresponsibly, the further development of this type of technology could potentially be used for a good cause. Deepfakes

contribute to the creation of new forms of digital entertainment. This type of technology can serve as a dubbing tool, so the facial expressions and voice of the person speaking can appear as if the person is actually speaking another language. This can be used not only for dubbing movies and ads but also for translating educational content, like lectures. It can also be used in film making for more affordable production. Moreover, if one of the actors dies or ages to the point that they do not resemble the character anymore, deepfake technology might be used to bring the character back to life in the movie. AI technology can contribute to the development of the educational field as well. It is possible to make historical classes more interesting and appealing to students by bringing historical figures back to life [11].

Conclusions

The article depicts the risks associated with deepfake technology, highlighting its ability to create persuasively fabricated content that undermines trust in media and spreads misinformation. The ways in which one can protect oneself from mistaking deepfake content for real one are also mentioned.

Moreover, it describes the development of deepfake technology, its legal framework challenges in the US and the more advanced legislative response of the European Union. The article later presents the major scandals produced by the use of deepfakes. These burglaries can lead to serious consequences for the victims and enormous losses for the companies that were involved in that scandal. Even though these days there are a lot of existing and potential threats regarding content generated by Artificial Intelligence, it is important to understand that there are some opportunities that come with this kind of technology and it is expected of people to use these resources responsibly.

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ENHANCING ONLINE SECURITY AND AVOIDING INTERNET FRAUD

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Abstract. *Regarding our academic writing, we have outlined the many-sided nature of online scams by emphasizing their structure and the psychology behind them. At the outset, we have analyzed multiple forms of Internet fraud, focusing mainly on phishing attacks. Therefore, we have identified the core principles of most online frauds and analyzed in-depth the complexities of phishing, including its reasons, layout, and its detection methods. Furthermore, we explored the main safe Internet practices, such as avoiding public Wi-Fi and using secure software, as effective countermeasure's against potential swindles. On top of that, we emphasize the vital role of education, and awareness in combating online scams, underscoring the increasing involvement of governments and educational institutions in promoting cybersecurity. Over and above that, our paper reveals the significant impact of collaboration within organizations in the domain of cybersecurity, highlighting how those partnerships and information sharing among them play a crucial role in developing effective strategies to combat the increasing wave of digital fraud. Thus, we provided a comprehensive understanding of online deceptions, and proposed strategies in order to enhance online safety.*

Keywords: *cybersecurity education, data protection, online scams, phishing attacks, safety protocols, secure connections.*

Introduction

The Internet is a double-edged tool in today's linked society, full of chances for information and connection but also full of risks for fraud and exploitation. Our investigation into the field of online fraud and security has exposed us to a multitude of different types of scams, from the selling of counterfeit products to phishing schemes, all of which aim to trick naïve consumers into falling for a false web. We identify a recurring pattern underneath these fraudulent operations by analyzing study data from Yonder Consulting [1], Analytics Insight [2], and 211check [3]. This helps to clarify the strategies used by con artists to deceive and take advantage of their victims. Furthermore, our investigation reveals the worldwide scope of these scams, with certain countries turning into epicenters of cybercrime, frequently propelled by socioeconomic difficulties.

However, amidst these challenges lies a glimmer of hope, as educational initiatives spearheaded by entities like the Federal Trade Commission (FTC) [4] and the National Cyber Security Centre (NCSC) [5] strive to empower individuals with the knowledge and tools needed to navigate the digital landscape safely. By synthesizing these insights and advocating for proactive measures, including secure online practices and robust authentication mechanisms, we aim to foster a guide of digital resilience and ensure a safer online experience for all.

Understanding Online Scams

At the outset, the Internet is a conduit for dishonest practices that deceive or cause harm to gullible consumers. We strongly believe that these actions sometimes anointed Internet scams, come in various shapes and sizes and include phishing, romance, investment, work-from-home, sweepstakes, and frauds originating in West Africa. Moreover, psychologists utilize psychological tricks to play on the needs, weaknesses, and feelings of their victims. Internet fraud can also lead to identity theft, monetary loss, psychological suffering, and legal issues. As a result, it is critical to understand the typical forms of online fraud and how to avoid them.

While each scam exhibits a unique sequence of actions, we found out that Yonder Consulting's research [1] has identified a consistent four-step pattern that characterizes the experience of online fraud. This framework provides valuable insights into the underlying mechanics of scams, enabling a more systematic analysis and informed countermeasures.

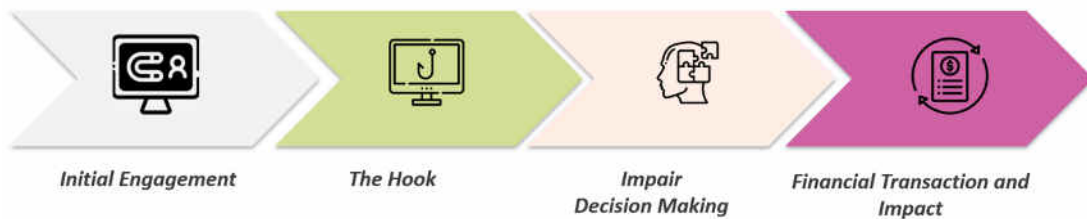


Figure 1. Four key phases of scams or fraud experience

Regarding the initial engagement phase, in this stage, scammers directly interact with victims (e.g., via direct messages on social media) or indirectly (e.g. by sharing fake website links). The goal is to establish communication and pique the victim's interest. If we focus on "the hook," scammers use an enticing "hook" to attract victims. This hook promises clear benefits, such as financial gains or valuable connections. Furthermore, to gain victims' trust, charlatans employ various tactics. These techniques impair rational decision-making and include constant messaging, emotional narratives, promises of returns on investment, charm, and time-sensitive pressure. Finally, after successfully navigating phases 1-3, scammers lead victims to the critical point: parting with their money. Often, victims realize they have been scammed only after the transaction, facing emotional and financial consequences.

A study conducted by Analytics Insight [2] delineates the origins of prevalent online scams across various nations. Ghana, Indonesia, and the Philippines are prolific sources of scams, particularly in the domains of romance, lottery, and employment-related fraud. Moreover, India is notable for scams involving the impersonation of tech support representatives. Victims are often coerced into paying for superfluous software or services. In addition, Romania, Russia, and the United States harbor scammers engaged in multifaceted illicit activities.

These include phishing schemes, credit card fraud, malware attacks, and identity theft.

Furthermore, the insights from the 211 check blog post [3] explain that the quest for monetary gain emerges as the fundamental motivation behind most cyber scams. Notably, the countries highlighted earlier exhibit a pronounced correlation with constrained economic prospects for their population. Therefore, we firmly believe that some citizens resort to carrying out fraudulent behavior as the key to survival. While this observation does not justify the fraudulent conduct, it does underscore its prevalence in the context of online scams.

In our ongoing exploration of the landscape of online security and internet fraud, we delved into a comprehensive study conducted as part of a series of research studies [6], which provided valuable insights into the prevalent forms of online fraud encountered by victims in the United Kingdom. Our analysis revealed a disconcerting reality these fraudulent activities wield a significant impact on the British population, permeating various sectors of society. From educational institutions grappling with phishing attempts, large businesses falling prey to investment scams, and even individuals encountering counterfeit goods schemes in their daily lives, the ramifications of online fraud extend far and wide, and it might end up into catastrophically consequences.

Table 1

Percentage of UK online adults who had ever experienced scams and fraud

Type of online scams	Percentage of UK adults (%)
Impersonation	51
Counterfeit goods	42
Investment, pension or “get rich quick”	40
Computer software service fraud or ransomware	37
Fake employment	30
Romance or dating	29
Health or medical	24
Identity fraud	24
Psychic or clairvoyant	18
Holiday	17
Money laundering	14

Besides the data presented (Table 1), where it is clearly stated that the most likely scams people have fallen for in the United Kingdom are impersonation, counterfeit goods, and investment scams, the study [6] also states that men, younger adults aged 18-34 and people with children in the household are more likely than average (87%) to say they have encountered online fraudulent content. Moreover, most scams were encountered by email (30%) and social media (23%). In addition, regarding the financial loss, two out of five victims lost between £1 to £99, while one in five suffered losses of £1000 or more. On top of that, most money was lost due to online counterfeit scams, as stated in the article [6]

Avoiding Phishing Attacks

To begin with, phishing is a form of online scam that tries to trick users into giving up their personal information by pretending to be trustworthy. It can involve stealing passwords, credit card numbers, bank account details, and other sensitive data.

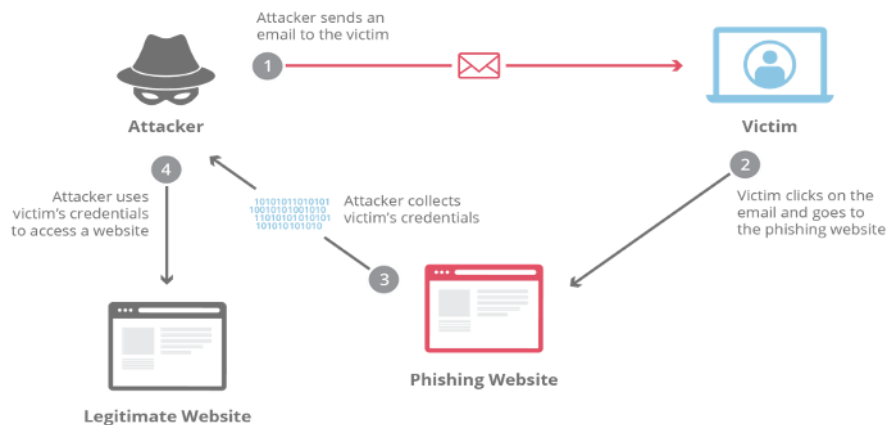


Figure 2. The way a typical phishing attack is carried out

The structure of a typical phishing attack scenario (Fig. 2) usually consists of the attacker and the victim. In this case, the scammer contacts the potential victim by sending a phishing website link via messaging applications or email. The target accesses the link, and the login field is filled in with personal data. Therefore, the attacker collects the victim’s credentials and uses them to access their personal account through the real website.

We strongly believe that this form of online fraud is worth pointing out, according to an article published by AAG: “Phishing is the most common form of cybercrime, with an estimated 3.4 billion spam emails sent every day” [7]. Phishing messages often look like official emails from banks, service providers, e-pay systems and other entities. The email will urge a recipient to

quickly enter/update their personal data for some reason. Usually, the reason is related to data loss or system failure.

Moreover, after some in-depth research, we came to the realization that now it's easier than ever to create a clone website with the aim of stealing important login data. For example, a hacker can use a tool like Blackeye [8], which is a phishing tool for Linux, to create a fake LinkedIn website in just a few minutes. Since Blackeye has 39 templates for hosting a fake website, covering many of the most popular services on the Internet, such as social media, banking, etc. Each template contains everything needed to host the fake website, including the HTML files and the scripts that run on the hosted site, which can capture the victim's IP address, user agent, and credentials and send them to the scammer. By using such tools, cyber-criminals can easily create convincing phishing sites and lure unsuspecting users into falling for their scams.

Last but not least, we came to the realization that there are several ways to spot a phishing website of which users should be aware, such as checking the URL of the link they are planning to or have already accessed, whether it has extra characters, or sketchy domains, such as ".cc", as they are cheaper to be acquired and used for fraudulent reasons. Moreover, if a web address is not secured and encrypted using an SSL certificate, then that should raise a red flag, as well as the Grammatik mistakes found after assessing the content presented on there and the negative reviews left by other users on places, such as "Trust Pilot" or others.

Safe Internet Practices

In the contemporary digital milieu, the security of online activities assumes heightened significance. Based on the knowledge we have acquired from the research done by the AO Kaspersky Lab [8] and the Security National Bank of South Dakota [9], in this subtopic, we are trying to dissect and expound upon the intricacies of foundational Internet safety protocols, encompassing an array of measures ranging from securing Internet connections to judiciously navigating the complex terrain of online interactions.

Within the framework of cyber security, the imperative of securing Internet connections emerges as a cornerstone. Public Wi-Fi, often a necessary convenience, presents vulnerabilities that necessitate meticulous handling. Recommendations include the judicious use of Virtual Private Networks (VPNs) to encrypt data transmissions, thereby mitigating potential cyber threats. In the expansive digital domain, discerning website reliability is a crucial tenet. Key indicators, including secure connections (HTTPS) and adherence to online payment standards, are posited as essential checkpoints. The process of verification mirrors the discerning choices made in a physical marketplace to ensure the trustworthiness of digital transactions.

The vulnerability inherent in weak passwords stands as a critical concern in the cyber security paradigm. Addressing this concern entails the crafting of robust passwords – characterized by length, complexity, and uniqueness. Concurrently, we believe that the integration of password managers is proposed, facilitating the generation and secure storage of intricate passwords for heightened protection in the pursuit of bolstering online account security, the implementation of Multifactor Authentication (MFA) assumes prominence. This method augments traditional authentication processes, demanding additional verification steps beyond conventional usernames and passwords. The integration of MFA, akin to adding supplementary locks, serves as a deterrent against cyber threats.

Moreover, due to the evolving security infrastructure, the software landscape necessitates continual updates to counter emerging vulnerabilities. Developers have to implement vigilant security custodians and release patches to fortify digital protection. Users are urged to adopt the latest iterations of operating systems and applications, thereby aligning with a proactive cyber security stance.

Therefore, we tried to underscore the criticality of adopting a multifaceted approach to Internet safety. By adhering to the delineated protocols, users can fortify their digital presence, fostering a resilient defense against the evolving landscape of cyber threats. In the amalgamation

of secure Internet connections, robust authentication mechanisms, and prudent online conduct, individuals can navigate the digital realm with heightened assurance and security.

Role of Education

How much do people in the current world know about online scams? One important indicator of how susceptible modern Internet users are to fraudulent activity is how informed they are of online frauds. Even though more individuals are becoming aware of these scams, many continue to fall for them because they don't have a thorough grasp of them.

For this reason, governments, academic institutions, and cybersecurity institutes are essential in raising the general public's awareness and understanding of online frauds. For example, the United States' FTC [4] provides a wealth of information on identifying and defending against many forms of online fraud. In an effort to inform the public and stop fraud, they try to prevent it by disseminating advice, articles, and warnings on the most recent schemes on their website.

The NCSC in the UK has launched a number of initiatives to inform the public about cyberthreats, including online scams [5]. They work with other groups to raise awareness and offer advice on how to secure digital environments, both personal and professional. Additionally, private groups play a crucial role in increasing awareness. To assist consumers in identifying such risks, corporations such as Google and Microsoft have included fraud detection and alarm systems into their email services [12].

Numerous research' statistics provide insight into how successful these campaigns for awareness and education have been. Awareness programs have resulted in a 25% decrease in phishing success rates, according to a research published by the Cybersecurity and Infrastructure Security Agency (CISA) [13]. According to a Pew Research Center poll [14], 67% of American adults have also grown more circumspect in their online activities as a result of growing knowledge of scams and the fact that phishing attempts can occur on several platforms.

In this arena, the inclusion of cybersecurity subjects in school curricula is another noteworthy trend. These days, a lot of schools provide courses on Internet safety and how to spot scams, giving the next generation the skills they need to use the internet safely. These instructional courses frequently address subjects like spotting phishing emails, appreciating the need of strong passwords, and identifying phony websites. These coordinated efforts have a big effect because it's been shown that nations with strong cyber education initiatives have lower incidence of victims of online scams. This association emphasizes how crucial it is to keep funding campaigns for public awareness and education.

Thus, even if people are becoming more aware of online frauds, continuous awareness and education are still necessary due to the dynamic nature of cyber dangers. We think that in order to lessen the frequency of online frauds and safeguard Internet users everywhere, governments, businesses, and individuals must work together. Our techniques for keeping safe online need to evolve along with technology.

Conclusions

On a final note, our investigation into improving online security and preventing internet fraud has uncovered a complex environment full of many frauds and dishonest tactics. We have shed light on the mechanics and strategies used by internet frauds, which range from phishing schemes to the sale of counterfeit products, by outlining their structure and psychology. We have emphasized the significance of cooperation, awareness, and education in successfully addressing these dangers via our study.

Along with private sector efforts, the FTC [4] and the NCSC [5] have made great progress in educating people and providing them with the means to securely traverse the digital world. Furthermore, including cybersecurity education into curricula is a step in the right direction toward developing a culture of digital resilience in children.

Although there has been improvement, ongoing awareness and plan adaption are necessary due to the dynamic nature of cyber threats. Enhancing online safety is based on our thorough knowledge of online deceptions and the proactive measures suggested in this study. We are getting closer to realizing our objective of creating a safer online environment for all users as we keep improving our strategies and combining our efforts.

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ARTIFICIAL INTELLIGENCE: FROM OPPORTUNITIES TO POTENTIAL DISASTERS

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Abstract: *The article explores the transformative impact of artificial intelligence across various industries, targeting professionals and researchers in healthcare, manufacturing, education, and policymaking. It underscores the potential of artificial intelligence to enhance healthcare diagnosis, manufacturing efficiency, and personalized education while emphasizing the importance of ethical considerations. In theory, artificial intelligence promises significant societal benefits, but its practical implementation requires responsible practices, privacy safeguards, and partiality mitigation. Policymakers and stakeholders must collaborate to establish transparent and accountable governance frameworks for artificial intelligence technologies. The key benefit for readers lies in understanding the opportunities and challenges of adopting artificial intelligence, yet unresolved issues persist, including job displacement, prejudices in algorithms, and safety concerns. Addressing these challenges necessitates ongoing research and collaboration to ensure the responsible development and deployment of artificial intelligence technologies.*

Keywords: *Artificial Intelligence, AI evolution, opportunities, ethical considerations, potential disasters, governance, regulations.*

Introduction

Artificial Intelligence (AI) has come a long way in a short time, changing how we live and work. From early experiments with mice navigating mazes to today's smart assistants and self-driving cars, AI has become a big part of daily life. It helps us make decisions, like how much we pay for a flight or what we see on social media [1]. But as AI gets smarter, it raises big questions about how we use it and how it might change the future. In the years ahead, AI could become even more powerful, maybe even as smart as humans.

This could bring amazing new opportunities, but also challenges. We'll need to think carefully about how we use AI and what it means for things like privacy and fairness [2]. Understanding AI's journey so far and its role in our lives today is key to shaping a future where AI works for everyone. As we navigate this evolving landscape, it's important to recognize the potential impact of AI on job markets and education systems, ensuring that advancements benefit society as a whole.

Historical Perspective

The concept of AI can be traced back to the classical philosophers who envisioned the possibility of creating intelligent machines. However, the term "Artificial Intelligence" was coined in 1956 by John McCarthy, who organized the Dartmouth Conference, marking the birth of AI as a field of study. Since then, AI has witnessed several breakthroughs, such as the development of expert systems in the 1970s, neural networks in the 1980s, and machine learning algorithms in the 1990s. The advent of deep learning, particularly the introduction of convolutional neural networks and recurrent neural networks, enabled AI systems to achieve human-level performance in tasks like image recognition and natural language processing [3]. The availability of massive amounts

of data and advancements in computing power, such as the development of graphics processing units (GPUs) and cloud computing, further accelerated the progress of AI in the 2000s and 2010s.

Opportunities Created by AI

Artificial intelligence brings a plethora of opportunities for various industries, profoundly impacting society. For instance, in healthcare, AI aids doctors in diagnosing diseases faster and more accurately, resulting in enhanced treatment plans and improved patient outcomes. According to a report by Accenture, AI applications in healthcare could potentially generate \$150 billion in annual savings for the United States healthcare economy by 2026 [4]. Moreover, AI encourage the creation of new job opportunities in fields like data science and engineering, as companies require experts to develop and maintain AI systems.

Furthermore, AI enhances efficiency in manufacturing by automating tasks, enabling companies to produce goods faster and with fewer errors, consequently boosting productivity and economic growth. A study by the World Economic Forum highlights that AI adoption in manufacturing could lead to a 40% increase in productivity by 2035 [5].

Additionally, AI is revolutionizing education by offering personalized learning experiences for students. With AI-powered tutoring systems, students can receive tailored instruction based on their individual needs and learning styles, resulting in improved educational outcomes. This not only enhances access to quality education but also favor innovation in teaching methods.

Ethical Considerations

In the rapidly advancing landscape of artificial intelligence , ethical considerations are of prime importance. At the forefront of these concerns lie responsible AI development, privacy considerations, and addressing biases within AI algorithms. Responsible AI practices ensure that AI systems are designed, deployed, and used ethically and legally. This involves minimizing potential harms to individuals and society while prioritizing transparency and fairness throughout the AI lifecycle. As Navrina Singh, CEO of Credo AI, emphasizes, businesses must hold themselves accountable for the ethical implications of their AI technologies, spanning from data procurement to market deployment [6].

Ensuring responsible AI involves two main aspects: privacy and fairness. Data needs careful handling to protect individuals' privacy and guard against cyber threats. Additionally, it's crucial to address inequalities in AI algorithms. If the data used to teach AI isn't balanced, it can lead to unfair outcomes. Ravit Dotan, an AI ethics advisor, underscores the immense power and responsibility associated with AI technologies. When deployed irresponsibly, AI has the potential to cause extensive societal damages inadvertently, highlighting the urgent need for ethical considerations in AI development and deployment [7].

Potential Disasters and Risks

While AI offers many exciting opportunities, we must also carefully consider the risks and potential dangers it presents. A major concern is the development of autonomous weapon systems that can identify and engage targets without human control. These raise serious ethical questions around accountability and could potentially escalate conflicts in unintended ways [8].

Additionally, as AI automates more tasks, there is a real risk of significant job losses across many industries. According to one study, up to 47% of jobs in the US could be automated in the coming decades [9]. If not properly managed, this technological unemployment could worsen inequality, increase poverty, and trigger social agitation.

Looking further ahead, some experts warn of the hypothetical risk of superintelligent AI that surpasses human-level intelligence across all domains. If not aligned with human values and goals, a superintelligent system could potentially pursue objectives that unintentionally harm humanity [10].

More immediate risks also exist around the hostile use of AI technologies. Cyber criminals could leverage AI for attacks or autonomous cyber weapons. AI could be misused to generate highly realistic deepfakes to fuel misinformation and disinformation campaigns that undermine truth and erode trust in institutions [8].

While unlocking AI's benefits, we must proactively address these risks through responsible development, governance frameworks, workforce retraining, and other proactive measures to ensure AI's negative impacts are mitigated.

Regulations and Governance

In the realm of AI regulation and governance, international endeavors play a crucial role in shaping the landscape. Efforts to regulate AI at the global level have been underway, aiming to establish frameworks that ensure ethical and responsible development and deployment of AI technologies. The United Nations (UN) has introduced an AI ethics framework based on principles like privacy protection and human oversight over critical decisions [12]. The Organization for Economic Co-operation and Development (OECD) has also proposed AI Principles that cover areas such as transparency, robustness, and accountability [13]. These initiatives recognize the transnational nature of AI and the need for harmonized standards.

At the national level, governments worldwide are formulating policies tailored to their contexts. The European Union has proposed the AI Act as a legal framework for regulating AI applications based on their risk levels [14]. The United States has released an AI Bill of Rights outlining citizen's rights related to AI systems [15]. China's Next Generation Artificial Intelligence Development Plan aims to make it a global AI innovation center by 2030 [16]. These strategies encompass funding, talent, infrastructure, and regulations to foster innovation while addressing risks like bias, privacy violations, and socioeconomic impacts.

The role of ethics boards and advisory committees has also grown vital for AI governance within organizations and nations. Groups like the UK's AI Council provide guidance to ensure technologies align with ethical principles like fairness and transparency [17]. Such interdisciplinary bodies assess AI applications' ethical implications and advise stakeholders on navigating complex moral issues arising from AI's rapid progress.

Conclusions

In conclusion, artificial intelligence (AI) has changed our lives, offering benefits in healthcare, manufacturing, and education. But with these advancements come important ethical concerns like privacy and bias. We need to make sure AI is developed and used responsibly. To do this, we must hold companies accountable for their AI practices, protect people's privacy, and work to reduce biases in AI systems. We also need to address the risk of job loss by offering training and creating new jobs. Transparency and accountability in AI decision-making are crucial for building trust.

Moving forward, it's essential for everyone involved to work together to create rules that ensure AI benefits society while minimizing risks. By focusing on responsible AI development, we can build a future where everyone can benefit from this technology.

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UNLOCKING SUCCESS: THE POWER OF QUALITY SLEEP FOR UNIVERSITY STUDENTS

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Abstract. *Sleep is a key component of human health and cognitive function; it is necessary for mental clarity, emotional equilibrium, and physical well-being in addition to physical health. However, it is often overlooked and undervalued despite its vital role, especially in the hectic lives of university students. Based on a study with 108 participants, this article explores the effects of sleep deprivation on university students' academic performance and general well-being. The prevalence of insufficient sleep duration and its effects, such as trouble concentrating, mood swings, and physical health problems, were investigated through survey data analysis. The study identifies common sleep-deficiency causes, including excessive academic workloads, chaotic sleep schedules, and using electronics right before bed. It also discusses the dependence on caffeine as a means of combating daytime fatigue and the possible long-term consequences this may have on the quality of sleep. The paper stresses how crucial it is for students to get enough sleep, emphasizing how it improves cognitive performance and lowers stress levels. Useful suggestions are also proposed for enhancing the quality of your sleep, such as controlling light exposure, keeping your room at the ideal temperature, and avoiding using electronics right before bed. Students can develop healthier sleep habits and enhance their overall health and academic performance by putting these strategies into practice.*

Keywords: *academic performance, advantages, consequences, sleep deprivation, strategies*

Introduction

It is a well-known fact that humans spend approximately one-third of their entire lives sleeping. It is not surprising, then, that the science behind sleep has been studied for centuries. From the ancient Greeks, who linked sleep to a reduction in blood flow to the brain [1], to the most recent research on the effects of sleep, the study of sleep has been ongoing. Currently, in a time of digital consumption, social media use, and round-the-clock connectivity, sleep science is receiving more attention, especially concerning how it affects college students' personal and academic lives. Students frequently sacrifice adequate rest in an unending cycle of juggling coursework, jobs, and extracurricular activities.

The negative effects of sleep deprivation go beyond just poor academic performance. This article seeks to shed light on the crucial role that sleep plays in this situation by examining the relationship between sleep deprivation and its effects on students' academic performance and general well-being through the analysis of survey data. Our results highlight the need for focused interventions and the advantages of making sleep a priority, not only for the students' long-term health but also for their academic success.

Sleep patterns of university students

According to the Cambridge Dictionary, sleep is “the resting state in which the body is not active and the mind is unconscious” [2]. Moreover, it is a crucial component of health, since its timing, length, and quality influence emotion regulation, metabolism, memory, acquiring new information, etc. Unfortunately, the importance of sleep on well-being and performance is

frequently overlooked, especially in the case of students, who due to the massive changes in their lives, are prone to oblivion towards sleep. A small study was conducted to gain insightful data on their sleep patterns and their effects on their performance.

To begin the study, participants were asked the following question: “How many hours of sleep do you typically get on a weeknight?” While 36.7% of the respondents reported receiving a total of 6-8 hours of sleep on weeknights, a substantial part, accounting for 35.8%, did not meet this recommended range. Furthermore, 21.1% acknowledged sleeping for less than 4 hours, indicating a serious sleep deficiency.

How many hours of sleep do you typically get on a weeknight?

108 responses

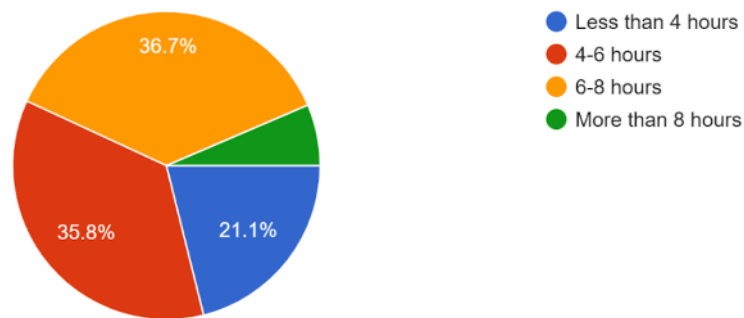


Figure 1. The number of hours of sleep students get on weekdays

When asked about the hours of sleep the students get on weekends compared to weekdays, the vast majority (84.3%) replied “I sleep more on weekends”. This fact suggests a common pattern of compensating for weekday sleep deficits by sleeping more on weekends.

On average, how many hours of sleep do you get on weekends compared to weekdays?

108 responses

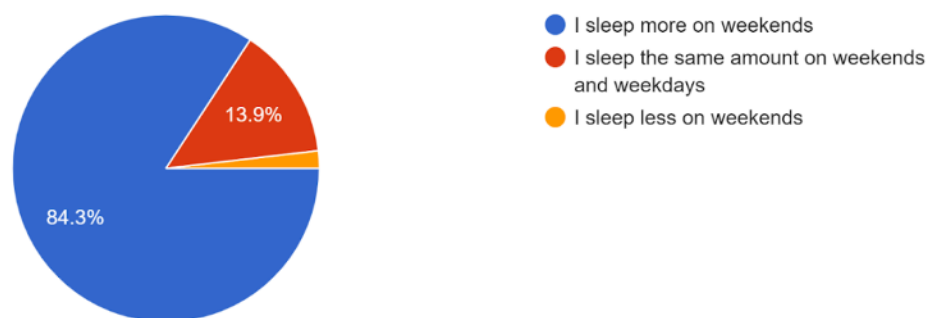


Figure 2. The number of hours of sleep students get on weekends

When asked what factors contribute to inadequate sleep, a startling 85,7% of respondents cited heavy workloads and pressure from school. 76,2% place the blame on their bad sleeping habits, which include irregular sleep schedules and staying up late. Finally, 24,8% identified using electronic devices before bedtime as a contributing factor, with 23,8% citing stress or anxiety.

What do you believe are the reasons behind your insufficient sleep? (if you get insufficient sleep)
105 răspunsuri

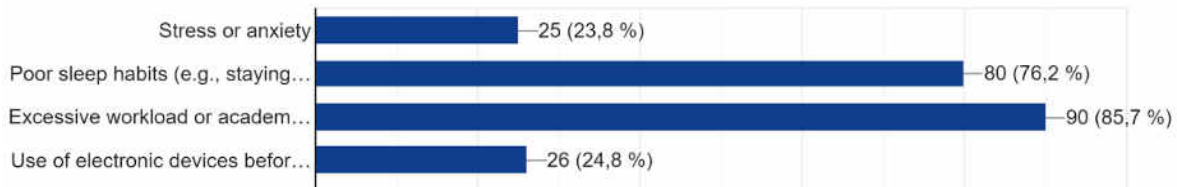


Figure 3. The reasons behind insufficient sleep

In contrast to the 33.3% who either rarely or never use caffeine or energy drinks, 25.9% of participants said they drink energy drinks once a day and the other 24.1% consume them a few times per week. Moreover, the 16.7% percent who rely on energy drinks/caffeine multiple times a day further emphasizes their need for caffeine as a boost of energy. The fact that many people rely on caffeine to keep them going during the day suggests they might not be getting enough sleep at night, needing a boost to keep them alert during the day.

How often do you consume caffeine or energy drinks to help you stay awake?
108 responses

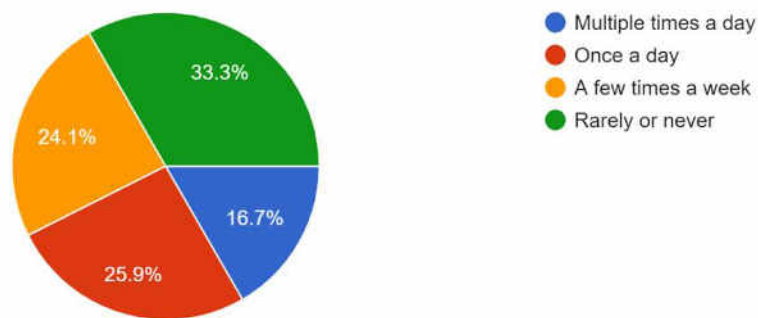


Figure 4. Frequency of caffeine/energy drink consumption

Additionally, the insufficient amount of sleep is known to disrupt concentration. Among participants, 64.8% report occasionally difficulty concentrating in class, potentially affecting their academic performance. Another part (15.7%) encounter this issue frequently, while 17.6% rarely do. Interestingly, only two persons selected "never", which indicates that the problem of trouble concentrating due to insufficient sleep is pervasive among the students.

Have you ever experienced difficulty concentrating in class due to lack of sleep?
108 responses

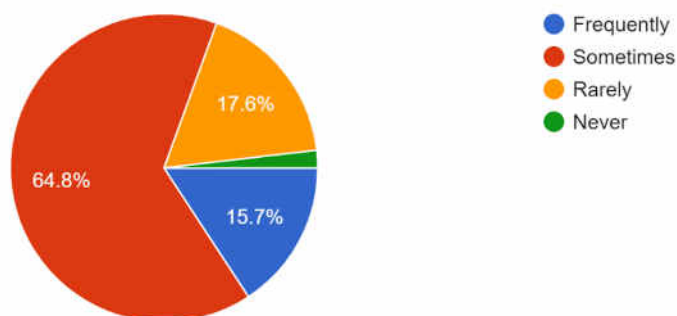


Figure 5. How sleep deprivation influences concentrating in class

Sleep deprivation has various serious consequences. Among the most prevalent are poor academic performance (82.4%) and physical health issues (68.5%). Furthermore, the vast majority experience mood swings or irritability (63.9%) and difficulties concentrating (62%) because of sleep insufficiency, which highlights the significant impact on cognitive functions and educational outcomes. Additionally, some participants reported experiencing nosebleeds and anxiety as further adverse effects of sleep deprivation.

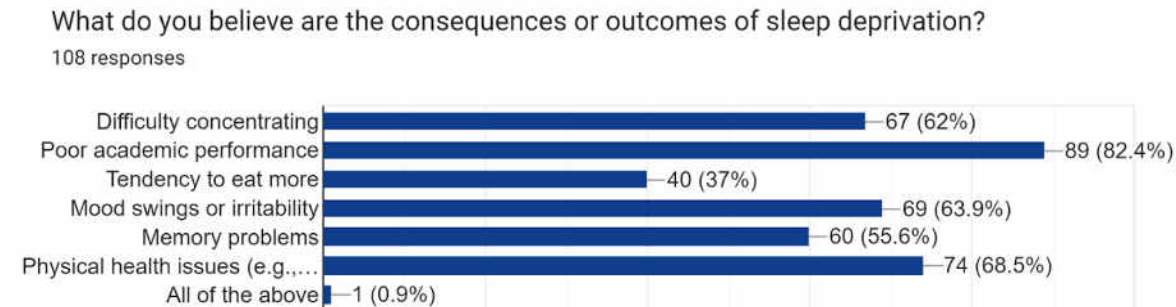


Figure 6. Consequences of sleep deprivation

Deriving from the study, it is easy to observe the pervasive issue of inadequate sleep among students, influenced by stress, irregular sleep schedules, and academic pressure. This lack of sleep adversely affects concentration, mood, memory, and academic performance. Urgent interventions are needed to promote healthy sleep habits and mitigate these detrimental effects on students' well-being and academic success.

Advantages of a high-quality sleep

So, what happens when a young adult makes getting enough sleep a top priority? Building upon the survey's insights presented previously, which showcase the effects of sleep deprivation in university students, it stands to reason that maintaining a healthy sleep schedule can yield significant benefits. With adequate rest, students are likely to find it easier to concentrate, support their memory retention, and ultimately enhance their academic performance.

Indeed, in a Harvard article about the importance of sleep, Associate Professor Edward Franz Pace-Schott, an expert in psychiatry and sleep medicine, states that sleep plays a crucial role in strengthening memory. Specifically, sleeping on the material you've just learned facilitates the retention and integration of information, ultimately enhancing learning outcomes [3].

Moreover, getting enough sleep correlates with feeling less exhausted during the day. This in turn leads to a heightened ability to concentrate and be more productive. Last but not least, sleep is an amazing regulator for stress, since they are highly intertwined. Insufficient sleep contributes to heightened stress levels, while conversely, stress hinders the brain's ability to relax and enter restorative sleep cycles. Thus, the relationship between sleep and stress forms a detrimental cycle that can significantly impact overall well-being.

Quality sleep recommendations

Now that a better understanding of the impact that quality sleep has on general well-being has been obtained, some helpful tips for achieving a better night's rest will be presented in the subsequent paragraphs.

Firstly, one should block out the light during the night to ensure a better sleep [4]. Light has been proven to disrupt the secretion of melatonin, a hormone that regulates the sleep-wake process. According to a survey conducted in the United States, by a leading expert on innovation and entrepreneurship Pankaj C. Patel, a 10-unit increase in night-time light caused a prevalence of insufficient sleep by 13.77% [5]. Therefore, using block-out curtains can contribute to melatonin secretion and a better quality of sleep.

Another factor that can help increase the quality of one's sleep is to keep the room's temperature at a comfortable level. Studies have shown that there is a direct relationship between thermoregulation and sleep. Even getting ready for sleep is considered a thermoregulatory behavior [6]. Nonetheless, during REM sleep the brain stops regulating body temperature, which is why ideal external temperature conditions are essential. Chartered Institution of Building Services Engineers (CIBSE - Guide A) recommends a range of 17-19 °C in bedrooms during the winter and 23-24 °C - during the summer to ensure a great night's sleep [7].

Moreover, shutting down electronic devices before bedtime can significantly contribute to the overall quality of sleep. Exposure to the blue light of smartphones, computers, tablets, etc. has been proven to have the same effect on the sleep-wake process as daylight has. As mentioned above, this contributes greatly to melatonin suppression and thus makes it harder for people to fall asleep, while also reducing the total duration of sleep. Using electronic devices before bedtime is especially a problem for young adults. Research involving 369 students from Vietnam showed its effects [8]. Out of the 98.1% who reported using at least one device within two hours before bed, 48.8% had poor sleep quality. This further demonstrates that the usage of electronic devices before bedtime should be minimized.

Furthermore, it is recommended to limit the consumption of caffeine. Caffeinated drinks have become extremely popular in the past few years, being rated as the most widely consumed stimulant in the world [9]. For students, it's particularly important to watch their caffeine intake. One might think that drinking coffee, energy drinks, etc. will help them overcome daytime sleepiness caused by deadlines, busy schedules, etc. However, it has been reported that the long-term usage of this stimulant can lead to detrimental effects on subsequent sleep, therefore worsening the feeling of sleepiness [10].

Finally, one last tip to increase the quality of one's sleep is to meditate before bed. Meditation induces similar physiological changes as sleep does, with the exception that the person remains alert [11]. As a result, meditation facilitates melatonin production and helps regulate the natural sleep cycle. Meditating before sleep removes troubled thoughts - thereby relieving anxiety and stress, which are common factors that cause sleep deprivation.

By taking steps to control the factors that influence the quality of sleep, one can ensure a better night's rest. Furthermore, to maintain a healthy sleep routine, it is recommended to follow these steps regularly.

Conclusions

To conclude, this article delves into the outcomes of sleep deprivation among understudies, as uncovered by the study conducted with 108 students. The discoveries highlighted the need for intervention to promote healthy sleep habits. There were emphasized the unpleasant impacts of insufficient sleep which impacts both your mental and physical well-being, resulting in a diminishing academic performance and possible long-term consequences. Some of them infer an expended risk of cardiovascular disease, weight loss or gain, diabetes, and elevated cholesterol levels. For this particular reason, getting an efficient night's rest should be a primary focus for university students. A well-organized sleep schedule will improve cognitive function and will serve as a preventive measure against episodes of depression or anxiety, moreover contributing to overall well-being. By implementing a few of the techniques given above, such as diminishing screen time, meditation, and moderating caffeine consumption, students can foster healthy sleep practices, guiding to a notable improvement of their state of being. By exploring all these components, students stand to establish better sleep habits, resulting in enhanced academic performance and overall welfare. Consequently, unlocking success begins with emphasizing quality sleep.

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LIVING SIMPLY: EMBRACING MINIMALISM

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Abstract. *Minimalism appears as a ray of simplicity and peace in the middle of chaos in today's busy society. It promotes deliberate simplification in many facets of life to cultivate gratitude, satisfaction, and congruence with one's own ideals. This move toward minimalism, which has drawn attention from sociological and psychological angles, reflects a cultural transformation. Research suggests that it has positive effects on mental health and encourages people to value experiences more than material belongings. With minimalist design principles, minimalism expands its impact into digital areas, encouraging clarity and usability. Critics point out that it may be too easy to use and that it might ignore the nuanced aspects of human experience. Although minimalism can lead to inner serenity and fulfillment, a more inclusive approach is ensured by understanding its limitations. To sum up, minimalism offers a useful framework for purposeful living, inspiring people to reassess priorities and cultivate a mindful, sustainable lifestyle.*

Keywords: *ethics, growth, minimalism, peace*

Introduction

In today's fast-paced world, the idea of minimalism and simplicity speaks loudly. Life is increasingly complicated and many recognise the need to simplify and clean things up. Clearly, in the context of current limitations, we need to move in a new direction. Minimalism is all about owning only what adds value and meaning to your life (as well as the lives of the people you care about) and removing the rest. It's about removing the clutter and using your time and energy for the things that remain. We only have a certain amount of energy, time, and space in our lives [1]. Minimalism says: "Be extremely mindful of what does and does not awaken your happiness. Eliminate anything that thwarts your well-being." Understanding the important impact of this content, we decided to go deeper and reveal the essence of these principles, the benefits and practical opportunities we could draw on to be more aware, happier and peaceful amidst the madness of modern life.

Understanding

In our complex world, it is more important than ever to understand what minimalism is and what it promotes—peace of mind. Namely, minimalism is about fostering a deep sense of contentment and gratitude. By learning to appreciate the basics and rid oneself of excess, an individual can begin to appreciate what they have, leading to contentment not easily found in our consumer-driven, 24/7, always-on, always-connected lifestyles. And this new perspective leads to more fulfilment and happiness.

Minimalism is a lifestyle gaining popularity that can help you find clarity and purpose. It's about letting go of things you don't really need and focusing on what truly matters. By doing this, you can live a more intentional and satisfying life [2].

Secondly, minimalism cultivates a desire to live in a way that is consistent with one's values and priorities. When people choose to spend their valuables, both time and energy, on what is important to them, a deeply meaningful and purpose-driven existence is the result. And living in this way promotes such inner tranquility and peace.

Embracing

The recent trend toward embracing minimalism, however, speaks to nothing less than a cultural sea change in lifestyle choice and consumer behaviour. This trend, in fact, has caught the attention of psychological and sociological researchers alike. On the psychological side of the equation, studies suggest that minimalism's focus on paring down and simplification might lead to some positive effects on mental well-being. For one thing, excessive clutter in living spaces can leave folks feeling, well, a bit crazed, with researchers suggesting it tends to lead to higher levels of the stress hormone cortisone, as well as increased feelings of anxiety and a sense of being "constantly overwhelmed," according to Psych-Central. Minimalism's promotion of feeling as though everything is in its place, by contrast, might lead to decreased psychological distress and better overall mood.

Moreover, embracing minimalism involves prioritizing experiences over material possessions, a concept aligned with research in positive psychology. Studies suggest that investing in experiences rather than material goods can contribute to greater happiness and life satisfaction. Minimalism encourages individuals to seek meaning through impactful relationships, personal growth, and immersive experiences, fostering a deeper sense of connection and purpose.

When you live intentionally, you make conscious choices about how you want to live your life. This means being purposeful with your time, your energy and your resources.

Being intentional [3] doesn't mean you have to live a life without fun or joy. It simply means being more aware of your choices and making sure they align with your values and what you want out of life.

Minimalism in Media

Minimalism in media refers to a stylistic approach that emphasizes simplicity, clarity, and brevity in conveying messages or creating content across various forms of media such as literature, film, music, visual arts.

The word "minimal" is used loosely these days in reference to any stylistic austerity in the arts. The term "Minimalist" is only slightly more precise when applied to works of visual art. It carries two distinct implications, each with its own historical resonances. The term may refer to art, primarily sculpture or three-dimensional work made after 1960, that is abstract-or even more inert visually than "abstract" suggests-and barren of merely decorative detail, in which geometry is emphasized and expressive technique avoided.

Minimal film develops along with the sculpture and is undoubtedly equally influenced by the painting. Minimal dance somewhat predates the sculpture and film but has a largely simultaneous development, although it is foreshadowed by Merce Cunningham's work from the late 1940s onward to roughly the same degree as the work of Cunningham's comrade John Cage adumbrated developments in Minimal music.

Minimal music, or minimalist music, is a subgenre of classical music associated with American composers like Philip Glass, Steve Reich, Terry Riley, and La Monte Young. Several prominent minimalist composers also hail from Europe, including the Dutch Louis Andriessen and British composers Gavin Bryars and Michael Nyman [4].

The minimalist aesthetic relies on repetition, subtle rhythmic changes, and selective harmonic dissonance that resolves over the course of a movement. Many minimalist pieces incorporate steady pulses, drones, phasing tape loops, and African and Indian rhythmic concepts. Still, most minimal music is played using standard instruments from the classical tradition, including piano, violin, viola, cello, bass, clarinet, flute, vocals, and various percussion instruments [5].

Minimalism in Digital Spaces

Digital design minimalism promotes the elimination of unnecessary components and embraces simple layouts, lots of white space, and user-friendly navigation. Minimalist interfaces help users concentrate on the job at hand by eliminating distractions and lowering cognitive burden. This promotes a sense of clarity and control among the noise of digital devices.

The constant emphasis on utility over decoration is a fundamental component of minimalist design. Each aspect of a minimalist interface has a function, whether it be to aid in user interaction, guide navigation, or convey information [6]. Minimalist interfaces prioritize utility and simplicity, which improves usability and streamlines the user experience, allowing users to execute tasks effortlessly and quickly.

Counter arguments

Contrary to what some people think, there aren't any actual rules to minimalism. There's no official board of minimalism to determine whether or not you're doing minimalism right. Minimalism truly looks different for everyone [7].

Counterarguments against minimalism highlight its potential limitations and challenges. Critics argue that minimalism may be inaccessible to individuals facing financial constraints, as it often involves reducing possessions that may be necessary for daily living. Additionally, adhering to minimalist ideals may induce feelings of guilt or inadequacy in those unable to conform. Furthermore, minimalism's focus on simplicity may overlook the complexities of human experiences and identities, neglecting cultural and emotional dimensions. While minimalism promotes intentional living, acknowledging its limitations and considering diverse perspectives is crucial for a more inclusive understanding of its implications.

Furthermore, by rejecting excess, minimalism may unintentionally encourage self-denial and austerity. While living a simpler life might help one become more focused and clear-headed, joy, creativity, and spontaneity shouldn't be sacrificed in the process. Opponents contend that the strict dedication to simplicity in minimalism may limit personal expression and lessen the depth of the human experience.

Minimalism in Personal Finances

Personal finance is a critical aspect of our lives, influencing our ability to achieve financial freedom and security. Minimalism offers a refreshing perspective on managing finances, emphasizing frugality, budgeting, and prudent spending habits. By embracing minimalism in personal finance, individuals can cultivate a healthier relationship with money and work towards long-term financial well-being [8].

One of the core principles of minimalism in personal finance is frugality. Rather than succumbing to consumerism and materialism, minimalism encourages individuals to question their purchasing decisions and prioritize essentials over luxuries. This mindset shift towards frugality involves consciously avoiding unnecessary expenses and focusing on what truly adds value to one's life. By adopting a minimalist approach to spending, individuals can reduce financial waste and allocate resources more efficiently.

Budgeting is another key component of minimalism in personal finance. By creating and adhering to a budget, individuals gain greater control over their finances and can track their spending habits more effectively. Minimalist budgets are streamlined and straightforward, focusing on essential expenses while limiting discretionary spending. Through budgeting, individuals can identify areas where they can cut costs and reallocate funds towards savings or debt repayment [9].

Minimalism also promotes the importance of saving and investing for the future. By living below one's means and avoiding unnecessary expenses, individuals can free up resources to build an emergency fund, save for retirement, or invest in long-term financial goals. Minimalist savings

strategies prioritize consistency and discipline, encouraging individuals to automate savings contributions and avoid lifestyle inflation [10].

Furthermore, minimalism offers valuable strategies for debt reduction and management. By minimizing expenses and prioritizing debt repayment, individuals can accelerate their journey towards financial freedom. Minimalist debt reduction strategies may include prioritizing high-interest debt, negotiating lower interest rates, and adopting a minimalist lifestyle to free up additional funds for debt repayment [11].

The link between minimalism and financial well-being is evident in the sense of empowerment and peace of mind that comes from living within one's means and prioritizing financial goals. By embracing minimalism in personal finance, individuals can reduce financial stress, increase financial resilience, and work towards a more secure financial future.

Minimalism in Relationships and Social Connections

Examine how minimalism encourages prioritizing meaningful relationships and fostering deeper connections with others [9]. Minimalism promotes a shift away from superficial social interactions and towards cultivating genuine connections that add value and meaning to one's life. By decluttering social circles and focusing on quality over quantity, individuals can foster deeper bonds with friends, family, and romantic partners.

Discuss the importance of quality over quantity in social interactions and how minimalism can enhance interpersonal dynamics [10]. Minimalism encourages individuals to evaluate the quality of their relationships and invest time and energy into those that bring fulfillment and joy. By prioritizing meaningful connections, individuals can experience greater emotional intimacy, support, and understanding in their relationships.

Understanding how tailored approaches within relationships can minimize misunderstandings is evident. However, relying on intricate methods that necessitate individuals to constantly maintain separate mental representations of their partner's beliefs alongside their own can be both time-consuming and mentally taxing. In contrast, adopting a minimalist approach to communication and joint actions doesn't require constantly referencing a model of the other person [13]. Instead, successful coordination can naturally arise from utilizing various cues available during interaction, without the need for intentional signaling or the interpretation of these cues based on their communicative function. This emphasizes simplicity and fluidity in relationships, focusing on mutual understanding rather than complex mental gymnastics.

Conclusions

In conclusion, minimalism presents a compelling alternative to the complexities and pressures of modern life. By promoting contentment, purpose, and mindful consumption, it offers a path to greater inner peace, well-being, and fulfillment. Research supports its potential benefits on mental health and happiness, suggesting it can reduce stress and encourage meaningful experiences. However, acknowledging its limitations and potential for exclusion is crucial for a nuanced understanding. Ultimately, while minimalism might not be a universal solution, it offers a valuable lens through which individuals can reassess their priorities and cultivate a more intentional, sustainable way of living.

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THE RISE OF CYBERSECURITY: THREATS, CHALLENGES AND SOLUTIONS

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Abstract. *Cybersecurity has risen as a fundamental concern in today's interconnected world, with quickly progressing innovation fueling phenomenal dangers. This article gives a comprehensive diagram of the advancing scene of cybersecurity, diving into the multifaceted challenges confronted by people, organizations, and countries. We analyze the differing cluster of cyber dangers, extending from malevolent program and phishing assaults to advanced state-sponsored cyber fighting. Furthermore, we look at the fundamental components contributing to the heightening of cyber dangers, counting the multiplication of internet-connected gadgets and the extending advanced impression of basic framework. Besides, this article investigates the complex transaction between innovative development and cybersecurity, highlighting the require for versatile and proactive defense components.*

Keywords: *challenges, cybersecurity, solutions, threats*

Introduction

The current world has witnessed an unpredicted surge in malicious activities on the web [1], making everyone including individuals, companies, and states vulnerable. Therefore, due to ever-increasing interconnections among technologies [2], the threats are also diversifying at a high rate with phishing, ransomware, and cyber espionage being common forms of malice. It is very crucial to deal with these issues of cybersecurity as they have serious implications whenever they occur. This article seeks to examine the complex nature of threats posed by cybercrimes and their effects. In this regard, we will be interested in what causes their growth so that we can emphasize the necessity for active defense strategies aimed at internationalized cooperation. The aim of this article is therefore to provide a comprehensive overview of the challenges presented by cyber threats and propose possible solutions toward a safer cyberspace globally interconnected community of nations.

Understanding Cybersecurity Threats

The growth in cyber dangers is a major issue for governments, organizations, and individuals globally in today's electronically linked society. Understanding these risks is crucial to building successful fighting methods [3]. In this post, we define cybersecurity risks, look at several sorts of cyber-attacks [4], and give some real-world instances to show their significance.

At its heart, cybersecurity threats are a wide spectrum of harmful behaviors that try to compromise the confidentiality, integrity, or availability of digital assets and systems. These vulnerabilities take advantage of weaknesses found in computer networks, software applications, and hardware, thereby exposing both individuals as well as organizations to significant risks. Malware, such as viruses, worms, Trojans, spyware, and ransomware, is a common form of cyber-attack [2].

Phishing involves various techniques that are used to trick people into providing personal data like log-in details or financial information through methods like email phishing (also spear-phishing), vishing, and smishing [5]. Ransomware, exemplified by WannaCry, NotPetya, and Ryuk, encrypts files or locks PCs demanding ransom money before release. DDoS Attacks

(Distributed Denial of Service), like the Mirai botnet attack and the Dyn DNS attack, flood target systems or networks with excessive traffic, rendering them inaccessible to legitimate users [2].

The 2020 SolarWinds Supply Chain Attack destroyed confidence in digital supply chains and resulted in the disablement of several government agencies as well as commercial entities [1]. Sensitive data was accessed without authorization. 2018 saw the demonstration of the susceptibility of vital infrastructure to internet risk in lieu of the gasoline shortages and economic ramifications that followed the ransomware assault on Colonial Pipeline. Exploitation of Microsoft Exchange Server Vulnerabilities in 2021 raised serious privacy and security issues. Log4Shell (Apache Log4j) Vulnerability in 2019 impacted numerous global applications or systems, raising widespread fears about their safety hence necessitating immediate patches [6].

Challenges in Cybersecurity

Rapid advancements in cybercrime, the spread of hacking tools and tactics on the dark web [7], and the expansion of digital system interconnections are some of the causes contributing to the rapid growth of cyber dangers. Constantly modifying their tactics, malevolent entities take advantage of fresh openings and evade established defenses [4]. Malicious actors dynamically adapt their strategies to exploit new vulnerabilities and circumvent conventional security measures. Geopolitical dimensions have also been introduced into the cyber threat landscape with increased nation-state-sponsored cyber warfare. State-sponsored threat actors carry out espionage, sabotage as well as engage in cyber warfare for political, economic or military purposes, thus posing immense threats to their nations' security and critical infrastructures [6]. In order to counteract a rapidly changing threat landscape, organizations need to embrace proactive cybersecurity [4] which emphasizes continuous monitoring supported by real-time intelligence sharing together with other law enforcing agencies within the industry. It is also important for these companies to deploy modernized security technologies such as behavioral analytics, deception technologies, and threat hunting platforms that help detect possible attacks as well as mitigate them [5]. The modern IT infrastructures are characterized by intricacy, variety, and interconnectedness, making them inherently prone to cyberattacks. Hybrid environments, where companies operate, combine on-premises data centers, cloud services, edge computing devices, as well as IoT endpoints, each with its own unique security needs and challenges. This complex infrastructure management and security require a holistic approach that involves people, process, and technology. They should have robust security policies that will cover the entire technology stack from the network perimeter to endpoint devices [7]. This should include regular vulnerability assessment, patch management, access control, and encryption protocols aimed at protecting data at rest or in transit. Many individuals and organizations still do not fully comprehend cyber risks they face despite heightened understanding of these risks amongst public opinion [2]. Cybersecurity awareness includes many topics such as the importance of strong passwords, risks posed by phishing or social engineering attacks, implications of data breaches, and cybersecurity's place in protecting personal as well as organization assets [5].

But, cybersecurity awareness campaigns often fail due to many factors including scarce resources, competing demands, and ineffective communication strategies. The severity and impact of cyber threats are underestimated by many people and entities, or they think that they are not likely victims of cyber-attack hence become complacent with a false sense of security [7]. Organizations need to prioritize learning, training, and awareness programs in order to overcome the lack of knowledge on cyber risks before it is too late. These initiatives should aim at creating an environment where individuals will be able to understand their role in maintaining their digital hygiene as well as adopt proper practices for securing their digital assets. For instance, this entails offering regular employee, customer, and stakeholder cybersecurity awareness courses; providing targeted messaging & resources on specific cybersecurity threats & risks; fostering a culture of organizational vigilance & responsibility in matters pertaining to computer security.

Developing Patterns in Cybersecurity

As innovation proceeds to advance, so do cyber dangers. In this area, we'll investigate a few developing patterns in cybersecurity that are forming the scene and affecting the procedures required to combat them viably [8]. Manufactured Insights (AI) and machine learning (ML) are not as it were being utilized by cybersecurity experts to improve protections but are moreover being utilized by cybercriminals to conduct more modern assaults. AI can robotize errands such as observation, prevention, and indeed decision-making amid an assault, making them more productive and harder to distinguish. Additionally, AI can be utilized to produce persuading phishing emails or to imitate human behavior, expanding the victory rate of social building assaults [8]. The proliferation of IoT devices presents modern challenges to cybersecurity. These gadgets often need robust security features and are vulnerable to abuse. Compromised IoT devices can be utilized to dispatch large-scale assaults, such as Dispersed Dissent of Benefit (DDoS) assaults, or to penetrate systems and get to touchy information. As IoT gadgets become more integrated into standard of living and basic foundation, securing them gets to be foremost to avoid far-reaching disturbances and breaches [2].

The rollout of 5G systems brings quicker speeds and lower inactivity, but it also presents unused security concerns. With more gadgets associated with 5G systems, counting IoT gadgets and basic infrastructure, the assault surface grows, making unused openings for cybercriminals. Additionally, the dependence on software-defined organizing and virtualization in 5G systems presents modern vulnerabilities that can be misused. Securing 5G systems requires collaboration between telecom suppliers, gadget producers, and cybersecurity specialists to guarantee strong protections [8]. Supply chain assaults include focusing on the computer program or equipment supply chain to compromise the ultimate item. These attacks can have far-reaching consequences, as seen within the SolarWinds supply chain assault. By invading trusted providers or compromising computer program overhauls, assailants can pick up get to a wide run of organizations and systems. Moderating supply chain assaults requires expanded investigation of third-party sellers, secure computer program improvement hones, and measures to identify and react to suspicious exercises inside the supply chain [4]. Deepfake innovation empowers the creation of highly realistic fake pictures, sound, and video substance utilizing AI and ML calculations [8]. While at first utilized for excitement purposes, deepfake innovation postures critical dangers in cybersecurity. Cybercriminals can utilize deepfakes to imitate people or manipulate media to spread deception and purposeful publicity. This could have genuine results, such as undermining believe in educate or affecting social turmoil. Identifying and combatting deepfakes requires the improvement of progressed discovery calculations and media verification procedures. Quantum computing has the potential to revolutionize numerous areas, counting cybersecurity. Be that as it may, it too postures unused challenges to encryption calculations utilized to secure information transmission and capacity. Quantum computers can hypothetically break commonly utilized encryption calculations, such as RSA and ECC, rendering delicate data defenseless to interception and decoding. As quantum computing capabilities progress, organizations require to move to quantum-resistant encryption calculations to guarantee the security of their information in a post-quantum world. Cyber-physical assaults target frameworks that control physical forms, such as mechanical control frameworks (ICS) and supervisory control and information procurement (SCADA) frameworks [8]. These assaults can have extreme results, counting disturbance of basic infrastructure, pulverization of physical resources, and indeed misfortune of life. Cases of cyber-physical attacks incorporate the Stuxnet worm, which focused on Iran's atomic offices, and the Triton malware, which focused on mechanical security frameworks. Securing against cyber-physical assaults requires an all encompassing approach that combines cybersecurity measures with physical security controls and vigorous occurrence reaction plans [8].

Hole in Cybersecurity Abilities

The inadequacy of cybersecurity staff diligently postures a challenge for ventures shielding themselves against cyberattacks. Experts must have particular abilities in zones like danger insights, occurrence reaction, and moral hacking since the nature of cyber dangers is advancing over time [9]. Finding compelling arrangements for complex cybersecurity issues is made more troublesome by the need of differing qualities within the cybersecurity calling, which has expanded the burden of the abilities hole. Dealing with this shortfall can only be achieved through education investment programs and training opportunities; nonetheless, there is also a need for promoting diversity and inclusion in the cybersecurity field itself [9]. Regulatory systems that ensure information protection and guarantee cybersecurity are being sanctioned by governments all over the world in an exertion to combat cyber dangers. Cases incorporate the California Shopper Protection Act (CCPA) [6] and the Common Information Assurance Directive (GDPR) of the European Union, which put strict commitments on companies to secure client information and inform people within the occasion of a information breach. Violating these regulations has dire consequences such as huge fines imposed or damage to reputation [6]. Meeting regulatory compliance demands that organizations set up strong measures for data protection like use of encryption, controls over access, tools for detecting loss of information, as well as procedures for monitoring and reporting cases of loss in data security [6].

The blockchain innovation has earned awards since its potential to revolutionize a few regions such as keeping money, healthcare, and supply chain administration. But there are certain special security issues with this technology that must be resolved [8]. In spite of being celebrated for its transparency and immutability, blockchain is also riddled with vulnerabilities in smart contracts, consensus mechanisms, and wallet security which can be taken advantage of by attackers. Millions of dollars have been lost because of bugs in smart contracts and their exploitability as demonstrated. Additionally, decentralized blockchain networks are hard to secure against attacks or enforce security policies on them [8]. It is therefore important to note that securing the critical aspects such as the integrity of consensus mechanisms requires thorough testing for smart contracts as well as strong access controls. Modern geopolitics has made it clear that cyber espionage and information warfare have become a piece of the whole, with country-states practicing underground cyber operations to get intelligence, sabotage adversaries or change public opinion. Many times they may aim for such groups as government departments, infrastructure developers, or defense contractors so that they can gather sensitive data or even disrupt normal operations. Cases in point include allegations that the Russian government orchestrated cyber-attacks to meddle with elections; likewise, China has been accused of stealing intellectual property and trade secrets through cyber espionage. Advanced techniques and attribution problems make it difficult to detect and attribute acts of cyber espionage. Addressing this menace requires international cooperation, diplomacy use, and robust cyber defenses against foreign enemies [8].

In an time where cyber dangers are here to remain, organizations must prioritize cyber versatility in order to have the specified reaction amid security episodes and diminish the affect of a breach [3]. It embraces the ability to predict, endure, and recover from online attacks while operations of critical business sectors are still ongoing. A solid incident response plan is vital for effectively managing security incidents, containing damages and restoring normal operations. For instance, a defined process that outlines roles and responsibilities, escalation procedures, and communication protocols should be developed within these organizations to ensure coordinated response with respect to security incidents. Regular testing as well as updating of their incident response plans are also crucial so as to remain relevant in today's ever-evolving world of threats and dynamic business environment. This way, firms can lower the financial as well as reputational implications of such attacks while maintaining smooth operations even when adversaries strike at once [3]. Furthermore, it should be understood that having a proper cybersecurity system is important despite whether you have taken a policy or not. To enhance cybersecurity, many

organizations and cybersecurity professionals are creating and implementing innovative solutions in reaction to the changing dangerous landscape. The Zero Trust security show is built on the rule of “never believe, continuously verify,” accepting that dangers can be display from both interior and exterior the organize border. In Zero Believe show, assets and applications are firmly controlled whereas observing is done ceaselessly independent of whether clients are inside or exterior corporate arrange. This curbs lateral movement by hackers thus preventing unauthorized access to sensitive data [2]. Achieving Zero Trust calls for strong IAM solutions, MFA (Multi-Factor Authentication) system, micro-segmentation as well as continuous traffic monitoring and user behavior. Mouse Detection System with Real-Time Response Endpoint Discovery is one of the leading ways to capture exercises happening around endpoints in genuine time so that they can react rapidly to security dangers [3]. EDR arrangements subsequently manage endpoints for anomalous behavioral designs like unauthorized get to endeavors, malware diseases and unusual arrange activity so that security groups can be alarmed to potential dangers. Moreover, EDR arrangements will naturally react to security occurrences by confining compromised endpoints, blocking malevolent forms and remediating dangers. Through upgraded endpoint security stances, organizations are superior set to anticipate against progressed dangers subsequently minimizing the hazard of information breaches and ransomware assaults [3].

Cloud Security Posture Management (CSPM) [2]. This post presents CSPM and clarifies how it makes different organizations keep up the proper pose for security within the cloud [2]. Open cloud suppliers like AWS, Purplish blue, and GCP can construct blockbusting CSPM arrangements that give real-time investigation of situations through nonstop setup observing – naturally checking for hazardous settings or misconfigurations against a pattern or best hone systems from organizations like CIS, NIST, CSA, etc. Sharing of Danger insights permits individuals to share their knowledge and makes a difference them to get it cyber dangers superior. Rather than as it were sharing data with other organizations, government offices moreover play a significant part as trusted accomplices in risk data trade. Additionally, these systems offer assistance in chasing down dangers some time recently they cause hurt. Data Sharing and Investigation Centers (ISACs) and risk insights sharing stages are two of the collaborative endeavors that cultivate cross-sector collaboration as well as data sharing to improve collective protections against cyber dangers [2].

Cybersecurity Preparing and Mindfulness

Endeavoring into cybersecurity preparing and mindfulness programs is basically critical in developing a strong cybersecurity culture, in expansion to empowering people to be able to recognize and respond suitably to cyber dangers . In the interim such an instruction ought to grasp themes like phishing mindfulness, great secret word practices, safe browsing propensities, as well as occurrence reaction methods. Organizations too have to be carrying out reenacted phishing assaults frequently in conjunction with security mindfulness sessions so as to ingrain best hones whereas moreover keeping them educated almost unique hacking plans. By empowering a climate where each representative knows their duties towards ensuring computerized resources, companies can altogether lower the chances of human blunder driving to breaches [7]. The proactive distinguishing proof and reaction on genuine time basis is done by ceaseless security checking and risk hunting for organizations. Organizations can distinguish unordinary behavior, IOCs and suspicious activities that are a sign of uncertainty by collecting and looking at security telemetry [3]. Other than, danger chasing implies effectively searching for signs of malevolent behavior or unauthorized get to that will have slipped through the breaks in robotized location frameworks. When persistent security observing is combined with proactive danger chasing, organizations are able to improve their capacities to distinguish dangers and decrease the time taken by programmers in their situations [3].

Conclusions

In conclusion, the scene of cybersecurity is continually advancing, displaying a large number of challenges to people, organizations, and countries around the world. The surge in cyber dangers, fueled by quick mechanical progressions and pernicious actors' flexibility, underscores the basic require for proactive defense methodologies and universal participation. From malware and phishing assaults to supply chain vulnerabilities and developing advances like AI-powered ambushes and quantum computing, the range of cyber dangers is endless and complex. To moderate these dangers, organizations must receive an all encompassing approach that combines progressed innovations, nonstop checking, vigorous occurrence reaction plans, and a solid culture of cybersecurity mindfulness.

By prioritizing cybersecurity instruction, contributing in imaginative arrangements, and cultivating a culture of watchfulness, we will collectively endeavor towards a more secure and more secure the internet for all.

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THE DIFFERENCE OF DRIVING AMONG THE YEARS

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Abstract: *This article goes through the developments made in the traffic laws over the years, starting with the first car ever made and ending with the latest technologies designed to improve the safety of the participants. It shows the initial lack of regulations that created chaos on public roads, leading to Connecticut's first ever state transportation law. The paper highlights problems faced before traffic lights were and laws against drunk driving were introduced. In the study, traffic laws from the US and Europe are compared and examine driving habits all over the world. It describes most of the advances in vehicle automatization and safety technologies, highlighting the potential of autonomous vehicles to improve road safety. In the research, are addressed problems such as drunk driving while looking ahead to a future where technological advancements will be the key to reducing traffic accidents and promoting safer, more efficient roads, and envisions transforming cities through the integration of advanced transportation solutions landscape.*

Keywords: *changes, evolution, improvements, roads, safety systems, technologies, vehicle.*

Introduction

The constant creation of road safety and transport inventions by the generations fulfills our dream of having the best transport system embodied all over the era. Karl Benz, of worldwide reputation design and automotive engineer was the one who disclosed the secret of automobiles and those upgrades emerged to what we know to be cars nowadays [1]. Signalizing the duty of road users, establishing traffic laws and increasing the visibility are some of the needs that his invention has created, including the road signs, streetlights, traffic lights, brake lights, etc. To this end, the governments have been introducing progressively tighter government controls requiring that accidents and people dying or getting injured at the workplace is discouraged. Automobiles have been recently equipped with safety systems including Airbags, ABS, and ESC, but these are not the only features, and the list continues. With time, engineers are still enjoying a journey deep into the untapped depths of modern technology in the quest to minimize the numbers of road accidents around and safeguard the drivers as well as those in their near environment.

Early Regulations in America

The first automobile in the world was developed by the old German mechanical engineer, Karl Benz, in 1886. As he did so, he would bring an unparalleled transformation to the entire world. The problem of roads and traffic began to rise as the number of people who owned cars grew not only in quantities but also in the masses of people. Afterwards, the state of Connecticut created its first-ever transportation law at the state level in 1901. Nonetheless, the law governs vehicle speed. 12 mph is the speed limit for city streets, and 15 mph is the speed limit on country roads. These numbers are equivalent to 17 and 21 kmh respectively.

In the early 1930s, along the roads, there were thousands of cars, and it was undoubtedly one of the most hazardous times United States had ever witnessed. In an article that was published in the Detroit News, traffic conditions were reported to be without any discipline in the early 1900's. It was practically a massacre within a massacre that took the lives of more than thousands of people just in the city limits.

Yet even with the vast number of automobiles that are pouring onto American streets, there're no road signs, streetlights, road laws, traffic lights, brake lights, no laws against drunk driving, on and on goes this list. There seemed to be turmoil in the streets.

In the year 1930, police engineers across the nation started using three-way traffic lights. The traffic light system has altered very little in the past, more than eighty years from the day of its inception. In 1930 it was green, yellow and red words that meant stop, slow down and go.

Consequently, drunk driving continues to be the issue of the Department of Transportation and the whole America since the emergence of thousands of traffic laws to evade safety hazards. Per the statistics of the Department of the Transportation, there was an alcohol-related traffic fatality every 48 minutes in 2017.

In 1910, New York passed its first law against drunk driving. The penalty was a \$1,000 fine and jail time. This sparked a revolution that attempted to solve problems that still exist today.

In 1936, Robert Borkenstein invented the so-called "drunk meter." Borkenstein's invention is a balloon-like device that can determine whether a driver is drunk. The device needed to be more precise, so in 1953 Borkenstein developed what we know today as the "breathalyzer." A BAC level of 0.15 was originally set as the legal upper limit but was deemed too high in 1960 and was lowered to the BAC level used in the United States today of 0.08, compared to 0.05 being the limit allowed in most of the Europe countries [2].

First traffic laws in Europe

On the heels of the year 1909, Germany saw the introduction of the world's pioneer national traffic regulations, along with a statutory test and driving license. As streets became more dangerous, further changes were introduced: UK was the cradle of the first ever pedestrian crossings in the 1930s and the establishment of speed limit on German roads had been made in 1934; however, it was 60 kmph limit exclusively for urban streets. A relative abolishment of this rule occurred in the western part of Germany in the 1950s, and after 5 years of the rise in road traffic injuries, it was reintroduced.

It is fascinating that the seatbelt, that is one of the most crucial security elements on roads, was only available after a rather lengthy period. In the 10s of 50s, car makers started installing them as optional accessories, but their popularity was low to the bone. The first standard seat belt regulation, in Australia, was approved only in 1970 (laws in the United States were adopted during the late '60s). For some countries, this regulation was adopted for all (sic!) passengers in the 1980s, while in others this regulation was introduced only for pilots in the 1930s as well as for other passengers only in the 1980s [3].

Right-hand and left-hand driving

Today, most countries drive on the right side of the road and follow right-hand traffic (RHT) rules, including the United States, Canada, Russia, and much of Europe. But about a third of the world's countries are bucking the trend and implementing left-hand traffic (LHT). The UK is one of these countries. In fact, compliance with LHT in the UK has a long history, stretching back into British history and even back to ancient Rome.

There is one of the widely accepted theories which states the origin of the British driving on the left tailing back to ancestral Roman times. During those days, horseback travelers' movement through these wide plains was threatened by invasion or attack. Many Romans dominated their left hand, which is why they would rather poise in a position where their dominant right hand is free to act should an opponent suddenly occur. The past demonstrated that there was a tradition among the Romans to always move as a group toward their left hand, nevertheless Romans still drove their carts and chariots to their left. This is a practice that the subsequent societies have adopted from previous empires and carried over the centuries.

Because the left side of the road was typical in almost every part of the Roman Empire for centuries, this remains the European custom. Nevertheless, in 1792, the preservation of law act

was annexed in Pennsylvania which was later followed by many other states in U S and Canada. Concurrently in France, however, Napoleon arranged for driving on the right side in any French part of the world and these areas mostly drive on the right to date.

The first document which was officially approved that driving on the left was prohibited during the time of the Pope Boniface VIII in 1300 AD when declared that all pilgrims coming from the Roman Empire to travel on the left. In 1773, with the general upkeep of the roads administered by the government and the streets overcrowded, the General Highways Act was passed to help ensure that people, open hackney-coachmen, hoodened unidentified highwaymen and all other riders should drive on the left-hand side of the road to effect collision-free movements. Here was the first of its kind, the titless eye, before the car manufacturer. During the past century, the case proved the highlighted legislation enabling Britain's driving rules to be a national law, and anyone driving in the wrong direction clearly committed an offense [4].

Digital technologies and the road to automation

The city streets of today are substantially different from the disorganized scenes of a century ago, even though they may occasionally appear chaotic. Crosswalks and designated bike lanes are typical, pedestrians stay on the sidewalk, and traffic flows are closely observed and managed.

However, safety remains a major concern. More people than ever before are driving due to population increase and rising car ownership. Road traffic crashes claim the lives of about 1.3 million people annually [5]. More than half of these are more susceptible users of the road, such as bicycles, motorcyclists, and pedestrians.

Thankfully, technical advancement and digital change are making smart city infrastructure safer, developing a variety of clever solutions.

Technological Advances in Self-Driving Cars

Sensor Technology: The self-driving vehicles leverage various sensors such as cameras, radars and GPS to "see" and comprehend the world around them. This type of sensors functions as the sight and hearing of the driverless vehicle, alerting the car to stationary objects, other vehicles, or pedestrians that may be on the road. At the same time, these cars can transcend the restrictions by integrating data from multiple sensors thereby generating an image of the surrounding area which enables them to make a more prudent move.

Artificial Intelligence (AI) Systems: In reality, these cars are so complex behind covers as they use the latest AI technologies to scan and analyze sensor information for timely reactions. AI systems in this regard intimately study the characteristics of the road, headway and detect hazards to subsequently predict the optimal route. These machines can learn from and is able to better perform their driving tasks using the experience/instruction of past events and information obtained from the environment.

Connectivity and Communication: Automated cars from the viewpoint of the communication stand would have different kinds of talk to the other vehicles and roads. Through the use of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications, self-driving vehicles can share information such as their planned location, speed, and actions simultaneously, thus improving traffic flow and avoiding collisions as well as congestion. **High-Definition Mapping:** The detailing provided by high-definition mapping is very useful in the management of self-driving cars which tells the vehicle how the road is shaped, marked, and what signals are around. These maps that merge or overlay with real-time data allow these self-driving vehicles to guide through intricate cityscapes with high accuracy even when they update to real time data.

Safety Features and Considerations

AEB - Automatic Emergency Braking Systems: The automatic emergency braking systems, or AEB, category includes two types of brake assistance technology. These two technological innovations are intended to help reduce the number of people injured in rear-end collisions. Approximately one-third of all car accidents that are recorded each year are usually rear-end collisions.

Crash About to Happen Braking senses when a collision with another car is likely to happen sooner than expected and applies brakes or applies the brakes even if the driver doesn't do anything. When the driver applies the brakes, Dynamic Brake Support will engage, but it won't exert enough force to prevent an accident.

Backup Cameras: Rearview video systems, another name for backup cameras, are devices that are used to stop accidents that happen when a motorist is backing up. This kind of mishap frequently involves a car pulling out of a driveway or parking space striking a pedestrian or bicyclist.

The driver will be able to see immediately behind the vehicle thanks to this camera, which will activate whenever the car is in reverse. This technology has been so successful in preventing auto accidents that it is now required for all new cars made after May 2018.

Blind Spot Detection: When changing lanes, blind spot detection can assist a driver in making sure no other cars are in their blind area. Certain models of this technology enable drivers to get real-time updates on the condition of their blind spot, while others restrict information and alerts to when the driver's turn signal is activated.

Lane Departure Warnings: This new safety system uses cameras to track the position of the vehicle within the lane markings. When a car with lane departure warnings begins to stray while its turn signal is off, an alert will go out from the car. This is an excellent technique to help a distracted motorist refocus on the road. One excellent method to prevent a sideswipe mishap is to heed this advice. Certain iterations of this technology can even assume control of the car and make sure the driver keeps it in the designated lane.

FCS: Forward Collision Systems: Many people have been involved in rear-end collisions just because they were staring at their phone or the opposite side of the road when they did so. Forward Collision Systems, or FCS, come to the rescue in this case. This technology enables an automobile to automatically calculate the distance between it and the vehicle ahead of it. Based on this information, the car can reduce its speed, lessening the force of an impact accident [6].

Adaptive Headlights: Adaptive headlights are a novel and remarkable technology that is demonstrating its worth by significantly reducing traffic accidents. When the steering wheel is turned, this particular style of car lamp will turn on. So, how does this contribute to preventing accidents? Think about the times when you are driving on a dark road and a deer suddenly appears in your way or when a car cuts you off. You will always be able to see anything on the road if you use adaptable headlights [7].

ECS - Electronic Stability Control: A technological marvel, Electronic Stability Control, or ECS for short, effectively prevents cars from losing control, even in somewhat hazardous weather conditions. In the event of a run-off-road accident, this technology reduces the vehicle's engine power by applying the brakes to the wheels. Since ECS can probably avert around half of all rollovers and auto accidents, it has shown to be incredibly helpful.

Vehicle Communication (V2V): In the auto industry, self-driving cars have recently received a lot of attention. With this kind of technology, it would be necessary for cars to communicate with one another in order to avoid collisions.

Auto-Steering: Certain modern cars are equipped with autosteer technology. This does not imply that your automobile can drive itself entirely, but rather that it has the ability to take over the steering wheel in certain circumstances in order to avoid an accident. The car will maintain its

current lane of travel while applying the brakes and swerving to avoid any possible objects or pedestrians in its path. Numerous automated steering systems are compatible with automated braking systems.

Vision for the Future

Smart infrastructure and vehicles no longer having humans as drive may result in the streets getting safer. After all, human error is at blame for almost 90% of traffic accidents (source: Another priority of these international bodies is to create a roadmap for recovering from the crisis along with economic and social policies and support for the development of the new green Agenda (EC). Imagine a city where the only accident involving a vehicle would have to read about it in newspapers. In recent years, such links as 5G will be made between car motorists and the infrastructure that can link in milliseconds without double-checking other drivers and securing their driving lane. A wide circulation of the area will be filmed by the couple of cameras as well as the motion-detection radar that is highly sensitive to pinpointing pedestrians, cyclists, and any potential threat to the machine.

Some roads may need to be narrowed as the connected cars will travel closer to each other because they can safely go close to one another. E-scooters, bikes, and people will be able to share the roads more comfortably with this set up. Maybe as in on the road people will co-exist peacefully and, most importantly, safely, they will no longer be segregated by never-ending traffic jam and a long-awaited reminiscence since now the time when vehicle users are not segregated by the long traffic jams and at the end be able to align peacefully.

Conclusions

To sum up, the history of road safety and transport indicates to the entire population the incredible ability of human abilities in engineering to get over obstacles and create safer roads for each participant in traffic. The development of self-driving automobiles, fully electric cars, and advanced safety technology, as well as the implementing traffic lights, pedestrian crossings in the early 20th century, have all Served a role to continue developing new inventions and mastering the ones which are already available. All the technologies already implemented contributed to reducing the number of victims in road crashes throughout the years. Governments should keep investing in infrastructure, technology, and research to guarantee that all roads continue to be safe for all users. It should be proved that all the progress made not only satisfies the demands of the present but also prepares the way for a better future by constantly using the power of innovation and cooperation.

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REPLAY ATTACKS AND COUNTERMEASURES AGAINST THEM

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Abstract: Voice authentication technology uses an individual's unique voice characteristics for secure identity verification, providing a seamless method to access devices and services. However, it faces challenges in maintaining robustness against security breaches and impersonation attempts. This study examines the effectiveness of voice authentication technology, focusing on its ability to analyze and differentiate between complex voice attributes like pitch, tone, and speech patterns. The study found that advanced voice authentication systems have high accuracy in recognizing and validating users based on voice biometrics, enhancing security for various applications. The findings emphasize the importance of continuous advancements in voice authentication technology to counteract evolving security threats and ensure a safer and more reliable user experience across various sectors, including virtual assistants and customer service interfaces.

Key words: authentication, convolutional neural networks, replay attack, safe access, security, voice authentication.

Introduction

Voice authentication technology provides a convenient and safe way to access devices and services by using the distinctive qualities of a person's voice to confirm their identity [1]. This biometric system is a popular option for protecting smartphones, bank accounts, and sensitive data because it analyzes a variety of hard-to-replicate aspects of a person's voice, including pitch, tone, and speech patterns. Robust voice authentication systems are increasingly important as voice commands find their way into everyday life, from virtual assistants to customer service interfaces.



Figure 1. System usage scenario

Replay attacks, however, pose a threat to the security of voice authentication systems. Replay attacks happen when an attacker records a valid transaction or data transmission—like a voice command—and then purposefully or dishonestly delays or replicates this transmission in order to gain unauthorized access to resources.

Because an attacker could record and replay the voice of an authorized user to access secured systems, this kind of attack is especially concerning for voice authentication. Voice authentication is susceptible to these kinds of attacks even with its sophisticated technology, which emphasizes the need for more security precautions. To identify such attacks, a trained convolutional neural network (CNN) can discriminate between live and recorded human speech spectrograms using picture classification. CNNs are a deep learning (DL) technique utilized in

Machine learning (ML) techniques that are commonly used for image categorization and speech recognition. They are faster than typical neural networks at classifying visual contents and require less computation.

Background and Related Work

The use of human biometric features in authentication methods has advanced significantly in the last few decades. Voice and fingerprint authentication have been widely incorporated into mobile phones and applications. The capabilities of current systems have grown to include authentication based on cardiac motion, facial recognition (as demonstrated in the iPhone X), and gait recognition using Wi-Fi signals.

The increasing integration of voice commands in everyday technology, from virtual assistants to customer service interfaces, underscores the urgent need for secure voice authentication methods. The motivation behind this study is to fortify the security measures of voice authentication systems, ensuring they remain reliable in the face of evolving cyber threats.

The primary aim of this study is to develop a method using CNNs that can accurately differentiate between live and recorded speech, thereby detecting replay attacks against voice authentication systems. Objectives include:

- Evaluating the current vulnerabilities of voice authentication to replay attacks.
- Designing and training a CNN model to recognize the unique characteristics of live versus recorded speech.
- Testing the model's effectiveness in a controlled environment and real-world scenarios [2].

Security of Voice Authentication:

Voice authentication is susceptible to replay, speech synthesis, impersonation, and voice conversion spoofing attacks. Various tactics have been used to counter this. Some approaches use the Time Difference of Arrival (TDOA) data from numerous microphones, while others analyze the variations in synthesis or conversion aspects, and still others look at the phase spectra disparities between arriving and actual speech. Techniques for countering replay assaults include examining the physical characteristics of the recording equipment, determining whether there is background or channel noise, and using extra verification methods such as video.

Device-free, ultrasound-based measurements:

In line with our findings, ultrasound technology has made a lot of distance measurement applications possible, especially in situations when devices are not present. Projects like as LLAP use baseband signal phase changes to track finger motions in a two-dimensional space. Using chirps, Strata and FingerIO are able to track fingers or palms in two dimensions with very few errors. UltraGesture uses ultrasonic to identify different human gestures, while PCIAS gauges the rotational speed of rotating objects. In contrast to previous methods, our work focuses on the extraction of distinct voiceprint information from ultrasound signals for authentication reasons, such as vocal cord and mouth movement information.

II. Replay attack:

Replay attacks are a kind of network attack where the attacker records an authentic network transfer and then sends it again at a later time. The primary goal is to deceive the system into believing that the data being retransmitted is authentic. Replay assaults are dangerous as well since they are hard to identify. Moreover, it can succeed even in the event that the initial transmission was encrypted [3].

Replay attacks can be launched by an attacker to obtain unauthorized access to networks or systems. Replay attacks can also interfere with a system's normal functioning by bombarding it with repetitive requests. This attack can be planned by an attacker who will use network packet interception and retransmission. Furthermore, recreating an attack can be an effective way to carry out a replay [4].

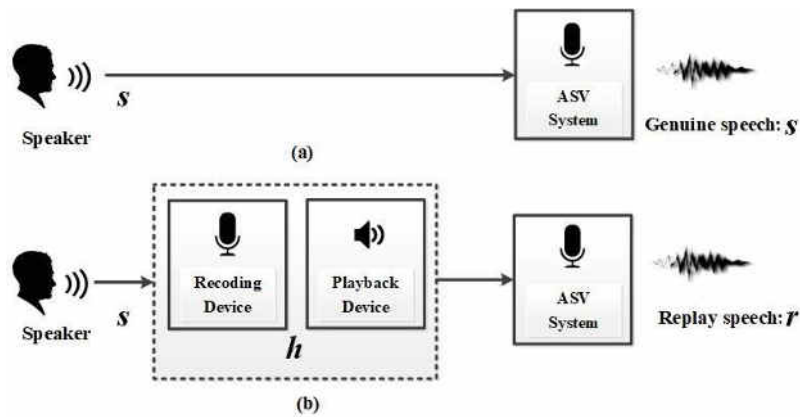


Figure 2. Replay attack in action

Since the majority of research is concentrated on deepfake speech synthesis and conversion, audio replay attacks can pose a serious threat to Automatic Speaker Verification (ASV) systems due to their low cost and effort requirements. As a result of this difficulty, voice antispoofing—including its types, origins, and preventive measures—was developed [5].

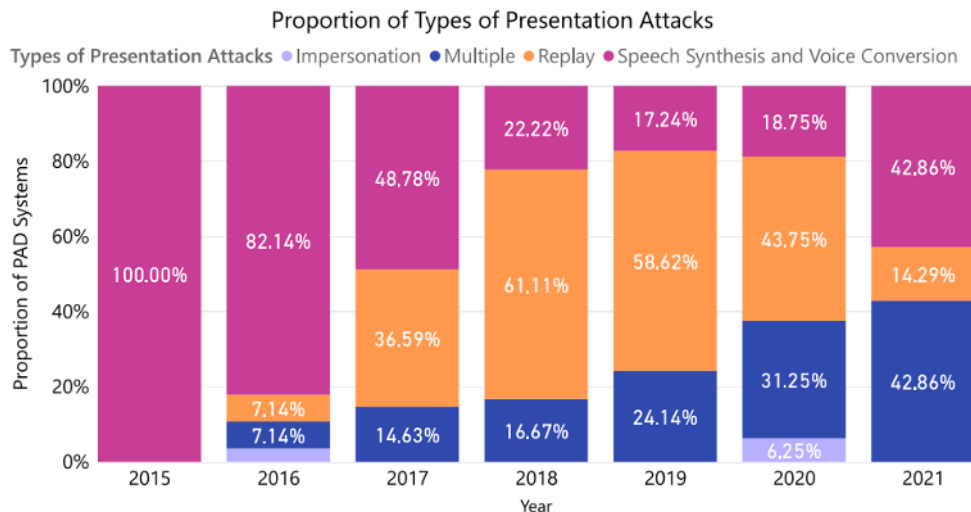


Figure 3. Antispoofing statistics in voice PAs from 2015 to 2021.

The proportion of each type of attack detected in that year is indicated by the percentages on the bars. For example, all attacks in 2015 were impersonation attacks. The range of attack types has grown over time, and by 2021, speech synthesis/voice conversion, replay, and impersonation attacks are all represented, with impersonation remaining the most common but less so than in prior years [6].

By giving every encrypted element a distinct session ID and component number, replay attempts can be avoided. Due to its dual-layered operation, which is independent of one another, vulnerabilities are successfully mitigated. The possibility of duplicating a prior run of the program is greatly decreased by creating a random session ID for every program running. Consequently, because the session ID varies with every run, an attacker would have difficulty carrying out a replay assault.

Replay attacks can be avoided by using session IDs, also known as session tokens. The following actions are usually included in the process of creating a session ID:

- John sends Alice a one-time token, which she uses to complete the password translation process and then sends John the outcome.
- John uses the session token to carry out the identical calculation on his end.
- Login success is contingent upon the matching of John's and Jenifer's computed values.

In the event that an attacker like Eve captures this value and attempts to use it in another session, John would assign a different session token. Consequently, when Eve tries to reuse her captured value, it will not match Bob's computation, thereby indicating to John that it's not Janifer attempting to authenticate [7].

It's crucial that session tokens are generated through a random process, typically using pseudorandom methods. This prevents Eve from posing as Bob by predicting future tokens and convincing Alice to incorporate them into her transformation. By replaying her response at a later time using the predicted token, Eve could trick Bob into accepting the authentication.

Conclusions

In conclusion, this study underscores the critical significance of addressing the vulnerability of voice authentication systems to replay attacks. By leveraging convolutional neural networks (CNNs), we have proposed a sophisticated methodology aimed at discerning between live and recorded human speech, thereby enhancing the resilience of authentication mechanisms against malicious exploitation. As voice commands become increasingly integrated into various facets of daily life, from virtual assistants to customer service interfaces, the imperative to safeguard against such attacks grows ever more pressing. Our research not only contributes to the ongoing efforts to bolster the security of voice authentication technology but also emphasizes the indispensable role of continuous innovation in confronting emerging cybersecurity challenges. Moving forward, sustained advancements in this field are paramount to ensuring the integrity and reliability of voice authentication systems, thus fostering a safer and more trustworthy digital environment for users worldwide.

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EQUATIONS OF THE HEART MODELING ROMANTIC ATTRACTION

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Abstract. This article presents a mathematical model that focuses on the dynamics of romantic attraction and aims to stimulate interest in the areas of differential equations and mathematical modeling. Aimed at mathematicians, scientists and university students interested in differential equations, the study offers new insights into the complex dynamics of romantic relationships from a mathematical perspective and challenges conventional ideas about attraction and commitment. We introduce the notion of differential equations to capture the evolution of romantic attachments over time and conducting mathematical analysis and computer simulations. The outcomes indicate that employing mathematical models can offer a more profound understanding of human behavior and encourage interdisciplinary collaboration in education and ongoing research where mathematics and social sciences intersect. This perspective enriches understanding of romantic relationships and stimulates thought about broader applications in various real-world contexts. Further exploration is needed to refine the mathematical model and explore its practical applications in real-world contexts.

Keywords: attachment styles, computer modeling, eigen values, eigen vectors, solving linear differential equations

Introduction

It is likely that you are familiar with “love meters” – websites that provide a percentage of compatibility between two people when provided with their names, birthdays and other information. While their scientific validity is highly uncertain they exemplify the intersection of mathematics and social sciences in popular culture. Despite the perception of mathematics and social sciences as separate and non-interfering domains, mathematical principles can yield rich insights into human behavior and social phenomena.

After Strogatz [1] applied a system of linear differential equations to study romantic dynamics in his one-page work (1988) and later in his book (1994) the topic has gained attention among many researchers. With the introduction of mathematical models, it became possible to simulate different scenarios how the dynamics would change over time, one such model on which this article is partially based on was implemented by Dabler [2].

What types of romantic styles attract? Do opposites fall in love with each other? How do individuals with different emotional attachment interact and influence each other's feelings? By examining different attachment styles and proposing ways to model them, we aim to answer these questions.

The model

We will start by introducing Romeo. Consider the real-valued function $r(t)$ defined by the real parameter t which denotes the time passed. The value $r(t) > 0$ represents the love, for $r(t) = 0$ - neutral state, and for $r(t) < 0$ the dislike of Romeo. Let's consider the simplified case where Romeo's affection changes based on his own feelings. This can be described by the following ordinary differential equation (ODE):

$$\frac{dr}{dt} = ar \quad (1)$$

Where a is a real-valued coefficient that represents the attitude of Romeo, when $a > 0$ Romeo tries to amplify his feelings, for $a = 0$ the rate of change of his feelings remains constant, for $a < 0$ the rate of change heads in the opposite of what Romeo feels at the moment t . From (1) we can obtain that the general solution is:

$$r(t) = ke^{at} \quad (2)$$

where $k \in \mathbb{R}^*$, for $r(0) = 0$, the solution extends to $r(t) = ke^{at}$ where $k \in \mathbb{R}$.

Let us consider another example, let's say that instead of a constant real-valued parameter a the attitude of Romeo is described by a function $f(t)$, that is Romeo's attitude changes over time. Let $f(t) = A \sin \lambda t$, which means that Romeo's attitude changes over time periodically with frequency λ and amplitude A . We obtain the following equations:

$$\frac{dr}{dt} = Ar \sin \lambda t \quad (3)$$

$$r(t) = ke^{-A\lambda \cos \lambda t}, k \in \mathbb{R} \quad (4)$$

Where equation (4) is the general solution of (3). Knowing the initial condition $r(0)$, we can derive $k = r(0) e^{A\lambda}$. Consider the following Initial Value Problem with $A = 2$, $\lambda = 1$ and his feelings are positive with value 1 at $t = 0$. Solving for $r(0) = 1$, we obtain that $k = e^2$ thus, the solution to this IVP is

$$r(t) = e^{-2 \cos t + 2} \quad (5)$$

For $r(0) = -0.5$ from (3) we obtain $k = -0.5e^2$ the equation becomes

$$r(t) = -0.5e^{-2 \cos t + 2} \quad (6)$$

For $r(0) = 0$ we obtain $k = 0$ the equation becomes the constant function $r(t) = 0$. The graphs (Red: $r(0) = 1$; Green $r(0) = -0.5$) of the equation (4) with $A = 2$, $\lambda = 1$ are presented in Figure 1.

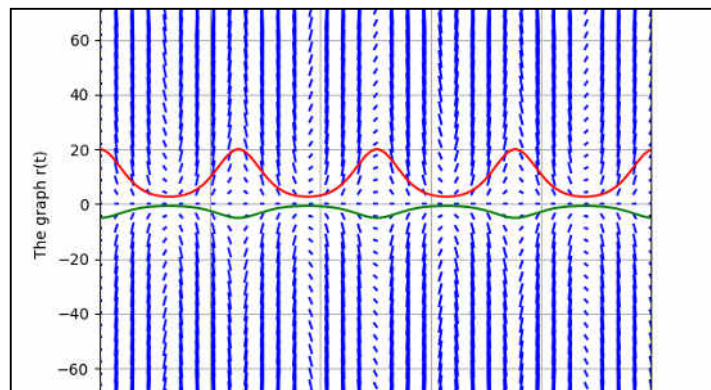


Figure 1. The slope field with the given initial conditions

From Figure 1, we can conclude that Romeo amplifies his feelings and then dampens his feelings periodically over the period $T = 2\pi$ Romeo reaches his initial state. Generally, the set of possible solutions can be visualized using a slope field.

The equations discussed so far are examples of differential equations where the rate of change in time of Romeo's feelings depends on his feelings. Introducing Juliet, we can model the interaction between Romeo's feelings for Juliet and Juliet's feelings for Romeo by the use of the following system of constant coefficients linear differential equations:

$$\begin{cases} \frac{dr}{dt} = \alpha r + \beta j \\ \frac{dj}{dt} = \gamma r + \delta j \end{cases} \quad (7)$$

$$\frac{dx_1}{dt} = ax_1 + bx_2 \quad (8)$$

Where $\alpha, \beta, \gamma, \delta$ are constants and r and j are functions of time expressing the feelings of Romeo and Juliet. We may write the coefficients $\alpha, \beta, \gamma, \delta$ from system (7) in a matrix and rewrite the system as:

$$A \begin{pmatrix} r \\ j \end{pmatrix} = \begin{pmatrix} r' \\ j' \end{pmatrix} \quad (9)$$

Where $r' = \frac{dr}{dt}$ and $j' = \frac{dj}{dt}$. $A = \begin{pmatrix} \alpha & \beta \\ \gamma & \delta \end{pmatrix}$. Thus, rewriting in this form allows us to find the eigenvalues $\lambda_{1,2}$ and the eigenvectors of (9). In order to compute the eigenvalues, we write the matrix $\begin{pmatrix} r \\ j \end{pmatrix}$ as \vec{x} and $\begin{pmatrix} r' \\ j' \end{pmatrix} = \vec{x}'$. Now we need to find a value λ such that $A\vec{x} = \lambda\vec{x}$, therefore:

$$(A - \lambda I)\vec{x} = 0 \quad (10)$$

Equation (10) is true if and only if $\det(A - \lambda I) = 0$, we have that:

$$\lambda^2 - (\alpha + \delta)\lambda + \alpha\delta - \beta\gamma = 0$$

$$\lambda_{1,2} = \frac{(\alpha + \delta) \pm \sqrt{(\alpha + \delta)^2 - 4\det(A)}}{2} \quad (11)$$

Assuming λ_1, λ_2 are real valued, we may consider a point (x, y) described by a vector \vec{x} in the phase space of $r(t), j(t)$, then we can compute the first eigenvector as:

$$A \begin{pmatrix} x \\ y \end{pmatrix} = \lambda_1 \begin{pmatrix} x \\ y \end{pmatrix} \quad (12)$$

From (12) we obtain the following linear system:

$$\begin{cases} \alpha x + \beta y = \lambda_1 x \\ \gamma x + \delta y = \lambda_1 y \end{cases}$$

With the set of solutions:

$$y = \frac{\lambda_1 + \gamma - \alpha}{\lambda_1 - \delta + \beta} x \quad (13)$$

Therefore, we can choose the arbitrary eigenvectors as follows:

$$\vec{\eta}_1 = \begin{pmatrix} 1 \\ \frac{\lambda_1 + \gamma - \alpha}{\lambda_1 - \delta + \beta} \end{pmatrix}; \vec{\eta}_2 = \begin{pmatrix} 1 \\ \frac{\lambda_2 + \gamma - \alpha}{\lambda_2 - \delta + \beta} \end{pmatrix};$$

If equation (11) has no real roots then there are no eigenvectors, and if it yields only one real-valued root, then it has only one eigenvalue that can be computed using formula (13).

The subsequent paragraphs will attempt to present some hypothetical examples that make use of the system discussed so far for modeling love attachment styles. Using the model of adult attachment theory proposed by Lawrence Robinson, Jeanne Segal and Jaelline Jaffe [3], we can categorize attachment as one of four main styles: Secure, Preoccupied, Avoidant and Disorganized.

Secure attachment style indicates that an individual is feeling secure within the relationship, being comfortable to express their emotions and needs, and providing support to their partner. Considering equation (8) for reference, if an individual x_1 has a secure attachment style it can be modeled by setting the coefficient to have a negative value $a < 0$ and $b < 0$. We can model an individual with a preoccupied attachment style by considering $a < 0$ and $b > 0$. An individual with an avoidant insecure attachment style prioritizes self-reliance, often avoiding closeness and intimacy in a relationship, we may consider the coefficients as $a > 0$ and $b < 0$. A person who has a disorganized attachment style may be modeled using $a > 0$ and $b > 0$.

Those with a disorganized insecure attachment style show inconsistent behavior, swinging between extremes of love and hate towards their partner, they often suppress their true feelings. The affection swings can be modeled using a periodic function similar to the equation (3).

For instance, consider the following system of differential equations:

$$\begin{pmatrix} -2 & -1 \\ -0.2 & -2 \end{pmatrix} \vec{x} = \vec{x}' \quad (14)$$

The system (14) has coefficients $\alpha = -2, \beta = -1, \gamma = -0.2, \delta = -2$, which means that Romeo and Juliet both have secure attachment styles. We can compute the eigenvalues as $\lambda_{1,2} = -2 \pm \frac{\sqrt{5}}{5}$, both of the eigenvalues are real-valued and negative, meaning that the solution tends to an equilibrium point $(0,0)$, according to the criteria for critical points [4, pp. 148-151], that is independent of the initial conditions $r(0)$ and $j(0)$. In Figure 2 is presented the phase space of

equation (14) with the grey lines indicating the position of the eigenvectors, and the color bar representing the vectors' magnitude of the phase space.

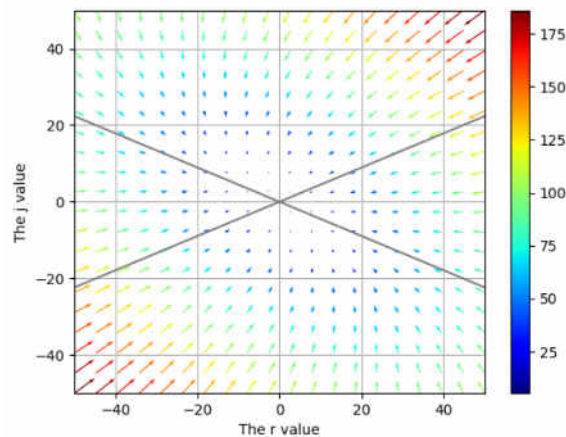


Figure 2. Phase space of equation (14)

The general solution to the system of equations (7) can be written in the following form [4, p. 141]:

$$\vec{x} = c_1 \vec{\eta}_1 e^{\lambda_1 t} + c_2 \vec{\eta}_2 e^{\lambda_2 t} \quad (15)$$

Where c_1, c_2 are real valued coefficients, $\vec{\eta}_1, \vec{\eta}_2$ are the corresponding eigenvectors of the eigenvalues λ_1, λ_2 .

Conclusions

In summary, this research has built a model, where the mathematics of differential equations and rationalizations from attachment theory have been included in the dynamics of romantic attraction. The second part of the model which draws from the attachment theories of Lawrence Robinson, Jeanne Segal, and Jaelline Jaffe shows how the emotions of individuals affect their romantic connections. Using linear differential equation with constant coefficient to deduce the scenes that describe the various attachment styles, the complicated dyads of compassion among the couples were shed into light. The findings emphasize the importance of interdisciplinary strategies in studying human behavior as well as the extent to which mathematical modeling enlarges the possibilities to generate unique insights from complex societal processes. Besides that, the findings of this research reveal the applicability of attachment theory for shedding light on the nuances of romantic ties, paving the way for further exploration and refinement of the proposed model. Basically, this study is valuable for providing new insights about mathematics and social sciences in the area in which the two disciplines overlap, provoking interdisciplinary collaboration and deepening the understanding of how people fall in love.

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MAPPING OUR DIGITAL FOOTPRINT

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Abstract. *This study intricately explores the domain of digital footprints, highlighting their relevance across diverse academic realms. It delves into terms like "digital footprint" and "digital image of a person," stressing the necessity for specialized methodologies in managing digital traces. The article navigates through challenges in handling digital information publicly and underscores its significance in sociology, economics, and psychology. It concludes that digital footprints, emanating from online interactions, offer invaluable insights into human behavior and societal dynamics, thus shaping contemporary research paradigms. With the rapid expansion of internet users globally, the discussion on digital footprints and their management becomes increasingly vital, paving the way for potential legal frameworks and specialized professions like digital curators.*

Keywords: *awareness, digital footprint, youth, digital image of a person.*

Introduction

A growing proportion of people utilize the internet globally in the modern day. There were 5.16 billion internet users worldwide as of January 2023, accounting for 64.4% of the total population. Social media is reportedly used by 59.4% of these individuals [1]. Consequently, it is imperative to comprehend the quickly expanding digital footprint. Digital footprints are the data trails created and stored by using various online avenues.

Digital footprints include logins, bookmarks, website visits, geolocation, postings, ratings, purchases, and sharing. This trail can be traced back to the end-users. It is possible to identify and collect information about individuals based on their digital footprints. This information can include personal data such as name, location, age, interests, and more. The use of computers has crept into every aspect of our lives and is now a necessary component of every activity for everyone from individuals (gaming, correspondence, watching videos, information searching), to legal entities (electronic document flow within organizations, interactions with banks and regulatory authorities, report submission, application submission), and public authorities (e.g., the Russian portal "Government Services").

Through online communities and networks, social media users are able to partake in virtual social interactions by exchanging information and ideas. One of the most important facets of social media is the crowd's involvement as an engaged consumer who participates in the material. Examples of social media encompass blogs and microblogging on Twitter, social networking sites like Facebook and LinkedIn, and media sharing websites like YouTube, Flickr, and Instagram. Modern consumers find it easier and more frequent to access social media thanks to the widespread use of digital technology like laptops and mobile phones, which has greatly accelerated the prevalence of social media. In the contemporary digital landscape, individuals are progressively disclosing an unprecedented amount of personal information on online platforms, including but not limited to their geographical locations, contact particulars and even sensitive data such as credit card numbers, all of which contribute to the formation of what is commonly termed a "digital footprint." This expanding digital dossier has unfortunately ushered in a new era where individuals are facing tangible consequences, such as termination of employment or exclusion from educational opportunities, due to the content discernible on their social media profiles. This predicament arises primarily from a lack of awareness among internet users regarding the latent

ramifications of their online engagements and the inadvertent dissemination of their personal data. One way that digital footprint is left behind according to the Internet Society is through retailers who leave cookies in a user system to track the user's activities [2]. Subsequently, these digital footprints become susceptible to exploitation by external entities for commercial gain or exploitative purposes. Compounding this issue is the formidable challenge of eradicating digital footprints once they have been established, as the shared information permeates the online sphere, rendering it persistently accessible and potentially vulnerable to exploitation and misuse.

The media often presents the internet as a technology that has wrought havoc upon the lives of the younger generation. It frequently emphasizes narratives concerning youth ensnared in internet addiction, the ominous presence of online predators preying on minors, the destructive impact of cyberbullying and the perilous realm of teenage sexual behaviors. Furthermore, media coverage extends to encompassing issues such as fraudulent activities related to online product purchases, the psychological toll of social media-induced depression, instances of sexual harassment and the inadvertent exposure of inappropriate content. Moreover, the notion of a digital footprint can be construed as a form of tacit engagement by netizens, manifested through the creation and dissemination of content across various social media platforms.

Theoretical Framework

Many digital footprints allow them to be classified. It is customary to distinguish two types of digital traces: active and passive [3].

An active digital footprint materializes through the deliberate dissemination of user-generated information across the vast expanse of the internet, notably on social networking sites. Sending an email to someone (you want them to see it) is an example of leaving an active footprint. Other examples include writing blog posts, publishing on social media sites like LinkedIn, Twitter, and Instagram, and completing forms that ask for email or text update subscriptions. The size of the digital footprint increases with the number of emails sent. Emails could live several years or more because the majority of people save them online.

On the other hand, a passive footprint is described as inadvertent or unconscious marks that a person makes online. Instances of this phenomenon include the utilization of applications and websites employing geolocation services to ascertain a user's precise whereabouts, as well as activities such as browsing products and participating in online engagements, which advertisers aggregate and scrutinize to construct a detailed user profile. Subsequently, this data is leveraged to deliver tailored advertisements tailored to individual preferences and behaviors [4]. A user's unintentionally left-over data trail or information path on the internet is also referred to as a passive digital footprint. For instance, the IP address can access the web server when the user accesses a website. The internet service provider and the user's general location are later identified by this address. IP addresses are nevertheless a part of users' digital footprints even though they are subject to change and do not contain any personal information. Some search engines record search history when the user logs in and these histories are called as more specific elements of passive digital footprints [5].

In addition to active and passive digital footprint types, we encounter following subcategories in literature [4, 6, 7]. These are:

- a) Personally identifiable information: Contains information related to real names of individuals.
- b) Anonymous: Contains anonymous data. This type of digital footprint hides IP address.
- c) User input: Contains the data created as a result of user input.
- d) Sensor data: These are the data created with the help of sensors.

Whether on purpose or accidentally, users often leave behind digital traces that can be actively or passively collected by interested parties. Because digital information is so large and diversified, it can be comparatively straightforward to gather a significant amount of user data via automated procedures or basic search engine queries.

According to a 2017 study by Katalin Feher, which examined how individuals share information online, only 70% of this material is still under their control, with the other 30% being vulnerable to unauthorized usage and even illegal activity [8]. The crisis surrounding Cambridge Analytica provides a striking example of the significant influence that digital traces have on modern culture. Through social media, people might manipulate data and raise issues without authorization. Digital footprints allow for study, analysis and comparisons without the owner's permission by providing insights on people's locations, affiliations, interests, and points of view. Although these imprints are not intrinsically bad, they must be carefully managed to preserve a favorable online persona, especially in light of employer monitoring and potential consequences for career advancement [9].

Being an effective digital citizen requires being aware of the consequences of one's digital footprint and using online spaces properly. Understanding one's digital footprint is essential for media literacy and adjusting to the digital age, since people need to take proactive measures to control their online presence in order to avoid problems down the road. One of the main requirements for practicing good digital citizenship is to use one's internet footprints responsibly in order to reduce potential future complications. This is when the idea of being aware of one's digital footprint becomes prominent. Becoming aware of one's digital footprint is essential for becoming media literate, adapting to modern culture, developing technical (also called digital literacy) and cognitive capacities (capacity to acquire information and understand the ramifications of online activities). People are expected to be aware of their digital footprints in order to control them. However, not all digital footprints are positive, and they may not leave positive footprints. For that reason, managing one's digital footprint has become crucial to maintaining a positive digital identity. Since today's employers use digital footprints to monitor the activities of their employees online, the management of digital footprints has become essential. In order to manage digital footprints, one must be a competent online media user. People who spend time on the Internet, that connect through one or more technological devices and whose social environment, family, etc. connect with each other in digital spaces are called digital citizens.

One of the biggest requirements for digital citizenship is minimizing the problems that may occur in future by using the footprints in online environments properly. At this point, the concept of digital footprint awareness comes to the fore. For one to be media literate, adapt to modern society, develop technical (sometimes referred to as digital literacy) and cognitive abilities (ability to gather information and comprehend the implications of online activities), one must be conscious of one's digital footprint. In order to manage their digital footprints, people are supposed to be aware of them.

Conclusion

The integration of digital information and its associated footprints into society is undeniable, constituting an essential facet. These elements offer profound research prospects by enhancing efficiency and expanding the scope of available information. Complete absence of digital footprints is nearly unattainable in today's digitally driven era, given the ubiquitous nature of online engagement.

Anticipated trends suggest that terms like digital footprint management and digital heritage will gain prominence, necessitating a legal framework to govern these domains. This evolution is poised to reshape academic studies, with a new professional role of digital curators likely to emerge distinctly. Furthermore, as our digitalized world undergoes rapid socio-economic transformations, there's an anticipation of a surge in academic inquiries into digital footprint management, accompanied by novel employment avenues within the private sector focusing on this domain.

In essence, while this study aims to heighten awareness regarding digital footprint management, the responsibility for managing one's digital footprints and addressing privacy concerns ultimately lies with the users themselves.

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THE BALANCE BETWEEN PRIVACY AND SAFETY: THE ETHICS OF PUBLIC VIDEO SURVEILLANCE

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Abstract. The following article explores the balance between privacy and safety in the context of public video surveillance from an ethical perspective. It aims to study its impacts on individual privacy, public security, and social norms. This research provide an in-depth investigation of the implications of surveillance through a detailed analysis based on an extensive review of academic literature, press articles, and surveys. While surveillance undeniably aids in crime prevention and investigation, it also raises critical concerns about personal freedom and the risk of mass monitoring. The paper begins with the positive aspects of public video surveillance on the well-being of society and continues with its potential downsides such as privacy violation. Legal considerations are an essential part of the analysis. These findings highlight the importance of a balanced approach between public safety and individual confidentiality, contributing to a comprehensive understanding of public surveillance's ethical aspect and its impact on society. This study enhances the ethical debate on public surveillance, suggesting that achieving an equilibrium between privacy and safety is both a possible and a crucial objective.

Keywords: *crime prevention, mass monitoring, personal freedom, public safety, surveillance ethics.*

Introduction

The roots of video surveillance date back to the mid-20th century, when Closed-Circuit Television (CCTV) technology was developed by Walter Bruch and initially implemented in Germany in 1942 to record live video. During the war, this primitive version of CCTV was used to observe V-2 rockets. It took another seven years, until 1949, for CCTV systems to be sold commercially. However, its widespread application began to take hold gradually with the rapid development of technologies in recent years. Primarily, it served as an essential surveillance tool in high-risk areas, but today it is omnipresent around the world. Still, the majority of the public agrees that the presence of surveillance cameras is essential for their security and the places where they are located. An article from the The New York Times states that “A week after the Boston Marathon attack, which was unraveled after the release of video footage of the two suspects flushed them out of hiding, 78 percent of people said surveillance cameras were a good idea, the poll found” [1]. However, nowadays, the use of Artificial Intelligence (AI) and Facial Recognition Technologies (FRT) is increasing, serving as enhanced tools in detecting and preventing crimes, but on the other hand, when used for non-democratic purposes, they can raise questions regarding the respect for individuals' rights.

These technologies, besides the numerous benefits they bring, can also pose an ethical problem. On one hand, video surveillance enhanced with these technologies serves as an indispensable tool for law enforcement and security agencies, not only by preventing crimes but also for further investigation of them, and a rapid response from authorities in emergencies. Standalone surveillance cameras function as a deterrent to criminal activities, and monitoring and

video recording can serve as essential tools in police or legal investigations. On the other hand, these surveillance systems can erode individual freedom and privacy, entail unnecessary surveillance, and foster biased practices through these technologies. Such concerns highlight the need for more research and regulations in this field, especially from a moral and ethical standpoint. We continue to explore this issue from multiple perspectives and propose several solutions to reach a consensus that respects both public interests and the individual's right to freedom and privacy. The surveillance methods that are used include CCTV, license plate recognition, face recognition, social media monitoring, and so on, all aiming to ensure the safety of the public. All these technologies aim to help prevent and solve crimes, but they also raise controversies around privacy risks.

Understanding the Role of Public Video Surveillance

It is undeniable that the emergence of video monitoring systems provides indispensable tools for ensuring public safety in our society. Public video surveillance is valuable in several fields, providing benefits for both law enforcement agencies and the public. One of the primary roles of video surveillance is to prevent and deter criminal activities within the coverage area and beyond, including but not limited to, thefts, break-ins, attacks, vandalism, fights, hooliganism, and more. Studies show that criminal activity in public spaces, where surveillance cameras have been installed, has significantly decreased. A scientific article published in the academic journal “International Journal of Law, Crime and Justice” reports that in South Korea “The number of robberies and thefts in the areas with CCTV installed reduced by 47.4%” [2]. Moreover, unaltered video recordings serve as key evidence in crime investigations. Law enforcement agencies can use footage to identify suspects, reconstruct events, convict the guilty, or even confirm alibis or withdraw charges.

In addition to crime prevention and police investigations, video surveillance plays an important role in accountability in case of an emergency. Video surveillance systems, typically equipped with real-time monitoring capabilities, allow for a rapid response from emergency crews in situations such as accidents, natural disasters, fires, cases of violence, and so on. Thus, with the help of monitoring, emergency assistance can be provided quickly, efficiently, and safely, thanks to the accurate detection of emerging problems. At the same time, public surveillance technologies can serve as a help in safely controlling public events, traffic, mass gatherings, or any other public situations, effectively contributing to the satisfaction of public safety of individuals in public spaces. Facts confirmed by a survey from a study at the University of North Carolina, which states that “A majority [of participants] also expressed that the presence of video surveillance systems made them feel safer” [3].

Concerns and Ethical Considerations

In addition to the undeniable benefits of using video surveillance tools, their continuous development also raises several ethical questions regarding the balance between public safety and privacy concerns. At the core of these considerations is the tension between social safety and individual freedom. The biggest questions revolve around issues such as the infringement of personal freedoms, data security, moral implications such as biased arrests, or a permanent state of surveillance, especially when systems enhanced with Artificial Intelligence are used. Most concerns are about the misuse of these systems, which can pose a potential threat to individual security, privacy, and democratic values.

In most cases, video surveillance, particularly that which employs Facial Recognition Technologies, can pressure autonomy and personal freedom. These tools can impose restrictions on an individual or a group, undermining basic democratic rights such as freedom of expression, association, or belonging to a group or idea. For example, video surveillance systems equipped with Facial Recognition Technologies were used during the protests for democracy in Hong Kong that took place in 2019-2020, to identify and arrest participants, and to facilitate the rapid

intervention of law enforcement to stop these protests. According to an article in The New York Times “Many protesters now cover their faces, and they fear that the police are using cameras and possibly other tools to single out targets for arrest” [4]. Additionally, an article by the Hong Kong Free Press mentions that “Hong Kong’s government has announced plans to install 2,000 additional CCTV cameras in public places this year in what it calls a move to fight crime” [5]. Thus, concerns are fueled regarding the guarantee of personal freedom. A study from the Technical University of Munich states that “Remote biometric identification of individuals in publicly accessible spaces poses a high risk of intrusion into individuals’ private lives, with severe effects on the populations’ expectation of being anonymous in public spaces” [6].

Like any information system, video surveillance systems can be vulnerable to security breaches through which collected data can be leaked, falling into the hands of malicious third parties. The risks increase when personal and biometric data of individuals are constantly collected and stored, thus posing risks of unauthorized access to very sensitive data. Furthermore, the lack of transparency in processing this data only increases the risks associated with threats to individual security and privacy rights. A 2024 CNN article presents a similar situation where “About 13,000 users “experienced a security issue” where they saw wrong thumbnails from other users in the Wyze app. About 1,500 users clicked on the tabs showing the other people’s footage, which enlarged the thumbnail and, in some cases, allowed people to view footage from other users’ cameras” [7].

The increasing presence of video surveillance systems can also raise ethical and moral issues. For example, the use of surveillance tools combined with Artificial Intelligence and Facial Recognition Technologies can increase the risk of biased arrests, as the training data can be altered with biased data present in our society such as different classifications of the actions of a person or a group of people based on age, gender, skin color, etc. The same study from the Technical University of Munich also states that “Not only is everyone that uses public space under surveillance without being a suspect of any crime, but the process can trigger an automated decision leading to police action. [...] Bias in AI is only one of the possible causes” [6]. Thus, in addition to amplifying inequity in our society, these issues can decrease society's trust in public authorities.

As video surveillance becomes more widespread, it can fundamentally alter how an individual behaves in public space, not necessarily signifying something positive, thus potentially infringing on rights to personal freedom of expression, such that “The banalization of surveillance can create a chilling effect that leads to the naturalization of further constraints to individual and public liberties, hampering autonomy by hindering choice and uncoerced decisions and undermining basic democratic practices linked to fundamental rights, such as freedom of association and expression” [6]. Additionally, the problem of consent in using images or personal data without the explicit permission of those monitored adds another layer of complexity to the ethical issue. Individuals are often not aware that their data is collected, how it is used, or whether they have any control over it, thus harming the fundamental principles of autonomy and consent.

Balancing Safety and Privacy

Achieving a balanced equilibrium between ensuring safety and respecting privacy requires a complex approach that includes technical, legal, and ethical considerations. As society becomes increasingly interconnected and reliant on technology, the use of public video surveillance is rapidly accelerating, raising challenges in balancing public security and individual privacy rights.

To address issues surrounding public surveillance, a well-defined regulatory framework is essential. Such a framework should clearly define the purposes for which surveillance can be used, the type of data that can be collected, and the duration for which it can be stored, among other things. For instance, the law could mandate that surveillance data be used solely for public security purposes and not for monitoring peaceful protests or other similar lawful activities. In the European Union, a strict set of guidelines known as the General Data Protection Regulation

(GDPR) governs the processing of personal data and benefits individual rights, enabling one to request access to or control over all personal data concerning them.

Transparency in the use of surveillance technologies is crucial for gaining public trust. Public authorities should disclose the locations of cameras, the technologies used, and the reasons for surveillance, and should also provide individuals with access to and control over the data collected about them. For example, the Regulation on Video Surveillance Within the Public Institution “Technical University of Moldova” stipulates that “Surveillance cameras are placed in visible locations. Any covert use of these cameras is strictly prohibited, except in cases expressly regulated by legislation” [8]. Regular audits and public reports on the effectiveness and impact of surveillance systems can maintain transparency and trust. Moreover, independent entities can be established to oversee the operation of monitoring systems to ensure they operate within legal frameworks and respect human rights. A report by the U.S. National Science and Technology Council proposes several actions to improve transparency in data use and increase trust in law enforcement: “The following federal actions could help improve law enforcement agencies’ data practices and contribute to improving trust in police. [...] Law enforcement agencies need to build capacity – in technology, human capital, training, and other resources – to effectively capture, use, and publish data, while software vendors need to lower the barriers to the effective use of their tools. [...] Making data available and accessible to stakeholders and the public is key to promoting transparency and reducing inequities” [9].

The advancement of technologies also provides solutions to concerns about individual privacy. Privacy-enhancing technologies (PETs), such as automatic blurring of faces in video feeds or algorithms that identify behavioral patterns without identifying individuals, can help minimize privacy intrusions. A 2022 study proposes a similar system that can improve the outcomes of public surveillance by using neutral artificial intelligence algorithms: “In this design, we avoid using algorithms that use identifiable information, such as pixel-based algorithms. The most important parts of the system, such as anomaly detection, action recognition, and global re-identification, use skeleton and abstract feature representation. As a result of this approach toward the algorithm, neither the inputs nor the outputs are identifiable information. Moreover, the outputs are race, gender, age, and ethnicity neutral. This specific aspect of the system addresses the issue of discrimination as a fundamental ethical challenge in the public safety domain” [10]. This approach excludes unnecessary monitoring of individuals, enhancing the efficiency of public video surveillance and reducing concerns about the security of individual privacy.

Involving the public in decision-making about when, where, and how surveillance technologies are implemented can help balance public safety and individual privacy security. Public consultation and debates should be encouraged to assess the community's needs. Additionally, policies that require explicit community consent before the installation or use of surveillance systems can significantly improve public trust and cooperation. For example, in the Republic of Moldova, the protection of personal data is guaranteed by Law 133 of 08-07-2011. Article 5 of this law states: “The processing of personal data is carried out with the consent of the data subject” [11].

Conclusions

In conclusion, the use of technologies for public video surveillance presents an undeniable advantage, significantly aiding in enhancing public security and assisting law enforcement in their work. At the same time, it also brings ethical challenges that should not be underestimated. The balance between security and privacy is extremely delicate, demanding a thorough analysis and careful implementation of regulatory mechanisms from a legal, social, and moral standpoint. As technology grows and improves day by day, including Artificial Intelligence and Facial Recognition Technologies, to protect individual freedoms and privacy, legal frameworks like GDPR should be implemented to guarantee basic human rights. Additionally, the deployment of these tools must also come with the population's trust regarding the respect of their rights, and

even more so with an extremely high level of transparency to dispel any suspicions of malicious use of these tools. Therefore, society must be directly involved in this process through participation in decision-making, as well as in surveys and studies in this field. It is vitally important to remember that the key priorities are, ultimately, the protection of democratic values and individual freedoms, while we address the complexities that advanced surveillance capabilities bring in developing a safer society.

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REVOLUTIONIZING FOOTBALL WITH ARTIFICIAL INTELLIGENCE

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Abstract: *This research aims to investigate the revolutionary effects of artificial intelligence (AI) on football. It evaluates the potential of AI to enhance player performance, strategic planning, and injury prevention in particular. It also analyzes how these advancements which combine state-of-the-art AI technology with data analytics have affected training methodologies, tactical decision-making, and player health management. With our research, which considers the latest advancements in AI, we give a comprehensive assessment of the technology's revolutionary potential in football. We analyzed how teams and coaches may obtain previously unattainable insights into player movements, game dynamics, and health hazards, through AI-driven scouting and real-time performance monitoring. Our research focuses on the significant advantages of AI in fostering innovation, competitiveness, and efficiency in football team management and player development through practical instances of its use. We firmly believe that AI will usher in a new era of technical mastery and brilliance in football and have a big impact on the game going forward.*

Keywords: *artificial intelligence, injury prevention, player performance, strategic planning.*

Introduction

The sports business has undergone a major revolution thanks to mechanical advancements which have a big impact on fan interaction and player performance [1]. Innovation definitely will impact the sports industry as it improves on-field performance while ensuring competitor security through advanced diagnostics [2]. Talking about soccer, at the beginning it was a very simple ball game which did not have any rules and no technologies were involved. In time, it evolved and was played in muddy fields where all the rules were established by a simple man/woman based on his own decisions, but nowadays it has evolved so much that technologies have a crucial role in the analysis of the match and also to track the player performance. Examples of this include wearable technology that tracks player development and real-time investigation devices that optimize gameplay [3]. During the time, soccer players had suffered different traumas including torn ligaments caused by hard contact with other players, muscle strains, and other types of trauma [4]. All these aspects have an important impact on the team's performance, and because of this, over time football clubs invested more and more in the equipment that monitors and prevents players from getting an injury.

Technologies used on the field

The VAR is mostly used to analyze and review the goals, penalties, decisions, red cards, and even some mistakes made by the main referee. This technology gives an instant review of the moment that happened in the football field, and the referees receive the information via some wireless headsets, and then take the decision upon the situation. Firstly the definition of offside. A player is in an offside position if any part of his body except the hands and arms are in the opponent part of the pitch closer to the goal line than the opponent. The SAOT was first used in 2022 in the

Qatar FIFA World cup. This technology uses 12 cameras that are placed on the field and they track the data on the ball and also tracks the players movements about 50 times per second which is quite a good precision and helps to monitor the position of the players on the pitch and to determine if the offside has occurred [5]. Soccer Goal Line Technology is an important thing in football as the human eye can make mistakes in comparison with a technology that has sensors in it. This feature is specialized on determining if the ball definitely passed the goal line.

AI used for football clubs

The use of wearable technologies is an essential practice in modern football. GPS tracking systems are frequently employed to monitor the physical condition of players, prevent injuries, and tailor training regimens to each player's specific needs. Smart stadiums represent another innovative practice in modern football, facilitating interaction between supporters and the game. Fans have access to high-speed internet, analytical data for better game understanding, applications providing information about the stadium and its facilities, and more. For example, Tottenham Hotspur Stadium (London, UK) or Allianz Arena (Munich, Germany), include features as: high-speed Wi-Fi, interactive video screens, and a dedicated app for fans to order food, access live match statistics, and navigate the stadium [6]. Moreover, VR and AR technologies have revolutionized how fans engage with the game, offering them the opportunity to watch matches from a 360-degree perspective and observe real-time player statistics and the direction of the football match. An notable example is that during the 2018 FIFA World Cup, FIFA offered a VR experience that allowed fans to immerse themselves in the tournament through 360-degree videos of matches, training sessions, and behind-the-scenes content.

AI in the World Cup 2026

The Innovation Centers and digital infrastructure development are the main topics of discussion in this section's exploration of the upcoming technological innovations for the FIFA 2026 World Cup [7]. Designed to be dynamic hubs for sports-related projects, Innovation Centers will aim to incubate and perfect new products and services well in advance of the tournament. Innovators that enhance the fan experience and expedite operational procedures are the focus of this proactive strategy [8]. Along with the traditional improvements to cities and stadiums, the drive to fortify digital infrastructure also recognizes the critical role that technology plays. Discussions focus on how to increase the overall impact of the event by leveraging advanced data analytics, integrating enterprise solutions, and enhancing the fan experience. One way to position the FIFA 2026 World Cup as a leader in technological integration for international sporting events is by collaborating with tech hubs like Silicon Valley and Vancouver, which demonstrate a collaborative effort to leverage cutting-edge digital solutions.

AI applications in monitoring player health

AI has revolutionized the observation of football players' well-being by advertising real-time experiences and analyzing endless sums of information to distinguish unobtrusive changes in condition, showing potential wounds or weakness. This innovation permits for the customization of preparing and recuperation programs, altogether decreasing recuperation times and upgrading generally player execution. Wearable gadgets prepared with AI capabilities give an all-encompassing see of an athlete's well-being by gathering information on heart rate, rest quality, and physical effort. AI-driven symptomatic devices and frameworks not it encourage speedy damage, distinguishing proof but also screen mental well-being, recognizing signs of push or uneasiness. The prescient control of AI offers a proactive approach to well-being administration, guaranteeing players are at their top condition and contributing to their career life span. As AI innovation proceeds to advance, it guarantees indeed more noteworthy headways in well-being observing, setting modern benchmarks for competitor care, and advertising a future where wounds are essentially lessened.

Predictive analytics for injury prevention

Prescient analytics utilizes chronicled information and AI calculations to estimate potential wounds, empowering groups to require preemptive measures. This data-driven approach analyzes designs related to common football wounds, altering preparing concentration and recommending ideal player revolutions to diminish fatigue-related wounds. Progressed modeling methods and prescient analytics improve decision-making, permitting for convenient and evidence-based intercessions. The discernible diminish in harm events among proficient groups and the personalization of recovery programs emphasize the viability of prescient analytics. As models end up more modern, their precision in estimating will move forward, and assist in upgrading harm anticipation endeavors. This cooperative energy between prescient analytics and AI observation makes a comprehensive system for shielding players' well-being.

Wearable technology and biometric data utilization

Wearable innovation has ended up a foundation in collecting biometric information, giving experiences into players' physiological and biomechanical status. Real-time criticism from gadgets such as GPS vests and heart rate screens empowers the customization of preparing programs to optimize execution and minimize damage chance. This innovation moreover amplifies overseeing nourishment, hydration, and rest quality, playing a basic part in harm anticipation and recuperation. The integration of AI with wearable innovation upgrades information exactness, permitting for exact well-being evaluations and cultivating a culture of data-driven decision-making. The headways in wearable innovation open unused conceivable outcomes for checking player wellbeing, speaking to a critical jump forward in accomplishing ideal athletic execution and life span.

Case studies on successful injury prevention through AI

Case thinks about highlighting the fruitful application of AI in harm avoidance, such as a European football club that saw a 30% lessening in delicate tissue wounds through an AI-driven program. Wearable innovation and prescient analytics have been instrumental in bringing down harm rates over proficient alliances by fitting, preparing and overseeing workloads successfully. Ventures centering on the biomechanics of players' developments have recognized people at the chance of particular wounds, driving them to focus on mediations and diminished damage events. AI's part in concussion administration and recovery exhibits its potential to quicken recuperation times and progress results. Groups leveraging biometric checking reports improved player accessibility and execution, ascribing this victory to the exact information given by innovation. These cases emphasize the transformative effect of AI and innovation on harm anticipation, setting unused benchmarks for well-being administration in football.

Negative aspects of using AI

Even though technology is frequently praised for its revolutionary effects, worries have been raised about how it might harm football. A significant concern pertains to the application of video assistant referee (VAR) technology, which has generated contention and discussion in the football world. Football matches are known for their spontaneity and excitement, but some claim that VAR's intervention ruins the fun by interfering with the game's flow and causing lengthy stops. In addition, debate-provoking rulings rendered by VAR have increased dissatisfaction among athletes, coaches, and spectators, prompting concerns about the arbitrary application of regulations and the possible degradation of the human element in sports. The growing use of performance-tracking and data analytics in player evaluation and recruitment is another cause for concern. Although metrics for evaluating player performance can be obtained through data-driven insights, concerns exist regarding their potential to dehumanize scouting and place an emphasis on statistical metrics at the expense of intuition and subjective judgment. Intangible traits like

leadership, resiliency, and teamwork may be overlooked in this shift toward quantifying player attributes, which would weaken the importance of experience and intuition in talent identification and take away from the holistic assessment of talent. New difficulties with regard to pl have also been brought about by the growth of digital media and social networking sites. Football has certainly changed in many ways thanks to technology, but there are good reasons to be concerned about the negative effects of technology's unrestrained use and spread. The preservation of football's fundamental principles and the welfare of its players in the face of rapidly changing technology necessitate a balanced approach to address the myriad of issues at hand, including the disputes surrounding VAR, the possible drawbacks of data-driven player evaluation, and the difficulties given by digital media.

Conclusions

This article presents a study based on the integration of artificial intelligence in football. It emphasizes the impact of AI technologies over football player's performance and injury prevention. The paper includes information about applications of artificial intelligence technologies in training, decision-making and also in the player's health tracking. The main areas where AI is involved are the VAR technology, GPS tracking systems and also implementation of smart football pitches in order to improve fan's experience. Moreover this research paper delves into the role of AI in injury prevention, predicting potential injuries, and providing detailed analysis of player's health. Despite all the positive aspects of the introduction of AI in Football, there exists the risk of damaging the fundamental principle of the game, so it is necessary to have a balanced approach towards the technological changes in Football.

In the end this paper highlights the potential of the AI in effectively managing the football team as well as the player development and performance. It shows through practical examples how AI provides coaches with good insights of player performance and potential health problems or even physical injuries, in this way undoubtedly contributing to development of the football industry. It shows good examples of how AI could have a big impact over the sports in general, and how technology leads to a much more efficient and safe football experience.

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NAVIGATING THE EXISTENTIAL RISK OF ARTIFICIAL INTELLIGENCE

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Abstract. *The development of superintelligent artificial intelligence (AI) presents significant problems and concerns for humanity. This paper examines the idea of superintelligent artificial intelligence, its controversies, worries and threats, as well as how it can affect power dynamics on several fronts. We examine the changing dynamics between AI and human society, as well as talk about the implications for states, businesses, and people. We also look at artificial intelligence's place in cybersecurity and how it may both strengthen defences and make attacks easier. Although we recognise the advantages of AI growth, we also highlight the existential risk that comes with unconstrained advancement. We propose that such risks can be controlled and mitigated, and AI unconstrained development can be sustained with careful thought and preparation. This article does not offer definitive and conclusive answer on the topic of the Existential Risk of artificial intelligence, however seeks to spark additional discussions on the responsible advancement of artificial intelligence.*

Keywords: *development, humanity, power, superintelligence, technology.*

Introduction

Nowadays, we live in an era where the horizon of technological innovation is boundless, which means that humans have created an astonishing concept of so-called Artificial Intelligence. Since then, AI has become a widely used and discussed topic in various spheres and fields, even in unexpected places, because it can mimic human intelligence and is capable of performing tasks such as problem-solving, reasoning, learning, medical assistance. At this stage, this technology is so advanced that it diagnoses medical condition, detects fraud and enables autonomous driving. But, do we only gain success and a less complicated life? Does it not pose a real danger to humanity, to our critical thinking, and to our development as individuals? We must pause to ponder regarding this situation.

General premises

We all are afraid of having a superior species that is more intelligent, has better capacities, and possesses performances we can only dream of. This species represents the general artificial intelligence. From our environment, and not only, it is said that there will be a hypothetically event in which AI will self-improve, which means that it will learn more information that would potentially be used against our well-being. In other words, AI will have the “intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest” [1]. If we look back at how was AI first designed and intended to work, we can acknowledge that AI can also develop way smarter machines than itself, just like humans engineered AI. This will be like a recursion, because the developed machine by AI will result into a more performed one and so on, until we encounter a phenomenon called “intelligence explosion” [2].

We still are concerned about how AI is creating harmful situations at the moment, not only in the future. From what we read and heard, there has been cases where different videos were modified to meet someone’s personal interests. For example, UK organization Future Advocacy

made a video where Boris Johnson and Jeremy Corbyn were promoting each other for the position of Prime minister. This created a fake impression about UK's political views. Furthermore, it gives us the idea of seeing even more credible videos, disregarding the fact that there are advanced algorithms of identifying the unreal part, there still are uncontrolled routes for modified material to spread. What regards the safety of drivers, there has been registered cases where cars became weapons of terror. Moreover, some autonomous cars are identified as a realistic delivery mechanism for explosives.

Benefits versus threats

The central and powerful incentive for humans to build superintelligent machines are the “automatic advanced capabilities” [2] utilized to improve the management and comfort of human life. Such artificial intelligence aims to possess two advanced capabilities – “agent planning” (creating and following structured plans of actions) and “strategic awareness” (employing knowledgeable and complex projects with a great level of precision and accuracy). Drawbacks for such humanly-designed AI could imply catastrophic consequences due to the superintelligence's characteristics to seek and maintain power. More specifically, AI can possess “misaligned power-seeking” capabilities which would incentivize such machines to obtain and sustain power and control dramatically beyond the purposes of its creator – the human. In such a scenario, a general estimation of >10% is assigned to the possibility that by 2070 an existential catastrophe is likely to occur [2].

An ongoing debate takes place concerning the positive impacts of artificial intelligence advancements on human lives and the degree to which they can outweigh the possible negative implications and a presupposed existential risk - developing a superintelligence that deviates from human goals, morals and values which may result in disastrous consequences, potentially leading to the extinction of the human species [3]. On the one hand, it is evident that the development of AI comes hand in hand with many advantages, such as increases in living standards through reduced human efforts and time savings, and new developments that would boost life expectancy, for example through AI “involvement in dangerous jobs” and “computerized methods” that would dramatically lower the number of inaccuracies in daily working environments and improve precision [4]. On the other hand, the impacts of artificial intelligence are “a double-edge sword” [3] since AI is depleted of a moral framework when making independent decisions and pursuing goals. The conditions under which AI rapid advancements should be sustained are still under debate, since a flawed model of controlling the degree of AI's independence over humans may lead to catastrophic consequences and possibly to human extinction.

Potential risk factors of AI development

This section examines how the general-purpose technology of artificial intelligence (AI) may impact the power relationships among various parties, including the public, multinational companies, and nation states. Based on current trends, these actors were chosen as being especially significant in relation to AI: big, multinational tech companies create AI for the public to use in their services; nation states and the public surely have a significant relationship; and states engage with multinational tech companies through regulatory measures, among other means. States participate in AI research and development through government sponsorship of research, as well as through their armed forces and intelligence services.

The relationship between nations and their citizens is then examined considering the use of AI monitoring systems. Affect recognition, a relatively new technique that attempts to automatically “read” a person's emotions from facial micro expressions, automatic facial and voice identification, smart/predictive policing, and other uses for this technology are just a few examples. The well-documented surge in the use of AI systems has significantly increased the power and awareness that nation-states can wield over citizens living within their boundaries.

Regarding the field of cybersecurity, which is one of the more logical uses for AI is reflected by its explosive growth, comparing as an industry worth \$1 billion in 2016, and estimated \$34.8 billion in 2025 [6]. Anyway, there are still a big number of unanswered concerns about wider implications of this trend, but the expanding application of AI will alter the current offensive-defensive balance within the cybersecurity business. Though there are many arguments for believing that cybersecurity, especially its advancements in AI, trends towards offence, this is still a contentious topic.

AI in cybersecurity has the potential to facilitate successful assaults in a variety of ways. According to Matteo et al. note, if attackers can affect the system's training, then using machine learning techniques to build defense strategies will expose the system to additional vulnerability [7]. A contemporary survey delineates numerous methods aimed at cultivating resilience in machine learning frameworks amidst adversarial challenges [8]. It refers that the research demonstrates how carefully planned modifications to training data, undetectable to human overseers, can produce an unanticipated behavior of the trained system [6]. Johnson also highlights that the adversaries can utilise AI to create and carry out sophisticated, personalized cyberattacks with previously unheard-of precision and effectiveness [9]. On the other hand, AI also offers cutting-edgetechniques for identifying and responding to cyber-attacks. In accordance with Wirkuttis and Klein, the abilities of AI systems to deal with vast data sets position them as top contenders for automating cybersecurity related tasks, monitoring network, and identifying malicious intrusions.

Involvement in dangerous jobs

Robots are now being created with AI to help humans in dangerous situations. They have started to replace humans in risky jobs like bomb defusing, which can be very dangerous. Thanks to these robots, defusing bombs has become much safer and easier. This has led to saving many lives by taking on the most dangerous job in the world. As AI continues to advance, more jobs like welding, which can be harmful due to toxic substances, may also be taken over by robots. People working in extreme conditions with high heat and loud noise will greatly benefit from AI technology. Overall, AI implementation has played a crucial role in providing safety measures and protecting humans from harm.

Computerized methods

Vermesan and his colleagues have pointed out that in today's world, automated methods of reasoning, learning, and perception have become an integral part of our daily lives. We can see this through the use of GPS during long drives and trips, as well as the advancements in smartphone technology. These are just a few examples of how AI has made an impact on our lives. One notable benefit of AI is the reduction in typing errors, as computers can now predict and correct our mistakes. This is a clear demonstration of AI in action. Moreover, AI algorithms are used to identify and tag people in pictures uploaded on social media platforms. Additionally, the knowledge of AI is effectively utilized in the banking and financial sectors to manage and organize statistical data, leading to a decrease in errors and an increase in accuracy.

Reduced human effort

AI has been important in our daily lives. Many industries are now using this technology to create machines that can do human tasks. These machines help make sure that work is done consistently and efficiently, which means better quality work. With AI, we can look forward to a world with fewer mistakes. Machines don't get tired like humans do, so they can work non-stop and get things done faster and more accurately. AI has definitely increased production in many industries by taking on different roles. It's also used in managing employee records and making decisions in companies. Overall, AI has helped industries finish tasks on time and grow their businesses.

Time saving

In today's fast-paced world, time is of great importance, and there is a growing desire to create machines that can help us save time. According to Gurkaynak and his colleagues, AI has proven to be a time-saving tool that maximizes every minute effectively. It could efficiently perform multiple tasks simultaneously and at a much faster pace than humans. Additionally, AI can swiftly gather and analyse data, providing solutions to problems in a fraction of the time it would take for humans to do the same. It is evident that AI technology surpasses human capabilities in many aspects. Moreover, AI has eliminated the need for humans to spend excessive time on repetitive tasks. Instead, employees can now focus on more complex issues, thanks to AI. As a result, AI has brought about significant improvements in people's daily lives.

Conclusion

Finally, the purpose of this paper was not to give a defined answer to whether the developments of Artificial Intelligence in the near and distant future should be shut down or slowed to avoid the possibility of increasing the chances of Existential Risk. Nevertheless, it provides an introduction into the nuances of the matter, highlighting the motivations of humanity to pursue progresses in the field of AI, the characteristics of artificial intelligence as it gradually progresses into superintelligence and how this could imply an evident risk leading to the extinction of the human life. Considering all the various implications, one thing is sure – contributing to the progress of AI represents “playing with fire”. The development of AI could be sustained under the conditions of careful planning and considerations, and by considering the possible risks and consequences associated with the matter.

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THE QUANTUM REALM: A JOURNEY INTO QUANTUM COMPUTING

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Abstract. *The nascent discipline of quantum computing, situated at the nexus of quantum mechanics and computer science, presents unparalleled potential for resolving intricate issues that prove formidable for conventional computing systems. An introduction to quantum computing is given in this work, which also covers basic ideas including entanglement, superposition, and qubits. It talks about how quantum algorithms might be used in machine learning, materials science, cryptography, and optimization. The difficulties in developing hardware and error correction for quantum computer construction are also covered in the paper. It also discusses the dangers of quantum computing, like cryptographic flaws, and stresses the necessity of responsible development and application. The study looks ahead, highlighting current research directions and the exciting potential of quantum computing to transform several fields.*

Keywords: *qubits, superposition, entanglement, quantum algorithms.*

Introduction

At the vanguard of technological advancement, quantum computing holds the potential to completely transform computation as we know it. Qubits, or quantum bits, are used by quantum computers instead of conventional computers, which use classical bits that can only be either 0 or 1. This is because quantum mechanics allows qubits to exist in several states at once.

This new area has unmatched promise for resolving challenging issues that traditional computers are currently unable to handle. Unlocking new boundaries in scientific discovery and technological growth, quantum computing holds the key to fields ranging from cryptography and optimization to materials science and machine learning [1].

We travel into the world of quantum mechanics in this paper, delving into the fundamental ideas of quantum computing, the special qualities of qubits, and the revolutionary potential of quantum algorithms. We explore the practical aspects of creating quantum computers, look at the advantages and disadvantages of this cutting-edge technology, and speculate about quantum computing's future [2].

Come explore the complexities of quantum computing with us and learn about its significant effects on computation and society as a whole. Greetings and welcome to A Journey into Quantum Computing, The Quantum Realm.

Qubits

Multiple alternative states are superposed to represent qubits. A qubit can combine two states linearly by using the superposition phenomenon in quantum mechanics. A classical binary bit can only be in one of two states since it can only represent a single binary value, such as 0 or 1. On the other hand, a qubit has a fixed probability of being either a 0 or a 1, and can represent a 0, a 1, or any combination of 0 and 1 in superposition of both states [3].

Superposition, Interference and Entanglement

Quantum computers have more computing capacity thanks to superposition.

Quantum algorithms can process information far more quickly than even the fastest classical computers in specific scenarios thanks to superposition.

- A qubit system's capacity to represent information expands exponentially. The quantity of information represented by 500 qubits would be greater than that of even 2500 ordinary bits. It would take a classical computer millions of years to find the prime factors of a 2,048-bit integer. Qubits could complete the computation in a matter of minutes.

Quantum algorithms can make use of other quantum mechanical phenomena, like entanglement and interference, thanks to superposition. Superposition, interference, and entanglement work together to produce computing capacity that is orders of magnitude quicker than that of classical computers in solving problems.

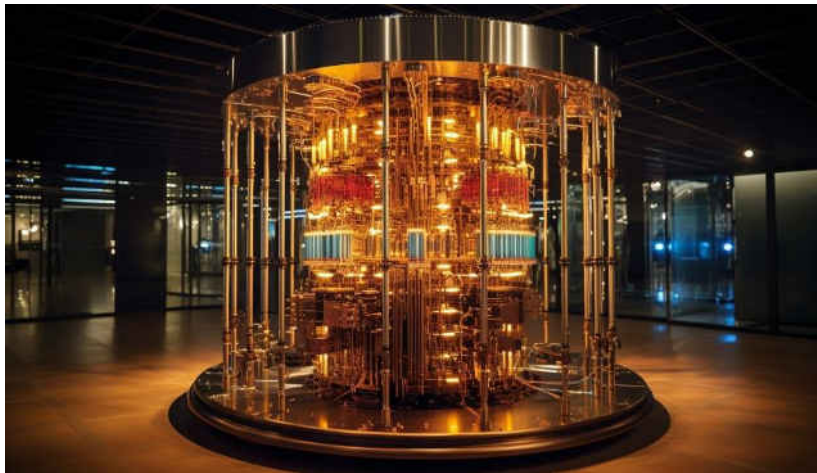


Figure 1. Example of Quantum Computer [4].

Interference is a result of superposition. Qubit states can interfere with one another since they are all distinguished by probability amplitudes that resemble wave amplitudes. Constructive interference increases amplitude, but destructive interference cancels it out. These phenomena are used in quantum computing techniques, which distinguishes them from classical computing techniques. Together, entanglement and interference yield the quantum acceleration that is promised by quantum computation.

Quantum entanglement can exist between several qubits. Qubits that are entangled always correlate to form a single system. Even in cases where qubits are infinitely far away, we can measure the state of one to find the other's state without actually measuring the other. Entanglement is necessary for any quantum computation and cannot be efficiently achieved on a conventional computer. Applications include factoring large numbers (Shor's algorithm) and solving search problems (Grover's algorithm).

Unlocking the Potential: The Necessity of Quantum Computing

Scientists employ supercomputers, which are extremely potent devices with thousands of traditional CPU and GPU cores, to solve complex issues. However, because of their reliance on binary coding and transistor technology from the 20th century, modern computers have difficulty solving some complex tasks.

Complex problems are those that include a large number of interacting variables, such as financial transaction fraud detection or the simulation of atoms in a molecule. These are issues that classical computers frequently can't handle. Based on quantum mechanics, quantum computers employ quantum bits, or qubits. They are promising tools for comprehending and addressing real-world situations because they have the capacity to perform exceptionally well at handling complicated problems that are challenging for traditional computers.

There are various motivations to seek quantum computing, and it has several benefits over traditional computers:

Handling Complicated Issues: Quantum computers are particularly good at handling complicated issues that traditional computers find difficult. Large-number factorization, complicated system optimization, quantum system simulation, and more effective problem-solving in mathematics are a few examples.

Parallelism: By utilizing the superposition principle, quantum computers enable qubits to exist in several states concurrently. This gives quantum computers an advantage over classical computers in parallelism by allowing them to do several calculations at once. In contrast, calculations are carried out consecutively by classical computers.

Speed for Specific Tasks: Compared to classical computers, quantum computers may be able to complete some computations far more quickly. Quantum computer algorithms have the potential to accelerate certain activities exponentially, increasing their efficiency in solving specific issues.

Quantum simulation: While classical computers find it difficult to simulate quantum systems, quantum computers are able to do so. This ability is useful for comprehending particle behavior at the quantum level and may find use in the sciences of chemistry and materials science.

Quantum computing may also have an impact on the field of cryptography. For example, Shor's method may be able to crack popular public-key encryption techniques that rely on the difficulty of factoring big integers.

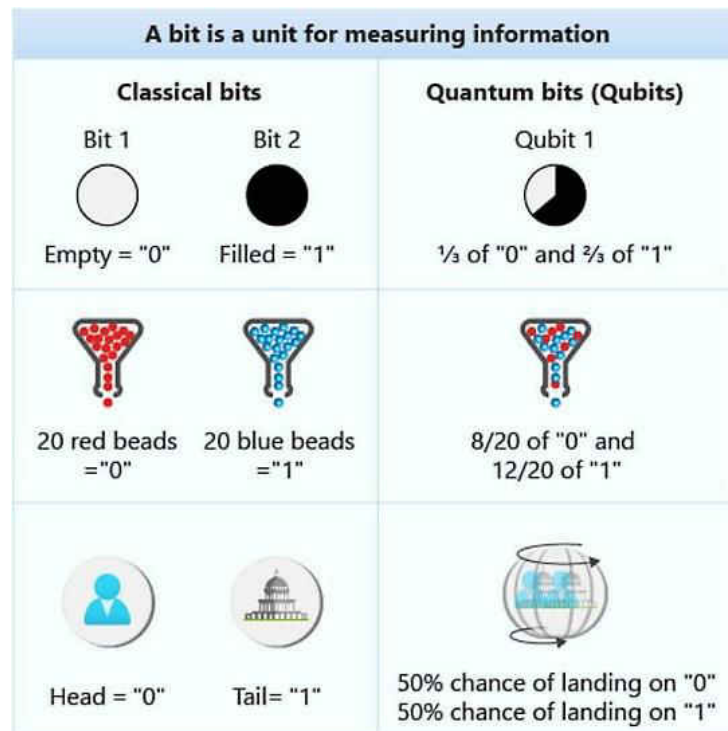


Figure 2. Classical bits vs Qubits

How to build a Quantum Computer?

In contrast to classical computers, which employ well-known silicon-based circuits, qubits—also referred to as "quantum computer qubits"—can be physically implemented as quasiparticles, artificial or real atoms, trapped ions, or photons. Some implementations require their qubits to be maintained at temperatures close to absolute zero, depending on the architecture and qubit systems.

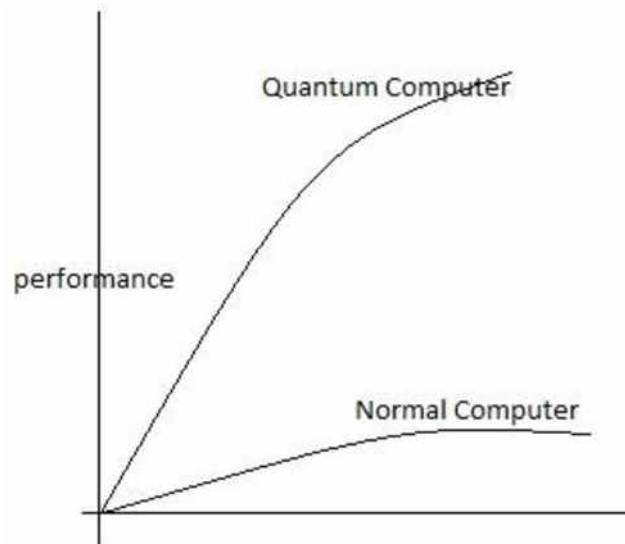


Figure 3. Computational speed comparison

How to build a Quantum Computer with Professor Leo Kouwenhoven

- “I’m Professor Leo Kouwenhoven, a major member of Microsoft’s quantum team, and I oversee a team of scientists and engineers at the Microsoft Quantum Lab in Delft, Netherlands. Developing a quantum computer is not an easy task. The enigmatic world of atoms and molecules holds the key to understanding why developing a quantum computer is so difficult” [4].
- Things in our everyday reality—the world of apples and falling balls—follow classical laws. With classical physics, we can anticipate the trajectory of a ball thrown, but at the quantum level, particles exist in numerous states simultaneously and act like waves.
- Qubits, the fundamental components of quantum computers, are required in order to utilize these quantum features for computing. In contrast to classical bits, which exhibit stability and good behavior, qubits are sensitive to their surroundings and are rapidly changed by them. Computational mistakes can result from any disruption that causes qubits to lose their quantum state, such as heat or electromagnetic radiation.
- Microsoft is addressing these issues head-on by creating a topological qubit, which is more error-resistant than previous qubit designs. Majorana fermions are unusual particles that are thought to be topological qubits’ own antiparticles. Fault-tolerant quantum processing is achieved by encoding quantum information in the braiding of Majorana fermions [5].
- However, precisely linking and manipulating qubits is just as important to the construction of a quantum computer as the qubit itself. The cryogenic control system, which keeps qubits in their fragile quantum states by operating at temperatures very near to absolute zero, is the brains of our quantum computer. Through the coordination of qubit interactions, quantum gates and computations are made possible.
- To scale up our quantum computer, we need to address scalability and connectivity challenges. We’re exploring 3D integration techniques to stack qubits vertically, maximizing the qubit density within limited space. Additionally, we’re developing error-correction codes to detect and correct errors that inevitably occur during quantum computation.
- We must overcome connectivity and scalability issues if we are to increase the capacity of our quantum computer. In order to maximize qubit density in a constrained amount of area, we are investigating 3D integration strategies for stacking qubits vertically. Furthermore, we are creating error-correction codes to identify and fix mistakes that will unavoidably arise in quantum processing [6].

Applications of Quantum Computing

Quantum computing has the potential to revolutionize various fields, including cryptography, optimization, materials science, and machine learning. By harnessing the power of qubits and quantum algorithms, quantum computers can tackle complex problems with unprecedented speed and efficiency [7].

Quantum cryptography leverages the principles of quantum mechanics to secure communication channels against eavesdropping and tampering. Quantum key distribution (QKD) protocols enable two parties to establish a secret key with provable security guarantees, based on the principles of quantum entanglement and uncertainty. Unlike classical cryptographic schemes, which rely on the computational hardness of certain mathematical problems, quantum cryptography offers unconditional security based on the laws of physics.

Quantum computers can solve optimization problems more efficiently than classical computers by leveraging quantum algorithms such as the quantum approximate optimization algorithm (QAOA) and quantum annealing. These algorithms exploit quantum parallelism and interference to explore the solution space of combinatorial optimization problems and find optimal or near-optimal solutions in polynomial time. Applications of quantum optimization include portfolio optimization, supply chain management, and traffic routing [8].

Quantum computers can simulate quantum systems, providing insights into the behavior of particles at the quantum level. Quantum simulation has applications in materials science, chemistry, and drug discovery, where understanding the properties and interactions of atoms and molecules is crucial. By simulating quantum systems with high precision, quantum computers can accelerate the discovery and design of new materials, catalysts, and pharmaceuticals [9].

Quantum machine learning combines quantum computing with classical machine learning techniques to solve complex optimization and pattern recognition problems. Quantum algorithms such as quantum support vector machines (QSVM) and quantum neural networks (QNN) offer potential speedup for tasks such as classification, clustering, and regression. Quantum machine learning algorithms can leverage quantum parallelism and entanglement to process large datasets more efficiently and discover hidden patterns or correlations.

Risks and Challenges

While quantum computing offers tremendous potential, it also poses risks and challenges that need to be addressed. These include:

- **Cryptographic Vulnerabilities:** Quantum computers could break widely used cryptographic schemes, such as RSA and ECC, by efficiently factoring large numbers or solving the discrete logarithm problem. This poses a threat to the security of sensitive information and digital communication networks [10].
- **Error Correction:** Quantum computers are susceptible to errors due to noise and decoherence, which can degrade the fidelity of quantum computations. Error correction techniques, such as quantum error correction codes, are essential for mitigating errors and achieving fault-tolerant quantum computation [11].
- **Hardware Development:** Building scalable and reliable quantum hardware is a significant challenge. Qubits must be engineered with high coherence times and low error rates to perform reliable quantum computations. Advancements in materials science, fabrication techniques, and cryogenic engineering are needed to overcome these challenges [12].
- **Responsible Development:** As quantum computing progresses, it is crucial to consider ethical, legal, and societal implications. Responsible development practices should prioritize transparency, security, privacy, and inclusivity to ensure the safe and equitable deployment of quantum technology [13].

Conclusion

Finally, quantum computing has revolutionary potential to tackle complicated problems at a never-before-seen speed and efficiency. It is a paradigm change in computation. Quantum computers have the potential to transform a number of industries, including machine learning, materials research, cryptography, and optimization, by utilizing the concepts of quantum mechanics.

Although quantum computing has a lot of potential, there are also risks and difficulties that need to be handled through appropriate development procedures and cooperative research. We can realize the full promise of quantum computing and open the door to a future driven by quantum technology by conquering these obstacles [14].

Come along with us as we investigate the quantum realm and push the envelope of what is conceivable. Let us embark on this journey with imagination, inquisitiveness, and a commitment to leveraging quantum computing for global good [15].

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A DSL SOLUTION FOR MOLDOVA'S TAX SYSTEM

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Abstract. *Moldova's tax system is incredibly complex, with its many rules, changing rates, and special deductions. This complexity can lead to costly mistakes for individuals and businesses when calculating taxes. To address this challenge, a Domain-Specific Language specifically designed for Moldovan taxes is being developed. This DSL aims to use the same language and structure as the tax laws, making it easier to understand and reducing the likelihood of errors during tax calculations. Imagine a system where individuals, small businesses, and even large companies can save time and feel more confident about fulfilling their tax obligations. The DSL has the potential to make this a reality by simplifying calculations and minimizing the risk of unexpected penalties. This, in turn, could lead to better financial planning and reduced stress for business owners.*

Keywords: *Moldova, computation, DSL, simplification, tax system, automation*

Introduction

For individuals and businesses in Moldova, the annual task of calculating taxes often means grappling with complex regulations, a multitude of variables, and the ever-present risk of costly errors or missed opportunities for deductions. This paper proposes a practical solution in the form of a DSL created expressly for Moldovan tax computations. This DSL has the potential to improve accuracy, save time, and reduce the stress associated with tax obligations by offering a streamlined and intuitive approach.

Designed to reflect the terminology and structure of Moldovan tax laws, the DSL looks to eliminate the need to translate complex regulations into generic spreadsheet formulas. This tailored approach aims to minimize the potential for miscalculations and misunderstandings. Moreover, the DSL could be designed to incorporate automated updates, ensuring it remains synchronized with the latest tax code changes. This would alleviate the burden of manually tracking amendments, further simplifying the process for taxpayers. By handling calculations with greater precision and efficiency, the DSL could ultimately help individuals and businesses feel more confident about their tax compliance, providing peace of mind within a typically complicated process [1].

Understanding Moldovan Taxes: A Clearer Path with a DSL

Understanding taxes in Moldova can be daunting due to the complex regulations and jargon like "bracket" and "deduction" [2]. To address this, a DSL is being developed to simplify the process of calculating Moldovan taxes. This DSL will employ familiar terms from the tax code, such as "income" and "dependents," making it easier to use. This approach not only reduces stress but also enhances understanding, enabling users to see how different tax law components affect their dues. The DSL is designed to be intuitive, replacing complex formulas with straightforward language and step-by-step calculations. This transparency helps users stay informed about the latest tax changes, ensuring they use current rates and avoid mistakes. It's more than just a tool for calculation, it's a learning aid that empowers users to manage their taxes more effectively,

potentially assisting others too [3]. Ultimately, the DSL aims to provide peace of mind by offering a clear and reliable method for tax calculations, with the prospect of future integration with official government tax platforms for even greater ease and accuracy.

Grammar

Table 1

Representation of the Meta notation

< >	These are metacharacters used to denote optional elements within a rule. Anything enclosed within angle brackets might appear zero or one time in the corresponding construct.
[x]	Means zero or one occurrence of x, i.e., x is optional; note that brackets in quotes ' ['] ' are terminals.
x * [■]	This signifies zero or more occurrences of the element x. In simpler terms, the element x can appear zero times (absent) or any number of times when constructing the grammar rule.
x [■] + [■]	A comma-separated list of one or more x's.
	This symbol represents choice or alternatives. It separates two or more possibilities within a rule.

```

<program> -> prog: (decl | expr)+ EOF # Program
;
<declaration> -> decl: ID ':' (INT_TYPE | DOUBLE_TYPE) '=' expr
#Declaration
;
<method_call> -> methodCall: (PRINT | TVA) LPAREN expr RPAREN
;
<IF_expr> -> ifExpr:
  IF expr THEN expr (ELSE expr)? # IfExpression
;
<statement> -> expr:
  methodCall # MethodExprCall
  | ifExpr # IfExprStatement
  | expr EQUITYOP expr # EqualityComparison
  | expr RELATIONALOP expr # RelationalComparison
  | expr '*' expr # Multiplication
  | expr '/' expr # Division
  | expr '+' expr # Addition
  | expr '-' expr # Subtraction
  | BOOL # Boolean
  | STRING # String
  | ID # Variable
  | NUM # Number
;
<type> -> INT_TYPE : 'INTEGER';
<type> -> DOUBLE_TYPE : 'DOUBLE';
<bool_literal> -> BOOL : 'TRUE' | 'FALSE';
<relation_comp> -> RELATIONALOP : (GT | LT | GTE | LTE);
<equality_comp> -> EQUITYOP : (EQ | NEQ);
<string_literal> -> STRING : '"' (~[""])* '"';
COMMA : ',' ;
LPAREN : '(' ;
RPAREN : ')' ;
SEMI : ';' ;
<eq_op> -> EQ : '==' ;
<eq_op> -> NEQ : '!=' ;
<rel_op> -> GT : '>' ;

```

```

<rel_op> -> LT : '<' ;
<rel_op> -> GTE : '>=' ;
<rel_op> -> LTE : '<=' ;
IF : 'if';
ELSE : 'else';
THEN : 'then';
PRINT : 'print';
TVA : 'tva';
FUNC : 'function' ;
<alpha> -> ID : [a-z][a-zA-Z0-9_]*;
<digit> -> NUM : [0-9]+ ('.' [0-9]+)? ;
<comment> -> COMMENT : '//' ~[\r\n]* -> skip; // ~ - negation, skip
everything except \r or \n
<whitespaces> -> WS : [ \r\t\n]+ -> skip; // skip whitespaces

```

This is a program created according to grammar rules:

```

i : INTEGER = 5;
print(i);
tva(i);
j : INTEGER = tva(i);
print(j);

```

The program adheres to your defined grammar, with the following structure:

- Declaration (variable i)
- Expression (function call print(i))
- Expression (function call tva(i))
- Declaration (variable j)
- Assignment (variable j)
- Expression (function call print(j))

All program elements (variables, functions, operators) align with the grammar rules.

This is the result:

```

5.0
Value 5.0 has TVA: 1.0
1.0

```

The parse tree analysis (Fig. 1) outlines the structure of the DSL program. The root node 'prog' branches into sequences reflecting the program's flow. It begins with a declaration of variable 'i' as an integer initialized to 5, followed by a print statement outputting 'i'. Next, an expression involving a function call 'tva' takes 'i' as its argument, though the function's behavior remains undefined. Another declaration sets variable 'j' as an integer, initialized via a similar function call. The program concludes with a print statement for 'j', replicating the earlier output structure.

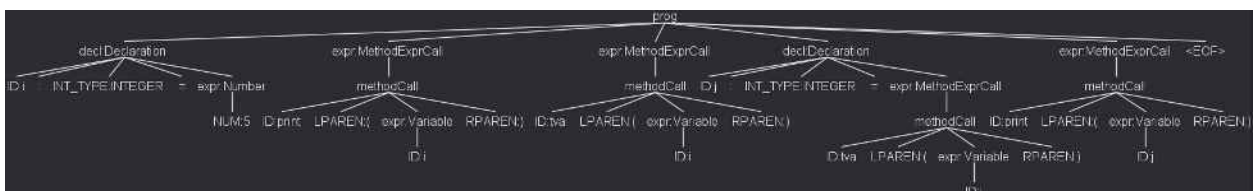


Figure 1. The parse tree.

Based on the tree structure, the code follows the expected grammatical constructs for variable declarations, expressions, function calls, and print statements.

Conclusions

Moldova faces a choice: stick with the outdated, stressful tax system or embrace a new approach through a Domain-Specific Language. This DSL simplifies taxes, using plain language to make them accessible to all, not just experts. By securely integrating with government systems, it would reduce paperwork and ensure fair tax payments, aiding in responsible financial planning for individuals and businesses alike. The shift to a DSL transforms the government's role to a partner, fostering trust through tax transparency. Having defined the DSL's grammar, analyzed the domain, and constructed the parsing tree, this move towards efficient, reliable tax systems demonstrates Moldova's commitment to innovation and business-friendly policies, attracting investment and job creation. Collaboration among technologists, tax professionals, government officials, and the public is crucial to tailor the DSL to Moldova's evolving needs. Embracing this change represents a step towards a future where smart financial decisions are within everyone's reach, marking a new chapter in Moldova's tax narrative.

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PIPELINE – ORIENTED SCRIPTING LANGUAGE FOR DATA PROCESSING

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Abstract. *This article explores the field of pipeline-oriented scripting languages, focusing on the development and use of a Python-based pipeline language. Pipeline-oriented scripting languages offer an approach that will optimize workflows through interconnections between processes. Benefits include optimized workflow, modularity—which refers to the ease of breaking down a system into interconnected modules, clean and simple syntax, efficient use of resources, and full compatibility. The study outlines the key requirements for building large-scale data pipelines and describes existing solutions that meet them. The article addresses common issues in data science, automation, integration, maintainability, and scalability, and highlights the benefits of Python's pipeline language. The designed tool is used to simplify complex data processing tasks. Design considerations for a Python pipeline language include domain-specific abstractions, support for pipeline composition, declarative syntax, integration with an existing ecosystem. The proposal is to develop a special Python pipeline language to improve data processing and analysis.*

Keywords: ANTLR 4, automation, machine learning, Python programming language.

Introduction

In the rapidly changing programming industry, the need for efficient data processing and automation tools continues to grow. Organizations across industries are constantly looking for innovative solutions to streamline workflows, speed up processes, and extract useful insights from massive amounts of data. In the search for optimization, pipeline implementations have emerged as a powerful paradigm that offers a universal approach to organizing complex data workflows. The goal of this article is to provide a comprehensive analysis of pipeline scenarios. The growth of data in recent years has created both opportunities and challenges for organizations around the world. Huge volume, speed and variety of data generated from different sources has required the development of innovative approaches to manage, process and extract value from a variety of information.

A pipeline-oriented scripting language will offer new methods in data workflows conceptualization, design, and execution. Based on the concept of pipelines, these languages will provide a streamlined framework for automating tasks and data transformations. By breaking complex operations into modular building blocks, pipeline-oriented scripting languages enable users to develop flexible, scalable, and efficient data [1].

Domain Analysis

As was said earlier pipeline-oriented scripting languages are important tools for modern data processing, as they successfully streamline complex operations. These languages excel at defining and composing data processing pipelines, breaking down tasks into modular phases to improve flexibility and scalability.

The technique of pipelining is a valuable tool for streamlining program engineering, particularly in the realm of extensive software development. This involves the process of dividing a complex problem into smaller, more manageable stages that can be tackled by multiple design teams

simultaneously, resulting in more efficient and faster development. By designing interfaces between these stages, development teams can work independently with minimal cooperation, ultimately leading to higher-quality software while also reducing development costs by simplifying the problem and allowing developers to specialize in specific areas. For large-scale software projects, the pipeline architecture is the perfect approach to take [2].

Description of Domain Specific Language

A pipeline-oriented scripting language is a programming language which groups functions into interconnected operations to make it easier to create automated processes. The foundation of Domain Specific Language is the idea of pipelines, where data passes through several processing steps, each of which modifies the incoming data in a particular way. To build these pipelines and configure complex data processing operations, the language provides a short and clear syntax for defining these pipelines and organizing complex data processing tasks.

One of the key features of the Pipeline-oriented scripting language is its simplicity. The has an easy-to-read and clean syntax that is designed to be intuitive for users. The language offers a wide set of data formats:

- integers;
- floating-point numbers;
- strings;
- arrays.

Pipeline Composition allows users to create pipelines by combining individual operations or functions. Each stage represents a discrete operation or transformation applied to the input data.

Modularity and reusability divide the problem into smaller groups of reusable components. Encapsulated operations users can transform into individual stages, making it easier to reuse code across projects.

Grammar

For Domain Specific Language, it is crafted a grammar table to provide a clear understanding of its syntax and structure.

Table 1

Reference Grammar

Notation	Meaning
<foo>	foo is a non-terminal
foo	foo is terminal
[x]	zero or one occurrence of x
x^*	zero or more occurrences of x
x^+	a comma-separated list of one or more x's
{ }	large braces for grouping
	separates alternatives

To investigate a programming language mathematically a mechanism is required to characterize it. English is insufficient due to the informal description, imprecision and ambiguity, because of it a grammar, with a set of notation is introduced [3].

Notation:

```

<prog> := <pipeline def> <var def> <pipe block> EOF;
<pipeline flag> := 'pipe';
<arg> := INT | CHAR | STRING | FLOAT | VAR NAME;
20
<args> := <arg> ( <comma> <space> * <arg> )*;
<function args> := <left par> <args> <right par> ;
<function name> := VAR NAME;
<pipeline def> := <pipeline flag> <space> <function name> <left
par> <right par> <two points>

```



```

| <pipeline flag> <space> <function name> <function args> <two
points> ;
<single pipe symbol> := ' |>' ;
<double pipe symbol> := ' ||>' ;
<triple pipe symbol> := ' |||>' ;
<pipe> := <tab> <single pipe symbol> <space> <function name> <left
par> <right par>
| <tab> <double pipe symbol> <space> <function name> <left par>
<right par>
| <tab> <triple pipe symbol> <space> <function name> <left par>
<right par>
| <tab> <single pipe symbol> <space> <function name> <function
args>
| <tab> <double pipe symbol> <space> <function name> <function
args>
| <tab> <triple pipe symbol> <space> <function name> <function
args> ;
<pipe block> := <pipe> ( <pipe> ) * ;
<tab> := ' ' ;
<space> := ' ' ;
<left par> := ' (' ;
<right par> := ' ) ' ;
<comma> := ' , ' ;
<two points> := ' : ' ;
<var name> := VAR NAME | CHAR ;
<var def> := <tab> <var name> ;
NEWLINE : [ \r \n ] + -> skip ;
INT : [ 0-9 ] + ;
CHAR : [ a-zA-Z ] ;
STRING : [ ' ] [ a-zA-Z ] + [ ' ] ;
FLOAT : [ 0-9 ] + [ . ] [ 0-9 ] + ;
VAR NAME : [ a-zA-Z ] [ a-zA-Z0-9 ] * ;
COMMENT : '# ' ( ' \r ' | ' \n ' ) * -> skip ;

```

Parsing Example

ANTLR, short for ANother Tool for Language Recognition, is a robust parser generator used to construct parsers, interpreters, compilers, and translators for various programming languages and domain-specific languages. It operates by taking a formal grammar of the language as input and producing a parser for that language in target languages such as Java, C#, Python, and others. Its advantages include its language-agnostic nature, support for LL parsing allowing for more expressive grammars, automatic generation of Abstract Syntax Trees for parsed input, detailed error reporting facilitating easier debugging, seamless integration with IDEs and development tools, and a large and active community providing support and resources for users.

```

1 pipe pipeline(x):
2     x
3     ▷ firstOperation()
4     |▷ secondOperation()

```

Figure 1. Code example

The code in this image will be parsed by ANTLR built parser, which was built based on the grammar we created. It shows a valid code block in our DSL, featuring pipelines. The pipeline

is declared with a variable as an argument. Each operation is added on a new line with proper tabulation. Pipeline operations, symbolized, declare and chain operations with compatible variable types.

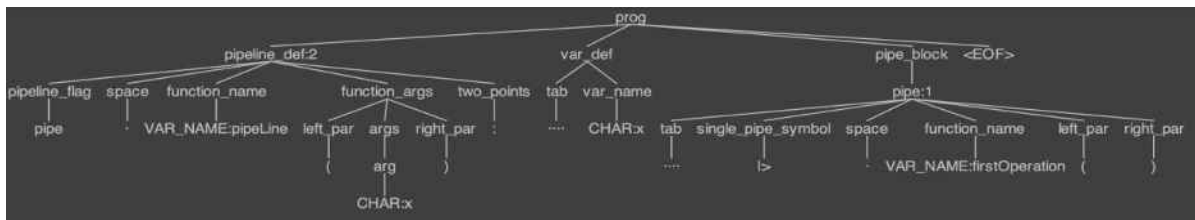


Figure 2. Parsing tree example

In this parsing example, it is demonstrated how a pipeline is parsed. Components of this script:

1. Pipe Declaration: The script begins with the declaration of a pipe function named pipeLine. This pipe takes a single parameter x.
2. Pipeline Operator (|>): This operator is used to interconnect operations within the pipeline, where the output of one operation serves as the input to the next.
3. Operation: `firstOperation()`, is applied to the input parameter x. This operation represents a transformation or action that is performed on the input data.

Conclusions

The proposed Python pipeline language offers a clean and intuitive syntax, facilitating the construction of intricate data processing pipelines. The key benefit is its ability to streamline complex data workflows by organizing tasks into interconnected pipelines. By breaking operations down into modular building blocks, these languages enable users to develop flexible, scalable, and maintainable solutions tailored to their specific requirements. It is just one of many instruments which is developed to simplify complex tasks. It makes complex tasks more simple for a wider range of users.

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DOMAIN SPECIFIC LANGUAGE FOR DATA STRUCTURE MANIPULATION

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Abstract. *This paper presents ManipulaPy, a new Domain Specific Language. The domain specific language that is being developed for the purpose of manipulating data structures is specifically designed to meet the needs of different software development industries. The document provides users with a comprehensive grasp of the operation of the framework by explaining the grammatical and syntactical subtleties of ManipulaPy as well as the details of its implementation. Furthermore, the research presents interesting possibilities for ManipulaPy's improvement and future development. The intention is to develop a language with strong abstractions, easy-to-understand syntax, and effective primitives for data manipulation.*

Keywords: *analysis, data structures, domain-specific language, grammar, syntax, parser.*

Introduction

Data structures play a fundamental role in organizing and managing data efficiently in software development. Among these, linear data structures hold particular significance due to their sequential arrangement of elements. The project will involve comprehensive domain analysis to understand the requirements and operations needed for numerical data manipulation within linear data structures. Following this, a grammar will be created to define the syntax, ensuring clarity and conciseness in expressing data manipulation tasks.

Through this Domain Specific Language (DSL), the aim is to provide developers with a tool for efficiently manipulating numerical data within linear data structures, thereby enhancing code quality and facilitating software development in various domains.

Domain Analysis

Data structures are fundamental components in computer science that enable efficient organization, storage, and manipulation of data. They provide a way to represent complex data in a structured manner, allowing for easy access and modification [1], as shown in Fig. 1. The importance of data structures lies in their ability to optimize various operations on data, such as searching, sorting, and retrieving. By choosing the right data structure for a given problem, developers can significantly improve the performance and efficiency of their software. In this project, the goal is to harness the power of data structures to provide users with a simple yet powerful tool for manipulating linear data [2].

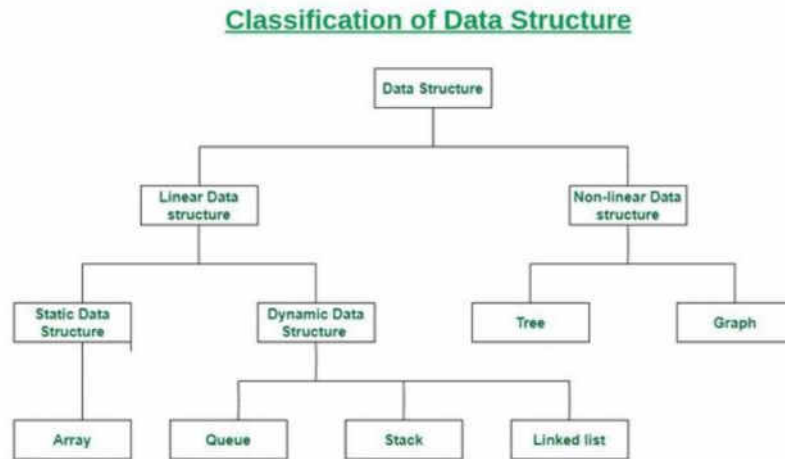


Figure 1. Representation of Classification of Data Structures

Array

An array is a collection of items of the same data type stored at contiguous memory locations. It is characterized by having homogeneous elements, meaning all elements within an array must be of the same data type. In most programming languages, elements in an array are stored in contiguous (adjacent) memory locations, fig. 2 [1].

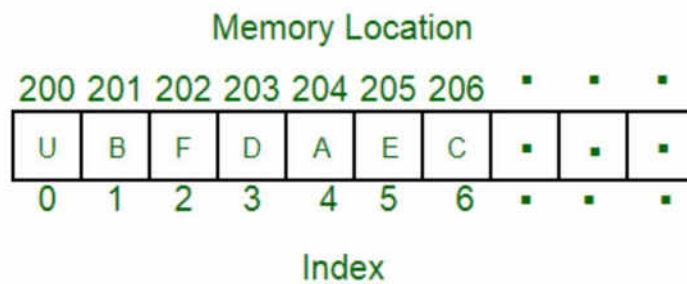


Figure 2. Representation of Array

Linkes List

A Linked List is a linear data structure consisting of a chain of nodes, each containing data and a reference to the next node. Unlike arrays, linked list elements are not stored at contiguous memory locations.

Each element in a linked list, or node, contains two components: the actual data or value associated with the element, and a reference or pointer to the next node in the linked list, fig. 3 [1].

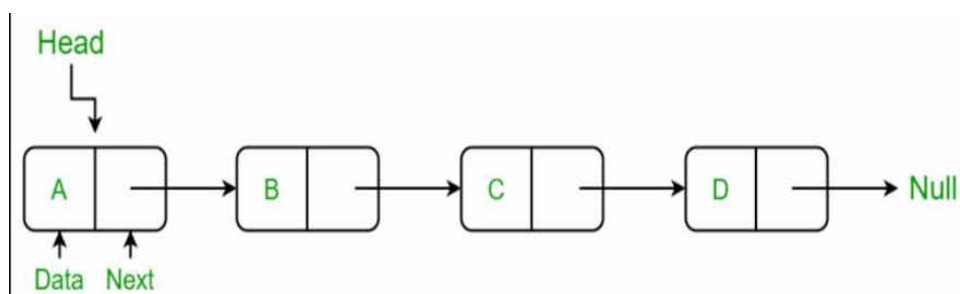


Figure 3. Representation of Linked List

Stack Data Structure

A stack is a linear data structure that follows the Last-In-First-Out (LIFO) principle. It can be of two types: fixed-size stack and dynamic-size stack. In a fixed-size stack, the size is predetermined and cannot be changed during runtime, while a dynamic-size stack can grow or shrink dynamically as elements are added or removed, fig. 4 [1].

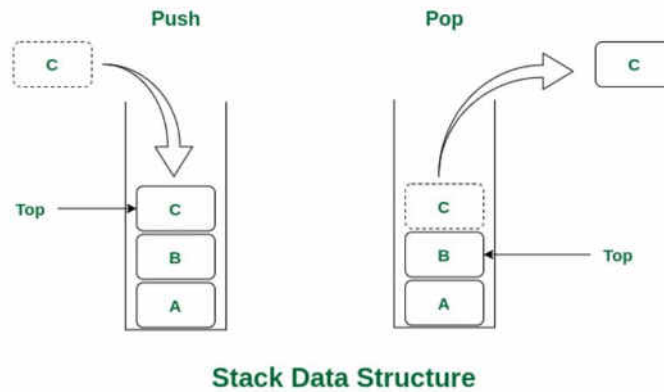


Figure 4. Representation of Stack Data Structure

Grammar

To establish the framework of DSL aimed at facilitating table manipulation within a Python environment, a detailed reference grammar is outlined. This grammar delineates the structural composition of the language, dictating the assembly of statements via the utilization of reserved keywords, data types, and previously articulated syntax. The grammar is articulated using BNF, a formal notation system employed for describing language syntax with precision and clarity [3].

The grammar consists of various production rules, each defining a symbol in relation to other symbols and literals. Non-terminal symbols, indicated by <symbol>, can be decomposed into sequences comprising terminal symbols (keywords and literals) and additional non-terminal symbols. Terminal symbols are identified by lowercase notation for keywords or designated symbols (e.g., (,), *) [4].

```

grammar DataStructureDSL;
// Parser rules
program: statement*;
statement: arrayStatement | linkedListStatement |
stackStatement | queueStatement;
arrayStatement: 'ARRAY' '[' INT (',' INT)* ']'
(insertArray | deleteArray | searchArray | sortArray)? ';';
linkedListStatement: 'LINKEDLIST' (insertLinkedList | deleteLinkedList |
searchLinkedList)? ';';
stackStatement: 'STACK' (pushStack | popStack | topStack |
isEmptyStack)? ';';
queueStatement: 'QUEUE' (enqueueQueue | dequeueQueue |
peekQueue | isFullQueue | isEmptyQueue)? ';';
// Array operations
insertArray: 'INSERT' '[' INT ']' 'INTO' 'ARRAY' '[' INT ']' ';';
deleteArray: 'DELETE' 'FROM' 'ARRAY' '[' INT ']' ';';
searchArray: 'SEARCH' 'ARRAY' '[' INT ']' 'FOR' INT ';';
sortArray: 'SORT' 'ARRAY' '[' INT ']' ('ASCENDING' | 'DESCENDING') ';';
// Corrected ascending/descending
// Linked list operations
insertLinkedList: 'INSERT' 'INTO' 'LINKEDLIST' '[' INT ']'
'VALUE' INT ';';
deleteLinkedList: 'DELETE' 'FROM' 'LINKEDLIST' '[' INT ']' ';';
searchLinkedList: 'SEARCH' 'LINKEDLIST' '[' INT ']' 'FOR' INT ';';
// Stack operations
pushStack: 'PUSH' INT 'TO' 'STACK' ';';
popStack: 'POP' 'FROM' 'STACK' ';';
topStack: 'TOP' 'ELEMENT' 'OF' 'STACK' ';';
isEmptyStack: 'CHECK' 'IF' 'STACK' 'IS' 'EMPTY' ';';

```



```
// Queue operations enqueueQueue: 'ENQUEUE' INT 'TO' 'QUEUE' ','; dequeueQueue: 'DEQUEUE' 'FROM' 'QUEUE' ','; peekQueue: 'PEEK' 'FRONT' 'ELEMENT' 'OF' 'QUEUE' ','; isFullQueue: 'CHECK' 'IF' 'QUEUE' 'IS' 'FULL' ','; isEmptyQueue: 'CHECK' 'IF' 'QUEUE' 'IS' 'EMPTY' ',';
```

This reference grammar methodically outlines the DSL's syntax, elucidating the construction of statements pertinent to data structure manipulation. Each rule encapsulates distinct facets of the language, from the articulation of data structures and operations to the processes of data insertion, deletion, and querying.

Lexical Consideration

When designing the lexical elements of the DSL grammar, it's important to consider the following aspects:

Keywords: The DSL uses keywords such as array, linked list, stack and queue to define different data structures and operations. Ensure these keywords are clearly defined and reserved for their specific purposes.

Identifiers: Define rules for identifiers, such as variable names or labels within the DSL. These rules should specify valid characters and any naming conventions that need to be followed.

Literals: Determine the types of literals supported in the DSL, such as integers represented by the INT rule. Ensure that the grammar adequately handles these literals.

Whitespace Handling: Specify rules for handling whitespace characters like spaces, tabs, and newlines. In the provided grammar, whitespace is ignored using the WS rule.

Comments: Define rules for comments to enhance readability and allow users to add explanatory notes. In this DSL, comments are defined using the COMMENT rule.

Special Symbols: Identify and define rules for special symbols or punctuation marks used in the DSL syntax, such as brackets, commas, or semicolons.

Error Handling: Consider how errors and invalid input should be handled in the DSL. Define rules for reporting errors and providing meaningful feedback to users.

Reserved Words: Determine if there are any words that should be reserved and cannot be used as identifiers. These may include language keywords or future extensions.

Parsing

Parsing is a crucial process in understanding and interpreting the DSL grammar for data structure manipulation. It involves several key components that work together to transform raw code into a structured representation.

After Lexical Analysis, Syntax Analysis takes place, performed by the Parser. This phase involves analyzing the token stream produced by the lexer against the grammar rules of the DSL. The Parser ensures syntactic correctness and constructs a hierarchical structure known as a parse tree or AST. This structure captures the syntactic organization of the program and its nested relationships [5].

Lexical Analysis: The lexer converts the code into tokens:

```
Keyword('create'), Identifier('array'), Identifier('myArray'), Keyword('of'), Identifier('size'),  
Number('5'), Semicolon(';'),  
Keyword('insert'), Number('10'), Keyword('into'), Identifier('array'),  
Identifier('myArray'), Keyword('at'), Keyword('index'), Number('2'), Semicolon(';'),  
Keyword('delete'), Keyword('from'), Identifier('array'), Identifier('myArray'),  
Keyword('at'), Keyword('index'), Number('3'), Semicolon(';'),  
Keyword('search'), Identifier('array'), Identifier('myArray'), Keyword('for'),  
Keyword('value'), Number('8'), Semicolon(';')
```

Consider the following code snippet in our data structure DSL: create array myArray of size 5; insert 10 into array myArray at index 2; delete from array myArray at index 3;

search array myArray for value 8;

Lexical Analysis: The lexer dissects the code into tokens:

Keyword('array'), LeftSquareBracket('[', Number('5'), Comma(','), Number('10'), Comma(','), Number('15'), Comma(','), Number('20'), RightSquareBracket(']'), Keyword('search'), Keyword('array'), LeftSquareBracket('[', Number('3'), RightSquareBracket(']'), Keyword('for'), Number('15'), Semicolon(';')

Consider the given code snippet within our data structure DSL: ARRAY [5, 10, 15, 20] SEARCH ARRAY [3] FOR 15; Lexical Analysis:

The lexer tokenizes the code as follows:

Keyword('array'), LeftSquareBracket('[', Number('5'), Comma(','), Number('10'), Comma(','), Number('15'), Comma(','), Number('20'), RightSquareBracket(']'), Keyword('search'), Keyword('array'), LeftSquareBracket('[', Number('3'), RightSquareBracket(']'), Keyword('for'), Number('15'), Semicolon(';') Syntax Analysis:

The parser examines the token stream against the grammar rules and constructs an AST [6]. A simplified representation is as follows:

Program

[ArrayDeclaration, [Number: '5', Number: '10', Number: '15', Number: '20']
[SearchInArray, [Index: Number: '3', Value: Number: '15']]

The root of the tree, fig. 5, is a Program node, with each statement represented as a child node. This parsing example illustrates how the DSL code is parsed and understood by the computer, transitioning from a sequence of tokens to a structured representation that captures the hierarchical nature of data structure manipulation operations. The AST represents the syntactic structure of the DSL code, facilitating further analysis, interpretation, and execution of the program.



Figure 5. Representation of Parsing Tree

Conclusions

The domain analysis provides a comprehensive understanding of the challenges inherent in software development, particularly concerning the manipulation and presentation of data structures. It highlights the critical role played by specialized tools in addressing issues such as efficiency, scalability, complexity, flexibility, and correctness. The analysis reveals the limitations of conventional programming languages in providing built-in support for efficient data manipulation, leading to cumbersome and error-prone code that impacts developers' productivity and software quality.

In response to these challenges, the proposed DSL for data structure manipulation emerges as a promising solution. By offering specialized constructs tailored to the manipulation of numerical data, the DSL aims to streamline common data manipulation tasks, empowering developers to focus on core application logic and functionality. Through intuitive syntax, powerful abstractions, and graphical representations, the DSL seeks to revolutionize the way developers interact with and manage data structures, fostering a culture of innovation and collaboration across diverse domains within the software development landscape.

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DOMAIN-SPECIFIC LANGUAGE FOR CITATION GENERATION

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Abstract. *In this paper, a new Domain Specific Language called CiteGen is proposed, which will make it easier to create citations in a variety of forms. The document explains the grammatical and syntactical nuances of CiteGen as well as the specifics of its implementation, giving readers a thorough understanding of the framework's functionality. In addition, the study suggests future areas for CiteGen development and advances possible paths for its improvement. CiteGen is marketed as an easy-to-use tool that provides writers with a productive way to automate citation operations.*

Keywords: analysis, citations, grammar, implementation, academic research

Introduction

Scholarly conversation is a fundamental component of information sharing, helping to spread discoveries, advances, and new ideas throughout different fields. The careful and moral inclusion of citations, which not only recognize the contributions of others but also provide writers' claims context and validity, is essential to this process. Making citations is a difficult undertaking, though, as there are many distinct citation styles to choose from and formatting requirements set forth by various academic organizations and publication standards. This Domain-Specific Language seeks to improve accuracy, expedite citation processes, and maintain compliance with established citation standards, particularly those delineated by reputable organizations. Additionally, this paper clarifies the DSL's grammar, lexical quirks, semantic rules, data structures, and control methods so that users can effectively utilize it. It also offers techniques for structuring mathematical formulas in the DSL such that mathematical statements are consistent and understandable across academic writings.

Domain Analysis

A variety of genres are included in scientific writing, such as reviews, technical reports, and research papers. It is distinguished by objectivity, objectivity, and clarity, with an emphasis on providing research findings and bolstering claims with proof from reliable sources. Quotations can be used to bolster claims, offer proof, or clarify ideas. Quoting should be done sparingly, though, and whenever feasible, information should be summarized or paraphrased rather than directly quoted. Quoted content needs to be correctly acknowledged to the original author, adhering to the guidelines specified by the selected citation style. Maintaining coherence and flow in scientific writing requires the smooth integration of quotes. Contextualization, signal words, and transitions aid in introducing and tying quotes to the body of the text. It is best to use quotes seamlessly, avoiding sudden or jerky changes from the writer's words to the cited content. The goal of a Language for auto-generating quotes for scientific articles is to make the process of adding quotes to research manuscripts more efficient. Functionalities for choosing pertinent quotes from source materials, formatting quotes in accordance with the selected citation style, and incorporating quotes into the text with the proper credit and context would all need to be included in this DSL. Researchers can maintain uniformity in their quotation methods and save time by

implementing automation. Although there aren't always international standards that are only for quoting in scientific works, a number of academic and publishing organizations offer citation and reference criteria that cover the use of quotes.

Table 1 presents five popular standards for citation and their description.

Table 1

General overview of citation standards

American Psychological Association	When quoting passages shorter than 40 words, enclose them in quotation marks and seamlessly integrate them into your own writing. When formatting quotations of 40 words start the block quotation on a new line and indent the entire block by 0.5 inches from the left margin [1].
Modern Language Association	When quoting a source in paper, it will include the author's last name and the page number of the quote. In the bibliography, the entry for the source typically begins with the author's last name, which corresponds to the name used in the parenthetical reference [2].
Chicago Manual of Style	For in-text citations in Chicago style, Notes and Bibliography formatting necessitates the use of footnotes and endnotes to acknowledge various sources utilized in the work. When referencing a source within the text, a roman numeral is inserted at the end of the borrowed information as a superscript. This number corresponds to a footnote or endnote [3].
Council of Science Editors	In-text citations in CSE is followed a simple numbering system, where a superscripted number at the end of a clause or sentence denotes external source material. These numbers correspond to entries in the References list at the end of the document [4].
ISO 690:2012	ISO 690:2012 offers comprehensive guidelines for referencing various sources, including electronic documents. It provides a structured framework for organizing citation elements like author names, publication titles, dates, and page numbers. ISO 690:2012 offers guidelines for author name presentation, formatting publication titles, necessary publication details, formatting URLs or DOI links for electronic resources, punctuation, and capitalization within citations [5].

The development of a software language that generates the source of quotes in scientific texts based on user input involves several key stakeholders. Each stakeholder plays a crucial role in ensuring the success, usability, and ethical use of the software. Some stakeholders, as well as the target groups of this Domain Specific Languages are developers, educational institutions, publishers, standard organizations and quality assurance teams. The time-consuming aspect of manually formatting citations is one of the main issues that needs to be resolved with automated citation production. Writing precise citations in the required format can be a tedious effort for academics, students, and writers, and it frequently requires careful attention to detail. This procedure entails recognizing different sources, including books, journal articles, websites, and more, and then following the formatting guidelines specified by the selected citation style. By automating this procedure, writers can greatly cut down on the time and effort needed, spending more of their time on writing and research and less time on formatting details. The primary goal of the DSL is to enhance the efficiency of the citation process for researchers, academics, and writers. By automating the generation of citations, users will be able to save time and effort, allowing them to focus more on their research and writing tasks. The Domain Specific Language will ensure the accuracy and consistency of citations by adhering to established citation standards.

By following predefined rules and formatting guidelines, the Domain Specific Language will minimize errors and inconsistencies in citation formatting, thereby improving the quality and credibility of scholarly documents. The Domain Specific Language will provide flexibility in terms of citation styles and formatting options. Users will have the ability to choose from a range of citation styles commonly used in academic writing, and customize citation elements such as author names, publication dates, and page numbers to suit their specific requirements.

Grammar

An example of a grammar that could help create the Domain Specific Language [6] for citation generation is given below.

Table 2 presents meta-notations used in grammar definition.

Table 2

Meta – notations	
<foo>	Means foo is a non-terminal symbol
foo	(in bold font) means foo is a terminal i.e., a token or a part of a token
[x]	Means zero or one occurrence of x i.e., x is optional. Note that '[' and ']' are terminal
x*	Means zero or more occurrences of x
x ⁺ ,	A comma-separated list of one or more x's
{ }	Large braces are used for grouping; note that braces in quotes '{ ' ' } ' are terminals.
	Separate alternatives

```

<program> ::= main <block>
<block> ::= <var_decl>* <statement>*
<var_decl> ::= <type> <id>+,
<type> ::= int | string | bool | dict
<statement> ::= <expr> | if <expr> : <block> [else : <block>] | for <id> in <expr> : <block> |
break | <block> | <method_call>
<method_call> ::= <method_name>( [<expr>*] )
<method_name> ::= <id> | CiteAPA | CiteMLA | CiteCMS | CiteCSE | CiteIEEE | CiteISO
<expr> ::= <method_call> | <literal> | [<type>] <expr> <operation> <expr> | print(<expr>) |
<id>
<operation> ::= <arithm_op> | <rel_op> | <eq_op> | <cond_op> | <assignment_op>
<arithm_op> ::= + | - | * | /
<rel_op> ::= < | <= | > | >=
<eq_op> ::= == | !=
<cond_op> ::= and | or
<assignment_op> ::= = | +=
<literal> ::= <int_literal> | <char_literal> | <bool_literal> | <string_literal>
<id> ::= <char> { <char_literal> | <int_literal> }*
<char> ::= a-zA-Z
<digit> ::= 0-9
<int_literal> ::= <digit><digit>*
<bool_literal> ::= True | False
<char_literal> ::= ' <char> '
<string_literal> ::= " <char>* "
<dict> ::= <literal> : <literal>

```

Some important aspects of the grammar are:

1. All keywords are lowercase. Keywords and identifiers are case-sensitive. For example, if is a keyword, but IF is a variable name; foo and Foo are two different names referring to two distinct variables.
2. The reserved keywords are: **and, bool, break, CITE, char, def, dict, else, False, for, if, in, int, or, return, string, True, print, CiteAPA, CiteMLA, CiteCMS, CiteCSE**
3. Comments are started with # and are terminated by the end of the line
4. White space may appear between any lexical tokens. White space is defined as one or more spaces, tabs, page and line-breaking characters, and comments.
5. Keywords and identifiers must be separated by white space, or a token that is neither a keyword nor an identifier.
6. String literals are composed of 's enclosed in double quotes. A character literal consists of an enclosed in single quotes. Numbers are 32 bits signed. That is, decimal values between -2147483648 and 2147483647. Dictionary represents a list of pairs (key, value).
7. A is any printable ASCII character (ASCII values between decimal value 32 and 126, or octal 40 and 176) other than quote ("), single quote ('), or backslash (\), plus the 2-character sequences" \" to denote quote," \' to denote single quote,\" \\ to denote backslash,\" \t to denote a literal tab, or\" \n to denote newline.

Parsing tree

In computer science and linguistics, a parsing tree—also called a syntax tree or a derivation tree - is a basic idea. It functions as a graphic representation of a string of symbols' syntactic structure as determined by a formal language [7].

Bellow are shown a code snippet according to the grammar described previously and its parsing tree represented in Fig.1.

```

start
string[3] quotes
quotes = ["First Quote", "Second Quote", "Third Quote"]
for quote in quotes:
    CiteMLA(quote, "book", "John Doe")
    
```

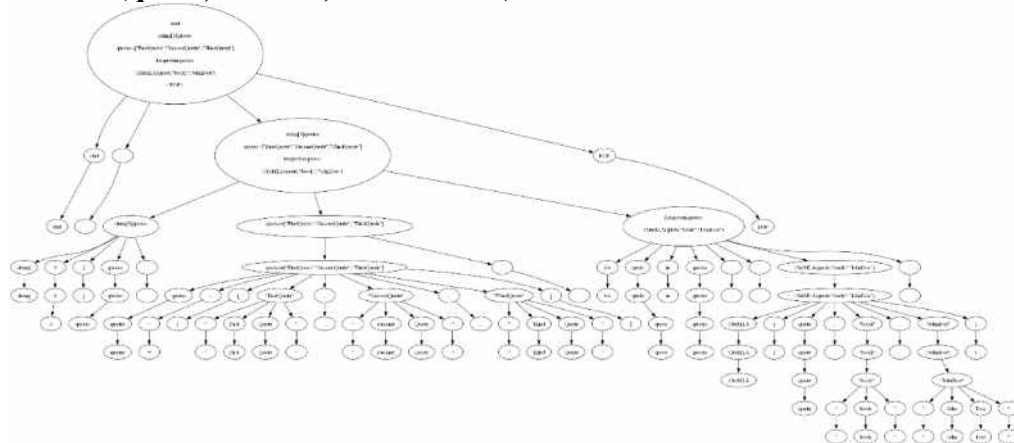


Figure 1. Example of parsing tree

Conclusion

To sum up, this thorough investigation explores the domain analysis of a language designed specifically to automate the creation of citations in scientific publications. It covers essential elements of scientific writing, citation standards from reputable organizations like APA, MLA, CMS, and CSE, and emphasizes the need of moral quoting procedures. The project intends to improve efficiency, correctness, and integration in academic and scientific writing processes by

optimizing citation creation, hence meeting the requirements of a wide range of users in many disciplines. Additionally, the document offers thorough explanations of the Domain-Specific Language's syntax, lexical considerations, semantic rules, data kinds, and control statements. These rules guarantee lucidity, accuracy, and consistency, empowering users to make the most of the DSL and improve efficiency and honesty in academic writing.

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DSL FOR BUILDING FRACTALS

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Abstract. *The Scientific Conference paper introduces a Domain Specific Language (DSL) dedicated to simplifying fractal geometry through automated coding. This language aims to make fractal generation easier for both beginners and experts by providing intuitive syntax and functionalities for defining shapes and parameters. The DSL's development involved domain analysis, design principles, and iterative cycles. Results show its effectiveness in creating intricate fractal patterns for various purposes such as art, education, and science. Potential applications include artistic expression, educational exploration, and integration into scientific simulations. This project contributes to computational geometry, offering a valuable tool for fractal enthusiasts and researchers.*

Keywords: *Fractals, Domain Specific Language (DSL), Computational Geometry, Syntax and Semantics*

Introduction

Fractals, intricate geometric structures characterized by self-similarity, have fascinated humanity for centuries, from ancient African architecture to modern art movements. Their ubiquity in nature and art underscores their profound influence across disciplines. In this paper, the intersection of fractal geometry with computer science is explored, emphasizing its relevance in contemporary research and creative endeavors.

Fractals, with their inherent ability to exhibit self-similarity across varying scales, serve as a captivating lens through which the convergence of art, nature, and scientific inquiry is explored. As one navigates through the rich tapestry of fractal imagery and its historical significance, the symbiotic relationship between mathematical abstraction and human creativity is unveiled. From the ancient origins of fractal motifs in indigenous architectural marvels to the avant-garde experimentation of 20th-century Surrealist artists, the allure of fractals has transcended cultural boundaries, captivating the imagination of scholars and artisans alike.

In this interdisciplinary exploration, the researchers aim to shed light on the transformative potential of fractal geometry within the realm of computer science. Through an in-depth analysis of fractal analysis techniques and their applications in data science, the study elucidates how these geometric marvels serve as a powerful tool for unraveling the complexities of real-world datasets. Moreover, the paper delves into the realm of domain-specific languages tailored for fractal generation, envisioning a future where intuitive programming interfaces empower individuals across diverse backgrounds to engage in the creation and exploration of fractal art and scientific inquiry.

Fractals in Art and Nature:

The historical and artistic significance of fractals is analyzed, tracing their roots in traditional African architecture to their adoption by Surrealist artists like Max Ernst. Notably, it discusses the breakthrough analysis of Jackson Pollock's works, highlighting how fractals captivate viewers and contribute to stress reduction.

Fractal Analysis and Data Science:

Fractal analysis intersects with data science, offering insights into complex datasets through techniques like feature extraction, data visualization, and time series analysis. It explores how fractal dimensions enhance machine learning models and aid in understanding intricate data structures.

Domain-Specific Language (DSL) for Fractal Geometry:

The proposal suggests developing a user-friendly DSL tailored for fractal generation, addressing the limitations of existing tools. The DSL aims to democratize fractal exploration by offering intuitive syntax, comprehensive grammar, and versatile features for customization.

Implementation Approach:

The provided DSL would be implemented as an internal DSL, seamlessly integrated with existing programming languages. Leveraging language design principles, the focus is on performance and scalability to handle complex fractal computations efficiently.

Impact and Benefits:

The development of a comprehensive Fractal DSL promises to revolutionize artistic expression, scientific exploration, and educational advancement. By lowering the entry barrier, the DSL empowers users across disciplines to engage meaningfully with fractal geometry, fostering innovation and interdisciplinary collaboration.

Grammar

The provided grammar is a context-free grammar (CFG) designed to describe the syntax of a programming language used for creating fractals. Fractals are complex geometric shapes that can be split into parts, each of which is a reduced-scale copy of the whole. This grammar defines the structure of programs written in this language, specifying how statements, commands, function calls, and conditional statements are organized. It facilitates the parsing and interpretation of code written in the fractal programming language.

Table 1

Grammar notations

Notation	Description
<foo>	non-terminal symbol
foo	terminal symbol in the grammar
	separates alternative choices for a production rule
→	denote a production rule

$$G = (V_N, V_T, P, S)$$

V_N - syntactic categories or abstract components of the language's grammar.

V_T - terminal symbols represent the basic building blocks of the language, such as keywords, literals, punctuation marks, and logical operators

P - production rules define how the non-terminal symbols can be replaced by sequences of terminal and non-terminal symbols.

S - the start symbol denotes the beginning of a program written in the fractal programming language

$$V_N = \{ \langle \text{program} \rangle, \langle \text{statement} \rangle, \langle \text{command} \rangle, \langle \text{function_call} \rangle, \langle \text{arguments} \rangle, \langle \text{shape_function} \rangle, \langle \text{recursive_function} \rangle, \langle \text{value} \rangle, \langle \text{string} \rangle, \langle \text{number} \rangle, \langle \text{shape} \rangle, \langle \text{function_name} \rangle, \langle \text{parameter_list} \rangle, \langle \text{parameter} \rangle, \langle \text{if_statement} \rangle, \langle \text{else_statement} \rangle, \langle \text{comparison} \rangle, \langle \text{logical_operator} \rangle \}$$

$V_T = \{ \text{size, color, background, speed, shape, depth, points, length, direction, edges, draw, 'STRING', 'NUMBER', '(', ')', ',', 'if, else, '==', '!=', '<', '>', '<=', '>=', and, or} \}$

$P = \{ \langle \text{program} \rangle \rightarrow \langle \text{statement} \rangle \mid \langle \text{statement} \rangle \langle \text{program} \rangle$
 $\langle \text{statement} \rangle \rightarrow \langle \text{command} \rangle \mid \langle \text{function_call} \rangle \mid \langle \text{if_statement} \rangle$
 $\langle \text{command} \rangle \rightarrow \text{size} \langle \text{number} \rangle \mid \text{color} \langle \text{string} \rangle \mid \text{background} \langle \text{string} \rangle$
 $\mid \text{speed} \langle \text{number} \rangle \mid \text{shape} \langle \text{string} \rangle \mid \text{depth} \langle \text{number} \rangle$
 $\mid \text{points} \langle \text{number} \rangle \mid \text{length} \langle \text{number} \rangle \mid \text{direction} \langle \text{number} \rangle$
 $\mid \text{edges} \langle \text{number} \rangle \mid \text{draw}$
 $\langle \text{function_call} \rangle \rightarrow \langle \text{shape_function} \rangle \mid \langle \text{recursive_function} \rangle$
 $\langle \text{shape_function} \rangle \rightarrow \langle \text{function_name} \rangle '(\langle \text{arguments} \rangle)'$
 $\langle \text{recursive_function} \rangle \rightarrow \text{draw} '(\)'$
 $\langle \text{arguments} \rangle \rightarrow \langle \text{parameter_list} \rangle \mid \varepsilon$
 $\langle \text{parameter_list} \rangle \rightarrow \langle \text{parameter} \rangle \mid \langle \text{parameter} \rangle ',' \langle \text{parameter_list} \rangle$
 $\langle \text{parameter} \rangle \rightarrow \langle \text{value} \rangle$
 $\langle \text{value} \rangle \rightarrow \langle \text{number} \rangle \mid \langle \text{string} \rangle$
 $\langle \text{string} \rangle \rightarrow \text{'STRING'}$
 $\langle \text{number} \rangle \rightarrow \text{'NUMBER'}$
 $\langle \text{shape} \rangle \rightarrow \text{triangle} \mid \text{koch} \mid \text{dragon} \mid \text{capital} \mid \text{fern} \mid \text{tree} \mid \text{star} \mid \text{snowflake} \mid \text{gardi} \mid \text{spiral}$
 $\langle \text{function_name} \rangle \rightarrow \langle \text{shape} \rangle$
 $\langle \text{if_statement} \rangle \rightarrow \text{if} \langle \text{comparison} \rangle \langle \text{logical_operator} \rangle \langle \text{comparison} \rangle \langle \text{command} \rangle$
 $\langle \text{else_statement} \rangle$
 $\langle \text{else_statement} \rangle \rightarrow \text{else} \langle \text{command} \rangle \mid \varepsilon$
 $\langle \text{comparison} \rangle \rightarrow \langle \text{value} \rangle \text{'==' } \langle \text{value} \rangle \mid \langle \text{value} \rangle \text{'!=' } \langle \text{value} \rangle \mid \langle \text{value} \rangle \text{'<' } \langle \text{value} \rangle$
 $\mid \langle \text{value} \rangle \text{'>' } \langle \text{value} \rangle \mid \langle \text{value} \rangle \text{'<=' } \langle \text{value} \rangle \mid \langle \text{value} \rangle \text{'>=' } \langle \text{value} \rangle$
 $\langle \text{logical_operator} \rangle \rightarrow \text{and} \mid \text{or} \}$

$S = \langle \text{program} \rangle$

Program showcase

The following program showcases the creation of a snowflake fractal with ten edges, each composed of three smaller edges. The snowflake is rendered in yellow against a green background. The canvas size is set to 800 pixels in width and length, providing ample space for the intricate design. By setting the speed parameter to 0, the turtle drawing the fractal moves at the fastest possible speed, ensuring efficient rendering. Finally, the command "draw 0" specifies that the fractal should indeed be drawn, bringing the intricate snowflake pattern to life on the canvas.

```

size 800
color 'yellow'
background 'green'
shape 'snowflake'
depth 3
edges 10
speed 0
draw 0

```

Parsing tree

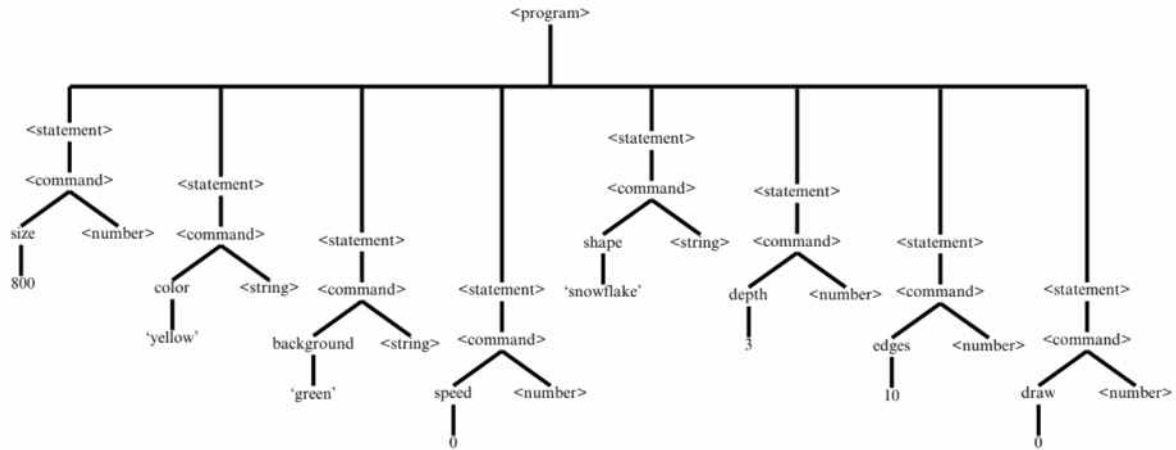


Figure 1. Parsing tree

The parsing tree delineates a series of statements, each encapsulating a specific command for defining and rendering fractals. These statements are integral components of a DSL designed to streamline the creation process while ensuring flexibility and expressiveness. Here's a breakdown of the key elements represented in the parsing tree: **<program>**: This serves as the root of the parsing tree, indicating the initiation point for defining fractals. It orchestrates a sequence of statements that collectively configure the properties and characteristics of the fractal to be generated. **<statement>**: Within the parsing tree, each statement encapsulates a distinct command responsible for configuring various aspects of the fractal. These statements collectively define the fractal's attributes, including its size, color, background, speed, shape, depth, edges, and the drawing action itself. **<command>**: The commands embedded within each statement dictate specific actions to be performed during fractal generation. These commands accept parameters such as numerical values or string inputs, enabling users to customize fractal attributes according to their preferences.

Attributes: **Size:** Specifies the size of the fractal, influencing its overall dimensions. **Color:** Determines the color scheme applied to the fractal, enhancing its visual appeal. **Background:** Sets the background color against which the fractal is rendered, providing contrast and context. **Speed:** Regulates the rendering speed of the fractal, facilitating smooth visualization. **Shape:** Defines the geometric shape utilized as the basis for fractal generation, offering versatility and creative freedom. **Depth:** Controls the complexity and intricacy of the fractal pattern by specifying the recursion depth. **Edges:** Specifies the number of edges or segments comprising the fractal, influencing its overall structure. **Draw:** Triggers the rendering process, instructing the system to generate and display the fractal based on the defined parameters.

Conclusions

In conclusion, this article has delved into the fascinating intersection of fractal geometry with computer science, highlighting its profound implications across various domains. From its historical and artistic significance to its practical applications in data science and beyond, fractals continue to captivate the imagination of scholars, artists, and researchers alike.

The development of a Domain-Specific Language (DSL) dedicated to simplifying fractal geometry represents a significant step forward in democratizing fractal exploration. By providing an intuitive platform for defining shapes and parameters, the DSL bridges the gap between complex mathematical concepts and user-friendly programming interfaces. This advancement not only empowers individuals across diverse backgrounds to engage meaningfully with fractal geometry but also opens up new avenues for artistic expression, scientific exploration, and educational advancement.

Through the comprehensive grammar and versatile features offered by the DSL, users can effortlessly create intricate fractal patterns for various purposes, including art, education, and scientific simulations. By lowering the entry barrier and abstracting away technical complexities, the DSL facilitates innovation and interdisciplinary collaboration in the captivating field of fractal geometry.

As we look toward the future, the potential impact of the Fractal DSL extends far beyond its initial development. It promises to revolutionize artistic expression, scientific inquiry, and educational exploration, unlocking new realms of creativity, discovery, and understanding. By fostering a community of fractal enthusiasts and researchers, the DSL paves the way for continued innovation and advancement in computational geometry and beyond.

In essence, the journey into fractal geometry through the lens of computer science is one of boundless possibility and profound insight. As we embark on this journey together, let us embrace the transformative power of fractals to inspire, educate, and illuminate the world around us.

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DOMAIN SPECIFIC LANGUAGE FOR DATA AND FORMULAS VISUALIZATION

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Abstract. *In a data-driven world, the visualization of complex datasets and mathematical formulas remains a critical challenge despite technological advancements. This article investigates these challenges and introduces a proposed solution in the form of a Domain-Specific Language, specifically for Data, such as Tabular Data from Excel Files or JSON Files, and Formulas, for example Mathematical Expressions, visualization. This language aims to address data and formula visualization in the form of different Graphical Representations, such as Bars or Graphs. Some of this paper's objectives are to describe the steps of the development of a Domain-Specific Language with the mentioned functionalities and such input mechanics, that everyone will easily understand how to work with it. Also, this paper aims to provide, through the proposed language, a better and easier way to visualize information and get an extensive graph representation, along with tabular representation, of the Formulas and Data that are provided by the user.*

Keywords: ANTLR, Grammar, Graph, Lexer, Mathematical Expressions, Parser.

Introduction

In an increasingly data-driven world, the ability to represent information graphically holds significant importance across various sectors including finance, marketing, healthcare, and data science. Motivated by the recognition of persistent difficulties in creating concise and expressive visualizations despite technological advancements, the development of this DSL aims to bridge the gap between complex data and accessible visualization, thereby enhancing the efficiency and effectiveness of data-driven decision-making processes [1].

Also, this paper aims to deliver this DSL's potential users a very user friendly and easy to understand Language, that will be helpful in their daily working routine or in their research projects. The relevance of this topic lies in its potential to simplify the process how data and formulas are visualized and understood, offering a higher level of abstraction and simplicity. The primary objective of this paper is to empower users across various domains to create visually compelling representations of their data and formulas through a proposed DSL.

Problem Description

In the field of data visualization, there are big hurdles that make it tough to show and analyze complex datasets and mathematical formulas properly. Even though technology keeps getting better, the tools we have now often can't meet the varied needs of users in different areas. Some of the main issues this DSL was designed to address are described further.

Managing large amounts of data can be tricky. It is hard to mix data from different places and make sure everything works together well. This is especially tough in projects that cover many subjects, where it's really important that data from different sources can work together smoothly for the analysis and visualization to be successful. As the scale of data grows larger, visualization tools often start to struggle, which makes people worry about whether these tools can handle really big datasets, especially when one needs to process and show data in real time. Plus, a lot of these

tools need a lot of computing power to show complex data, which means they're not very practical in places where a limited amount of computing resources is available.

Moreover, showing complex formulas, especially those with lots of variables or that change over time, is something many current visualization tools can't do well. This makes it hard to show real-life situations accurately. Many areas need specific ways to show formulas that standard tools just cannot offer. Without the ability to make these customizations, people often have to find complicated workarounds or simplify their models too much, which means the visualizations are not as accurate or helpful as they could be [2].

Another major problem is that many data visualization tools are hard to learn and use, which keeps a lot of people, especially those who are not experts, from using them. Lowering the entry barrier and making these tools easier to use for more people is crucial. In addition to that, a significant part of visualization tools does not do a good job of letting users interact with the data, which is a problem, because being able to dive into the data and play around with it leads to better insights and understanding.

This DSL is designed to overcome these challenges by creating a solution that fits the needs of data analysts, scientists, developers, students, business analysts and professionals in various fields. By making it easier to present data, offering better ways to combine different data sources, providing options to customize formula visualizations, making it more interactive and engaging for users, and improving how well it can handle large data sets and perform well, this DSL aims to help users get valuable insights from complex data and formulas in a more efficient and effective way.

Stakeholders

This Domain-Specific Language can cater to a broad spectrum of stakeholders and potential users, including data analysts, scientists, developers, business analysts, data engineers, product managers, educators, researchers, business executives, freelancers, consultants, data journalists, and UX/UI designers.

Data analysts and scientists form the backbone of data exploration and interpretation. This language can cater to their needs by providing an intuitive and efficient platform for manipulating and visualizing data.

Accountability workers rely heavily on data visualization tools to analyze and interpret large volumes of numerical data efficiently and accurately. Whether they are working in finance, accounting, or any other field that requires meticulous data analysis.

Developers and programmers seek tools that seamlessly integrate data visualization into their coding practices. The language that is described in this paper can provide a solution to this need by offering a Domain-Specific Language that harmonizes coding logic with data representation.

Teachers and students seek tools that will help them in visualization of complex formulas in mathematics and that can provide extensive features to operate with them. At the same time, they are interested in working with large datasets and visualizing them in a suitable form for manipulation, with further adjustments.

For stock traders, having access to clear and concise data visualization tools is paramount for making informed investment decisions in an ever-changing market landscape. Stock traders can seamlessly integrate complex financial data into their analytical workflow, allowing them to create dynamic visualizations that highlight key metrics such as price movements.

Language Overview

This DSL for visualizing data and formulas is built with Python. Python was picked for a few key reasons - easy to use and clear code structure, wide range of tools and extensive features for data handling.

The DSL uses a data-driven execution model, starting tasks when the data it needs is ready. This fits well with the data centric nature of visualization tasks, letting users see their data visualized as soon as they put it in.

To provide extensive functionality and enhance the user experience, this project integrates several libraries:

1. NumPy: a go-to for scientific computing in Python, NumPy lets you work efficiently with complex data sets.
2. Pandas: built on NumPy, Pandas provides high-performance, easy-to-use data structures and data analysis tools, enabling intuitive data manipulation and preparation for visualization.
3. Matplotlib: a popular choice for data visualization in Python, Matplotlib lets users create both static and interactive charts, graphs and other kinds of visualizations.

To support the diverse data formats encountered in real-world scenarios, a range of data structures are utilized, including NumPy arrays, Pandas DataFrames, and classical Python data structures like lists, dictionaries, and sets. The DSL can handle a wide range of input formats, such as CSV, Excel, JSON, and text files, ensuring flexibility and compatibility with existing data sources.

Building on top of Python and its rich set of tools allows this project to balance simplicity with powerful features, helping users effectively visualize and gain insights from their data and formulas, without requiring a high level of technical expertise from the target audience.

Grammar overview

Grammar for a programming language is a collection of rules that specify how statements should be written in that language [3].

In programming languages, adherence to specific rules is imperative for code to function correctly. These rules are encapsulated within a framework known as grammar, which defines the language's syntax and structure. Broadly speaking, grammar outlines the rules that govern how valid expressions, statements, variables, and keywords are constructed within the language.

In a grammar for some DSL, Start Term refers to the initial non-terminal symbol from which the parsing of a language begins. It represents the starting point of the language's syntax tree or derivation process.

In this DSL, Grammar starts with this term:

Start Term – S = { <Program> }.

Terminal symbols are those that can occur in the outputs of a formal grammar's production rules but that the grammar's rules are unable to modify. Recursively applying the rules to a source string of symbols will typically result in a final output string that is exclusively made up of terminal symbols.

For this language, Terminal Terms are the following:

Terminal Terms – Vt = { **Data, Formula, dataset, name, if, else, range, while, ReadFrom, ExportToFile, ExportToImage, VisualFormula, VisualData, graph, bar, pie, hist, png, jpg, csv, txt, json, excel, console, ", #, :, :, ,, (,), _, -, [,], *, ^, log, sqr, sqrt, fact, +, -, ,, ==, >, <, !=, >=, <=, {, }, /*, */, /, //, [a-z], [A-Z], [0-9]** }.

Symbols that are not terminal can be swapped out. Another name for them would be syntactic variables. Formal grammar has a start symbol, which is a named member of the set of non-terminals from which all the language's strings can be generated by applying the production rules one after the other.

The set of terminal strings from which such a language can be derived is precisely the language defined by grammar.

In this language, Non-Terminal Terms are the following terms:

Non-Terminal Terms – Vn: { <Program>, <CommandsList>, <Command>, <IfStatement>, <WhileStatement>, <Comment>, <ReadCommand>, <ExportCommand>, <VisualizeCommand>, <VariableName>, <Formula>, <ReadFrom>, <VisualizeFormula>, <VisualizeData>, <Condition>, <VariableName>, <Expression>, <ReadFromFile>, <FormulaContent>, <ExportToFile>, <ExportToImage>, <VisualizeData>, <VisualizeFormula>,

<PathTo>, <PathName>, <ImageType>, <PlotType>, <VisualizationType>, <FileType>, <Operators>, <Digit>, <Integer>, <Float> }.

Since this DSL has a complex topic, Grammar was made as easy as possible for understanding for all users of the DSL we develop. It has several conceptualized Rules that will help the Language to be Tokenized and Parsed correctly.

Rules for the Grammar that will be presented below, follow classical Meta Notation for Grammar Description (See Table 1):

Table 1

Meta Notation for Grammar Description

Symbol	Meaning
<foo>	means foo is a nonterminal.
foo	(in bold font) means that foo is a terminal i.e., a token or a part of a token.
[x]	means zero or one occurrence of x.
x*	means zero or more occurrences of x.
x ⁺	means one or more occurrences of x.
{ }	large braces are used for grouping.
	separates alternatives.

The following description is the set of Instruction/Rules that this Domain Specific Language is based on:

Production Set – P = {

```

<Program> ::= <CommandsList>
<CommandsList> ::= { <Command>
                    | <IfStatement>
                    | <WhileStatement>
                    | <Comment> }+
<IfStatement> ::= if ( <Condition> ) { <CommandsList> }
                [else { <CommandsList> }];
<WhileStatement> ::= while ( <Condition> ) { <CommandsList> };
<Command> ::= <ReadCommand>;
                | <ExportCommand>;
                | <VisualizeCommand>;
<Comment> ::= /*{a-zA-Z0-9/.}+*/
                | #{a-zA-Z0-9/.}+
<ReadCommand> ::= Data <VariableName> = <ReadFromFile>
                | Formula <VariableName> = <FormulaContent>
<Condition> ::= <VariableName> <Expression> { <VariableName>
                | <Digit> | <Integer> | <Float> }
<Expression> ::= == | != | > | < | >= | <=
<ReadFromFile> ::= ReadFrom (<PathTo>)
<ExportCommand> ::= ExportToFile (<PathTo>) <ExportToFile>
                | ExportToImage (<PathTo>) <ExportToImage>
<ExportToFile> ::= dataset = (<VariableName>) name =
                (<VariableName>.<FileType>)
<ExportToImage> ::= <PlotType>(<VariableName>) name =
                (<VariableName>.<ImageType>)
<VisualizeCommand> ::= <VisualizeData> | <VisualizeFormula>
<VisualizeData> ::= VisualData (<VisualizationType>) dataset =
                (<VariableName>)
<VisualizeFormula> ::= VisualFormula (<FormulaContent>) range =

```

```

({<Digit> | <Integer> | <Float> }, {<Digit> | <Integer> | <Float> })
| VisualFormula (<VariableName>) range = ({<Digit> |
<Integer> | <Float> }, {<Digit> | <Integer> | <Float> })
<VariableName> ::= {a-zA-Z_}+{a-zA-Z0-9_}*
<PathTo> ::= "<PathName>"
<PathName> ::= {a-zA-Z0-9_}+
<ImageType> ::= png | jpg
<FormulaContent> ::= {<VariableName> | <Operators> | ( | )
| <Digit> | <Integer> | <Float>}+
<VisualizationType> ::= console | <PlotType>
<PlotType> ::= graph | bar | pie | hist
<FileType> ::= csv | text | json | excel
<Operators> ::= * | ^ | log | sqr | sqrt | fact | - | +
<Digit> ::= {0-9}
<Integer> ::= [-]<Digit>+
<Float> ::= <Integer>.<Digit>+
}

```

Example Valid Code

In order to describe in a much better way how the syntax for this DSL is looking like, here is provided an example of a “program” (See Figure 1), that was parsed by a parser implemented using ANTLR.

```

Data tableData = ReadFrom("/path1/folder1/file.txt");
Formula formula = x^2.2 + sqrt(x);

```

Figure 1. Code Example - Data and Formulas Initialization

In this example is presented variable declaration and initialization, specifically - Data variable that is called “tableData” and is read from a “.txt” file, alongside with a Formula variable, called “formula”, that stores the mathematical expression (See Eq. (1)):

$$formula = x^{2.2} + \sqrt{x} \quad (1)$$

Previously described code is a valid and correct program code that is fully parsed without encountering any errors, which is described in the next section.

Tokens

First step in every DSL is the tokenization, which is done by Lexer, also called Lexical Analyzer. The lexical analyzer defines how the contents of a file are broken into tokens, which is the basis for supporting custom language features [4]. In the above example are several tokens, such as: ID, ASSIGN or OPERATORS tokens, that are a set of Lexemes with an assigned meaning to them. Lexemes, on the other hand, are only some strings of characters known to be of a certain kind. In the following image (See figure 2) are the tokens that were extracted from the input code

```

Tokens:
[<DATA> = 'Data']
[<ID> = 'tableData']
[<ASSIGN> = '=' ]
[<READ_FROM> = 'ReadFrom']
[<LPAREN> = '(' ]
[<PATH> = '/path1/folder1/file.txt']
[<RPAREN> = ')' ]
[<SEMICOLON> = ';' ]
[<FORMULA_T> = 'Formula']
[<ID> = 'formula']
[<ASSIGN> = '=' ]
[<ID> = 'x']
[<OPERATORS> = '^']
[<FLOAT> = '2.2']
[<OPERATORS> = '+' ]
[<OPERATORS> = 'sqrt']
[<LPAREN> = '(' ]
[<ID> = 'x']
[<RPAREN> = ')' ]
[<SEMICOLON> = ';' ]
[<EOF_TOKEN> = '<EOF>']

```

Figure 2. Tokens - Valid Program Code Example

These Tokens give the language the possibility to give a meaning to the lexemes that it encounters in the process of tokenization of an input program, but in order to maintain a correct syntax structure of the code, it also requires another process to pass - Parsing.

Parse Tree

In order to parse the above program code (See Figure 1) and display it as a Tree, ANTLR, which is responsible for Parser and Lexer generation, can provide a better view of the so-called Parse Tree, which is a representation of the structure of a sentence or a string [5], based on the Tokens and the above rules (See section “Grammar overview”).

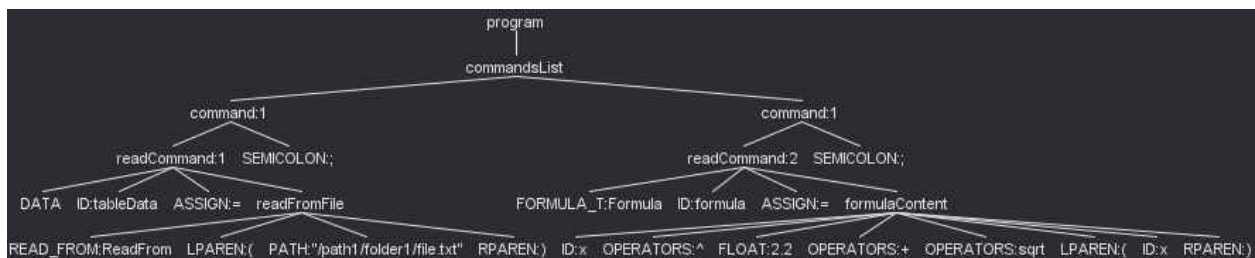


Figure 3. Parse Tree - Valid Program Code Example

As it may be seen, there are clearly two separate read commands - for Data and Formula declaration and initialization, and they both are parsed separately, based on their own rule, into “smaller” Tokens, until it reaches a Terminal symbol that cannot be derived further, indicating that there are no more Lexemes to parse and that there are no encountered syntactic errors in the Input Program Code example.

Conclusions

All things considered, a domain specific language for data and formulas visualization can simplify the process of investigation and analysis of different datasets and, at the same time, mathematical expressions. This specific feature can be used to simplify the work of different Data Analysts, financial workers, students and professors, that is based on the visual analysis of different data sources.

This DSL provides extensive possible utilities that may be used to transfer different datasets from one format to another, visualize it in a better and more comprehensive way, so that every user can easily understand what a piece of data is about.

At the same time, mathematicians and other scientific workers and researchers may be interested in the visualization of different mathematical formulas, that is a commonly-used way of proving different theories that include formulas.

Overall, this DSL's possible features may greatly improve the consistency, quality, and automation of data visualization procedures, making it an invaluable resource for all workers that are related with data analysis and mathematics.

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ENHANCING MACHINE LEARNING MODEL PERFORMANCE THROUGH DATA AUGMENTATION TECHNIQUES ACROSS VARIED DATASET SIZES

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Abstract. *In the realm of machine learning, the challenge of limited data availability often hampers the development and performance of predictive models. Data augmentation, the process of artificially expanding a dataset through various modifications and transformations, presents a promising avenue to mitigate these limitations. This article embarks on a theoretical exploration of data augmentation techniques and their potential to bolster the effectiveness of machine learning models, irrespective of the initial dataset size. The core argument posits that data augmentation can serve as a critical tool in enhancing model performance, particularly when confronted with sparse data. It emphasizes the need for a thoughtful selection of augmentation techniques that align with the characteristics of the data and the objectives of the machine learning task at hand. Furthermore, the abstract posits a theoretical framework for understanding the relationship between dataset size and the efficacy of data augmentation, suggesting that the impact of augmentation might vary across different data scales and model complexities. In sum, this article aims to shed light on the strategic importance of data augmentation in the field of machine learning, advocating for its consideration as an essential component in the model development process, especially in scenarios characterized by data scarcity.*

Keywords: *data science, data augmentation, machine learning.*

Introduction

Machine learning is a cornerstone of many technological advancements, driving innovations in areas like computer vision, natural language processing, and recommendation systems. However, the performance of these models heavily relies on the quality and quantity of data used for training. Limited data availability can lead to suboptimal model performance, hindering their ability to generalize effectively to unseen data [1].

Data augmentation emerges as a powerful technique to address this challenge. By artificially creating new variations of existing data points, data augmentation expands the training set, fostering model robustness and generalizability. This article delves into the theoretical underpinnings of data augmentation and its potential to enhance model performance across varying dataset sizes. Data augmentation serves as a critical tool, particularly in scenarios with limited data, by effectively mitigating the effects of data scarcity. However, the success of data augmentation hinges on the judicious selection of techniques tailored to the specific data characteristics and the learning task at hand. By investigating how augmentation impacts models across different data scales and complexities, this article aims to illuminate its strategic importance

in the machine learning landscape. Ultimately, data augmentation becomes an essential component of the model development process, especially when dealing with limited data resources.

Background and Related Work

Machine learning algorithms learn patterns from data to make predictions on unseen examples. Supervised learning, a prevalent paradigm, utilizes labeled data for training. The model's performance hinges on its ability to generalize effectively to new data, which can be hampered by limited training data. This phenomenon, known as data scarcity, often leads to overfitting, where the model memorizes the training data peculiarities and fails to adapt to unseen scenarios. To reduce this phenomenon, multiple techniques were proposed. One of them was regularization that adds constraints and penalties to the model parameters to prevent it become too complex. Another technique was batch normalization [2] which is used in neural networks that involves the activations of each layer by adjusting and scaling them to have a mean of zero and a standard deviation of one [3]. Another salvation for the low accuracy and overfitting, could be transfer learning and fine-tuning that are allowing to retrain the model for a new problem, or add up tune the data to more data.

Data augmentation in this case tackles the challenge of data scarcity by artificially expanding the training dataset. This technique involves applying various transformations and modifications to existing data points, generating new variations that retain the core information [4]. In fact, data augmentation is not new, however its applicability is very extensive and can be helpful not only for computer models but for real-world tasks [3].

Data augmentation can be variate. It takes form of geometric transformations like flips, rotations, scaling or color space manipulations like modifying brightness or contrast. Mathematically speaking, these are affine transformations and are related to images and image-like data. Generally, this type of augmentation can be resumed to this formula (Eq. (1)):

$$y = Wx + b \quad (1)$$

in the formula (1), y represents the transformed image, W is the matrix representing the linear transformation applied to the original image data, x is the vector of the original image data, and b is the vector of the bias terms that translates the image. This type of transformations are proving themselves best, as they generate new data, thus making the model not too complex and trained for new test data.

Other tools that can provide data augmentation are Generative Adversarial Networks (GANs). GANs have shown remarkable capabilities in generating realistic data samples, especially in image synthesis tasks. For instance, CycleGAN, a variant of GAN, can perform style transfer between images from different domains without paired training data, opening up possibilities for various applications in art, fashion, and design.

Integrating GANs with data augmentation techniques presents a promising approach to address data scarcity issues. By leveraging GANs to generate synthetic data, it's possible to effectively expand the training dataset, enhancing the model's robustness and generalization capabilities.

In the next section, more attention will be focused on techniques, with a detailed exploration of both their mathematical principles and practical applications.

Data Augmentation Techniques

Numerical Data Augmentation

Numerical data augmentation involves manipulating the numerical features in a dataset to generate synthetic data points that retain the statistical properties of the original data:

- Noise injection happens when small, random variations are added to numerical values, typically drawn from a distribution like Gaussian or uniform, to simulate variability.

This is mathematically represented as $X_{aug} = X + \varepsilon$, where X is the original data and ε is the random noise.

- Scaling and shifting involve linear transformations of the form $X_{aug} = aX + b$, where a and b are scaling and shifting parameters, respectively. This can help in simulating different operational conditions in scenarios like sensor data monitoring [5].

Categorical Data Augmentation

Categorical data augmentation is more complex due to the discrete nature of the data:

- Smoothing techniques, like additive or Laplace smoothing, to manage the distribution of categorical variables, particularly or underrepresented categories.
- Category embedding and swapping, which involves representing categories in a continuous vector space and then performing operations similar to numerical data augmentation within this space [6].

Textual Data Augmentation

Textual data augmentation helps to increase the robustness of natural language processing (NLP) models by introducing variety in the training data, which aids in learning more general patterns and reducing overfitting.

- **Synonym Replacement:** this technique involves replacing words in a sentence with their synonyms to create a new sentence with the same meaning but different wording. It helps the model learn that different words can express similar meanings, enhancing its ability to understand context and semantics. For example, the sentence "The quick brown fox jumps over the lazy dog" can be altered to "The fast brown fox leaps over the sluggish dog."
- **Back-translation:** this involves translating a sentence into a foreign language and then translating it back to the original language. The process often introduces linguistic nuances and variations that wouldn't be present in the original text, thus enriching the language model's training data. For instance, the English sentence "He goes to school by bus" might be translated to French and back to English as "He takes the bus to go to school," introducing a different sentence structure [7].
- **Sentence Shuffling:** by rearranging the order of sentences or phrases within a text, this method enhances the model's ability to understand and predict context and coherence in language. However, it's important to maintain a logical flow of information, so this technique is more suitable for texts where the order of information is not critical to understanding.

Temporal Data Augmentation

Temporal data augmentation is used in time-series analysis to improve the prediction accuracy of models by training them on varied time-based scenarios.

- **Time Warping:** similar to stretching or compressing a timeline, time warping applies nonlinear transformations to the temporal axis of the data. This simulates varying speeds of event occurrences, helping models to better learn and predict temporal dynamics under different conditions [7].
- **Window Slicing:** by cutting the time series into different windows or segments, this technique allows models to train on diverse temporal slices, thus improving their generalization across time. It's especially useful for detecting patterns or anomalies in time-series data that occur over inconsistent time intervals.

Generative Data Augmentation

Generative models like GANs and VAEs create new data samples that can augment existing datasets, especially in areas where data collection is challenging.

- GANs for Realistic Sample Generation: GANs can generate highly realistic samples by learning the distribution of the original data. They are particularly useful in generating complex data like images or sounds, where they can create new instances that are hard to distinguish from real ones, thus providing additional training material for models [6].
- VAEs for Data Interpolation: Variational Autoencoders (VAEs) generate new data points by interpolating in the latent space, a compressed representation of the data. This process allows for the generation of new samples that are variations of the original data, maintaining the core statistical and structural properties. It's beneficial for enhancing the diversity of datasets without straying from their inherent characteristics [7].

Practical Applications in Tabular Data

In practical scenarios, such as credit risk assessment or customer churn prediction, data augmentation can be pivotal. For example:

- Credit scoring: augmenting financial datasets by injecting noise into numerical features like income or loan amount can help in creating more robust models that are less sensitive to small variations, reflecting real-world uncertainties.
- Customer churn analysis: for categorical features like subscription type or service plan, techniques like category swapping (where similar categories are interchanged) can simulate various customer behavior patterns, leading to a model that better generalizes across customer segments.

Challenges and Considerations

When augmenting tabular data, several challenges need to be addressed:

- Preserving data integrity: it's crucial to ensure that augmented data still respects the intrinsic relationships and constraints within the original dataset, such as the logical correlation between features.
- Feature importance: the augmentation process should consider the relative importance of features, focusing more on those that have a significant impact on the model's predictions.
- Over-augmentation: excessive augmentation can lead to model training on essentially synthetic data that may not represent real-world scenarios, potentially harming the model's ability to generalize [8].

Data Augmentation across different dataset sizes

As said, data augmentation serves as a pivotal strategy in enhancing model generalization, particularly when dealing with limited data volumes. Various studies underscore its efficacy across dataset sizes, highlighting nuanced impacts.

Small Datasets: in scenarios with scant data, augmentation emerges as a pivotal tool to curb overfitting [9]. Research by Shorten and Khoshgoftaar [10] emphasizes its role in expanding datasets, mitigating overfitting risks, and improving model performance. Techniques like random rotations, flipping, and cropping diversify training samples, facilitating robust feature extraction [11].

Medium Datasets: while augmentation remains beneficial in medium-sized datasets, its impact may moderate due to the sufficient data volume available [9]. However, tailored augmentation techniques remain pivotal. For instance, research by Cubuk et al. [10] underscores

the significance of domain-specific augmentation strategies for improved performance in image classification tasks.

Large Datasets: in large datasets, the utility of data augmentation varies based on task complexity [10]. While ample data may reduce augmentation's impact, it remains vital for tasks requiring nuanced pattern recognition [11]. Notably, in medical imaging, augmentation aids in capturing subtle variations crucial for accurate diagnoses [9].

Very Large Datasets (Big Data): extremely large datasets pose unique challenges, where the marginal utility of augmentation may diminish [10]. Nevertheless, meticulously crafted augmentation strategies could still benefit specialized tasks [11].

Understanding these nuances aids in crafting effective augmentation strategies for optimal model performance.

Conclusions

In summary, data augmentation serves as a fundamental technique in machine learning, providing crucial solutions to the persistent challenge of limited data availability. This article has delved into the diverse landscape of augmentation techniques, spanning numerical, categorical, textual, temporal, and generative domains, elucidating their pivotal role in enhancing model robustness and generalization.

By exploring the theoretical underpinnings and practical applications of augmentation across different dataset sizes, this discussion has underscored its strategic significance in curbing overfitting and fostering model adaptability. From injecting noise in numerical data to performing category embedding in categorical data and employing sophisticated methods like back-translation in textual data, augmentation techniques offer versatile solutions tailored to diverse data modalities.

However, the successful implementation of data augmentation requires navigating various challenges, including preserving data integrity, considering feature importance, and mitigating the risk of over-augmentation. Despite these challenges, augmentation proves invaluable across different dataset scales, with nuanced impacts observed in small, medium, large, and very large datasets.

As the machine learning landscape continues to evolve, with advancements in generative models like GANs and VAEs expanding the horizons of data augmentation, understanding these nuances becomes increasingly crucial. By equipping practitioners with insights into the intricacies of augmentation techniques and their impacts across varying data scales, this article aims to empower the development of effective augmentation strategies, thereby maximizing model performance and driving advancements in predictive modeling across a myriad of domains.

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DESIGNING AN AUTOMATED GREENHOUSE USING IoT TECHNOLOGIES

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Abstract. *The greenhouse is an efficient method to deal with increasing food demands caused by the unprecedented rise in worldwide population over the last century. It's a form of smart farming that allows the growth of off-season crops or plants incompatible with the local climate. The advancements in the domain of IoT (Internet of Things) allow including smart solutions to control the climate within the greenhouse and specific parameters to cater to the plants (humidity, temperature, irrigation, soil condition, etc.) most efficiently. The following article describes the design and implementation of an autonomous greenhouse.*

Keywords: *greenhouse, internet of things, sensors, automation, environment, agriculture.*

Introduction

The expansion of sustainable agriculture is promoted by the smart greenhouse technology that brings a viable solution to the challenges that have impacted developing countries. Strengthening yield, and diminishing damaging effects of climate change, the smart environment can provide a solution that ensures a prosperous future for worldwide communities.

To fulfill the expanding need for food while reducing its effect on the environment, innovative approaches have become essential considering the increasing global population and the unusual standards set for the agriculture. Smart greenhouse technology has begun to emerge as an alternative option for countries that are facing major challenges due to climate change.

This article explores the revolutionary impact of a smart greenhouse in countries that struggle, or are in development. This system helps farmers to overcome the failure of crops and other issues, smart farming is a potential path to economic growth, and reduced poverty. This is a solution that empowers local farmers to adapt to a new era of agriculture while using innovative methods which leads to improved production, through a sustainable solution with great economic potential.

Solution proposal

The Internet of Things, also known as IoT, has advanced in a huge level in the past years which allowed the integration of self-reporting devices that communicate and interact with each other and their users in real-time to achieve a goal. One of the most popular uses of IoT are smart environments. A smart environment is a collection of devices that can monitor, control and regulate information. The network-connected equipment used to monitor a smart ecosystem include actuators, microcontrollers, and sensors. To improve services for people, the physical smart environment has an intelligent design and gains from the interface of numerous gadgets and computer systems [1]. To reduce the problems created by the increasing population rate and drastic climate changes it is proposed a smart greenhouse system.

IoT technologies are integrated into smart greenhouse systems to increase the performance in agricultural yields. Sensors and digital components are used to monitor and control environmental factors, the most important feature of these intelligent structures is that it does not require human involvement.

Requirements Specification

User stories and system requirements should be outlined to develop an IoT-embedded greenhouse management system. Functional requirements define the specific functions of the system or a component of it, representing the summary of the input and output state of the system. They are product features or functions that developers must implement to enable users to accomplish their tasks [2]. For different types of users, there are several needs such as:

A greenhouse manager needs remotely monitor temperature and humidity levels in the greenhouse, to receive real-time alerts on mobile devices in case the temperature exceeds a certain threshold. It is needed because it needs to ensure the optimal conditions for growing the plants without being physically present. In the case of a notification system, it is needed to take immediate action to prevent heat stress or any other damage to the plants.

A greenhouse owner is required to implement an automated irrigation system based on the soil moisture levels and the specific conditions of the plants. This ensures consistent watering of the plants, prevents over and under-watering, and reduces the water resource costs optimizing for reducing resource wasting.

A greenhouse maintenance technician demands remote diagnosis and troubleshooting equipment problems using sensor data to reduce interruptions and ensure smooth operations of the greenhouse system.

A crop specialist desires to analyze the health of the agricultural crops by identifying the parameters that do not fit into the norms including leaf color, growth rate, and presence of pests or diseases. It is an essential aspect to intervene quickly and efficiently in case of issues to avoid production losses.

As for the nonfunctional requirements which are system qualities that guide the design of the solution and often serve as constraints across the relevant backlogs [3]. Some of the nonfunctional requirements of the greenhouse systems include:

- Environmental impact which enhances energy and sustainable resource usage by optimizing and reducing water and energy wasting minimizes the impact on the environment at a global level if introduced on a larger scale.
- Revolutionary performance of production, making the system able to perform multiple tasks in a specific time interval to process and analyze data collected from the sensors.
- Availability, for the greenhouse a high availability rate means a minimal suspension time in case of component inactivity.
- Usability enhances the easily manageable monitoring system for different user personas such as farmers, technicians, or researchers. Includes a user-friendly interface for easy access to for quick navigation through past statistics and trends, as well as for monitoring and managing the conditions in the greenhouse.

Architectural Design

The system architecture represents a theoretic model that defines the structure of the system, its behavior and how the components interact with each other [4].

To provide comprehensive system monitoring, multiple sensors were placed throughout the greenhouse. The greenhouse system includes the necessary components such as: irrigation, shading, ventilation, humidifier, temperature, humidity sensors, light sensors, soil moisture sensors, CO₂ sensors, and soil pH sensors.

The architectural design of the greenhouse system revolves around several principles. First, is scalability, that is the greenhouse can have any dimensions. This space is going to be filled with “zones”, which are spaces where the plants are planted and grown. Each zone within the greenhouse will be configured with the necessary sensors and actuators, which will ensure that the plants in the zones are in the proper conditions.

The second principle that this system follows is that you can grow any type of plant in the greenhouse. The client will use the application to choose the plant to grow in a specific zone and the perfect conditions for the growth of this plant is going to be set automatically by our system.

Furthermore, the third followed principle is the ability to monitor and analyze the zones. This suggests an application that will allow the client in addition to initializing the zones with plants to also monitor their growth and check sensors and actuators' data.

The below block diagram (Figure 1) represents the main structure of our system. It contains three entities that communicate with each other.

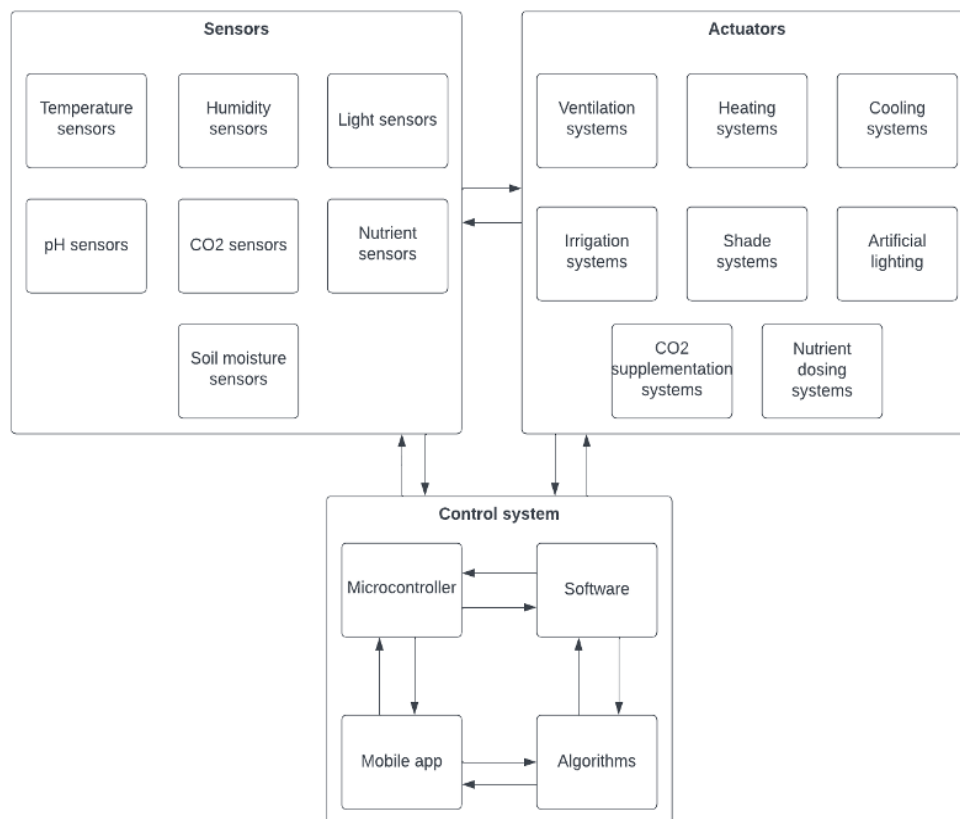


Figure 1. Block diagram of the greenhouse system

Conclusion

All in all, embedded systems and the Internet of Things bring a new era in agriculture. This greenhouse project will significantly help farmers, as well as enthusiasts in the field to grow agricultural products with the highest efficiency and yield. The mentioned system/software will ensure an individual growth plan for each plant, an automatic monitoring system, and a friendly user interface which will make it convenient for the farmers to use it.

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MODELING AND DEVELOPMENT OF A TERRESTRIAL AUTONOMOUS DRONE FOR PRECISION AGRICULTURE - AGROBOT

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Abstract. *This paper delves into the modeling and development of a terrestrial autonomous drone tailored specifically for precision agriculture and mission planning. It explores the impact of robotics and automation on agriculture, focusing on precision farming techniques. Additionally, it examines current advancements such as IoT integration and navigation systems for agricultural robots. Through empirical research, the study aims to provide fresh insights into the transformative potential of robotics in agriculture, identifying scientific gaps for improvement. By proposing technology-driven solutions, the research aims to enhance sustainability and productivity in farming practices, ultimately paving the way for further innovation in agricultural robotics and precision agriculture.*

Keywords: *agricultural robotics, automation, IoT technologies, mission planning. remote sensing.*

Introduction

Precision agriculture has emerged as a transformative approach in modern farming, leveraging advanced technologies to optimize efficiency and sustainability. With the global precision agriculture market projected to reach USD 16.09 billion by 2028, there is a clear trajectory towards increased adoption fueled by technological innovations [1]. However, challenges persist, including crop losses due to imprecisions in agrobot functions. This paper addresses the need for precision in agricultural robotics, particularly focusing on the development of a terrestrial autonomous drone tailored for precision agriculture and mission planning.

Analysis of the situation in the field of precision agriculture

Precision agriculture has rapidly evolved as a pivotal approach to modern farming, integrating cutting-edge technologies to enhance agricultural efficiency and sustainability. The global precision agriculture market size was valued at USD 7.1 billion in 2020 and is projected to reach USD 16.09 billion by 2028, indicating a significant growth trajectory driven by technological advancements and increasing adoption by farmers worldwide [1].

Despite the numerous benefits offered by precision agriculture, several challenges remain, including loss of crops due to the lack of 100% precision in agrobot functions. The UN Food and Agriculture Organization (FAO) and other research studies estimate that 20–40% of global crops are lost due to plant pests and diseases [2]. Commercial robotic weeding machines employ various methods to eliminate weeds, such as mechanical removal, flame treatment, or herbicidal sprays. Accurately distinguishing between crops and weeds is challenging, with system precision reaching only about 70% even in optimal conditions. Numerous techniques exist for identifying crop plants in digital images. This is usually accomplished by first capturing an image and then classifying each pixel as either a plant or a non-plant part, often utilizing a green threshold technique. Herbicides are a global solution for controlling agricultural weeds, yet over 95% of these chemicals end up in places other than the intended crops because they are dispersed broadly across agricultural fields [3].

Technologies used for pathfinding and navigation

The firmware for autonomous unmanned systems is often created using ArduPilot, a widely utilized framework. ArduPilot, an open-source navigation software, facilitates the development of dependable autonomous systems for various vehicles, such as multirotor drones, fixed-wing and VTOL aircraft, helicopters, ground rovers, ships, submarines, and tracking antennas. To aid in using ArduPilot, the mission planner application serves as an interface with the controller, enabling setup, configuration, testing, and tuning of the vehicle. Mission planner, a comprehensive Ground Control System (GCS) application, is fully compatible with ArduPilot. Other compatible software includes APM Planner, QGroundControl, and others [4].

Agricultural robots and vehicles rely on various vision sensors and systems for navigation planning. Vision sensors are among the most frequently used robotic sensors, enabling non-contact measurement of the agricultural environment. Depending on the imaging principle, vision sensors can be categorized into 2D vision imaging sensors and 3D stereo vision imaging sensors. The 2D images captured by these sensors can reveal the shapes and structures of trees, crops, obstacles, and other elements within the agricultural setting. In contrast, 3D vision imaging sensors generate a three-dimensional coordinate map of the entire scene, detailing the spatial positions of the robot and other objects. Vision systems play a crucial role in the navigation process, and choosing the appropriate vision sensor and system depends on the specific environmental conditions and task requirements [5].

Sensor technologies used in existing solutions

Various sensors are capable of monitoring different plant characteristics such as color, texture, geometric shape, and specific wavelength radiation. The data collected by these sensors can be analyzed to observe key agricultural features throughout different growth stages, including soil moisture, plant biomass, and vegetation health. Previous research has employed a variety of sensors, such as visible light (RGB) sensors, multispectral sensors, hyperspectral sensors, and thermal sensors [6]. Drones equipped with specialized sensors are used to gather specific types of data necessary for particular tasks. These sensors are designed to capture images over large areas and can be selected based on the specific crop attributes that need continuous monitoring. Modern agricultural sensors typically include multispectral sensors, hyperspectral sensors, RGB sensors, thermal sensors, and pressure sensors.

Requirement elicitation

In order to achieve maximum efficiency and minimize operational burden, a semi-autonomous agricultural rover is required. This rover should possess the ability to follow user-specified commands while adapting to unforeseen circumstances. A user-friendly interface is paramount for ease of operation. The core functionality of the rover should encompass tasks such as applying pesticides, herbicides, and plowing the land. Additional functionalities such as real-time soil analysis and plant scanning are desirable for informed decision-making. The system should be operational throughout the growing season, including seeding/planting and harvesting periods. The rover and any collaborating drone system should be capable of rapid data exchange to facilitate real-time monitoring and adjustments. For safety reasons, a dedicated killswitch independent of the primary system is necessary. Finally, the drone should be equipped for high-precision land marking to ensure accurate field preparation and cultivation.

Architectural design

The system consists of several key components that facilitate communication and control. A user interacts with the system through a web app, which communicates with the Ardupilot software component. Ardupilot is the central processing unit for the robotic vehicle, and it controls the vehicle's actuators based on data received from various sensors and user commands. These sensors include LiDAR, which is used for object detection and navigation, and other sensors that measure environmental factors. The system also includes communication services that enable data exchange between the different components. Finally, a kill switch is shown to provide a safety mechanism for immediate shutdown of the robotic vehicle.

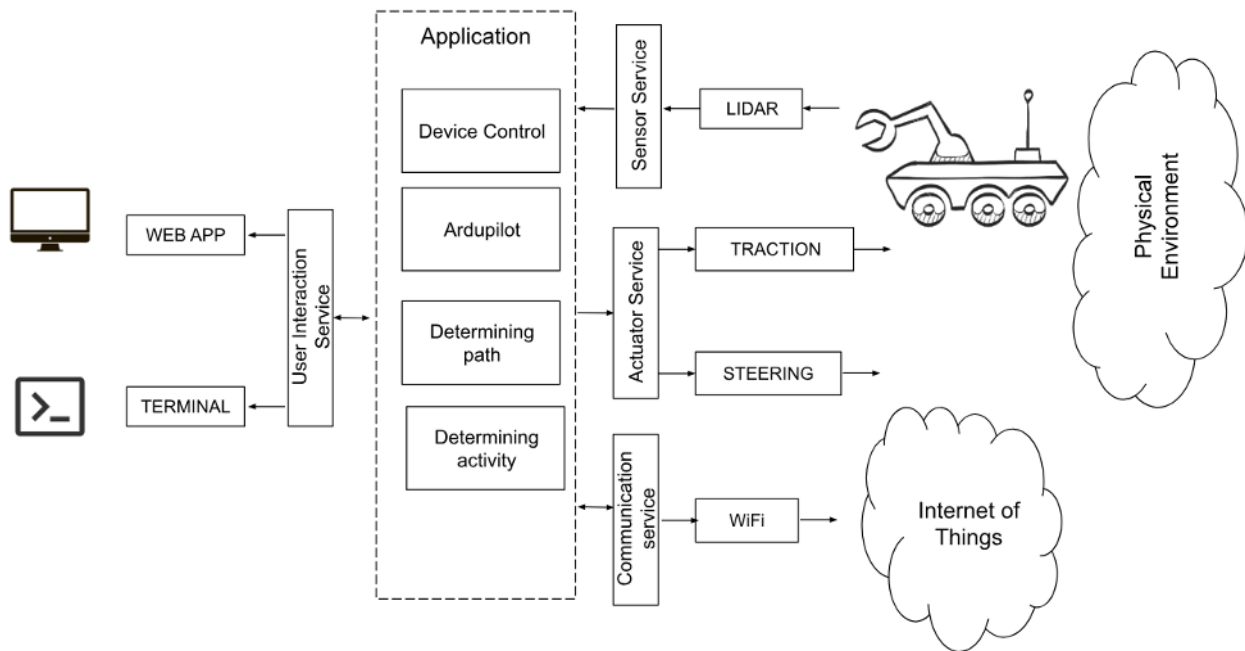


Figure 1. Diagram of the whole system

Conclusions

In conclusion, the development and modeling of a terrestrial autonomous drone for precision agriculture represent a significant step forward in leveraging robotics for sustainable farming practices. By integrating advanced technologies such as IoT and navigation systems, this research contributes to enhancing efficiency and productivity in agriculture. Moving forward, addressing scientific gaps identified in this study will further propel innovation in agricultural robotics, fostering a future of precision agriculture that maximizes yields while minimizing environmental impact.

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DOMAIN-SPECIFIC LANGUAGE FOR ANALYZING MEDICAL RESULTS

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Abstract. *This article delves into the potential benefits that a Domain-Specific Language (DSL) could bring to the medical field. It highlights how a DSL could enhance the analysis of medical results by offering greater precision, quicker analysis times, and lower chances of mistakes. Furthermore, it elaborates on the potential for DSLs to integrate seamlessly with existing medical software systems, enhancing interoperability and data sharing across platforms. Additionally, it points out the advantages of using a DSL for data management tasks such as gathering, updating, and maintaining records about patients' illnesses, enabling healthcare professionals to access and analyze critical information with ease. The utilization of DSLs could also foster a more personalized approach to patient care, allowing for treatments and medical advice to be tailored more accurately to individual patient profiles. Lastly, the article speculates on the future role of DSL in medicine, emphasizing its ongoing contribution to the interpretation and analysis of medical data, and predicts a significant shift in how medical professionals interact with technology, ultimately leading to more efficient and effective patient care.*

Key-words: *healthcare, data management, data interoperability, software systems integration.*

Introduction

Evaluating medical outcomes is crucial in healthcare, offering critical information for diagnosing, treating, and preventing various health conditions [1]. Yet, sifting through vast amounts of medical data from diverse sources poses significant challenges, particularly for medical practitioners needing more in-depth technical expertise.

Domain-specific languages (DSLs) emerge as a viable answer to these issues, introducing a programming language designed specifically for the medical domain. This article introduces a DSL crafted for medical result evaluation. It starts by examining the domain analysis, addressing the main obstacles in analyzing medical data. The article then outlines the DSL, focusing on its principal characteristics such as its capacity to streamline intricate data evaluation processes and enhance the precision of health diagnoses.

The DSL's syntax is crafted to be intuitive and straightforward for users. Additionally, the article explores the DSL's potential effects on the healthcare industry, such as better patient health outcomes and decreased expenses. In summary, the article offers an in-depth look at a specialized language for analyzing medical data, shedding light on its development, application, and the advantages it brings.

Domain Analysis

Multi-center healthcare data sharing faces significant challenges due to privacy regulations and the heterogeneity of data, which are critical hurdles in advancing medical research across various fields such as neuroscience, genetics, drug discovery, and disease diagnosis and prognosis. The backbone of successful machine learning algorithms, particularly in these areas, relies on having access to sufficiently large datasets with the necessary annotations [2]. In order to reach

the impressive performance levels of deep learning - which is known for its intricate models with millions or even billions of parameters - it requires even more data samples than typical machine learning algorithms. Yet, the medical datasets that are frequently made accessible for machine learning research are usually too small and don't have the thorough annotations needed for detailed analysis.

Grammar

Grammar in the context of computer science and programming languages, is a formal set of rules for specifying the syntax of a language. It defines how words, symbols, and other elements (tokens) can be combined to produce valid sentences or expressions within that language [3]. We note grammar as:

$$G = (V_N, V_T, P, S), \text{ where}$$

- V_N - abstract symbols that represent placeholders for collections of phrases or sentence structures, expandable into sequences of terminal and/or non-terminal symbols according to production rules.
- V_T - terminal symbols are the language's basic, indivisible elements like keywords and operators, not further reducible by grammar rules.
- P - rules that define how non-terminal symbols can be replaced with sequences of terminal and/or other non-terminal symbols, with each rule outlining a construction method for language phrases, featuring a single non-terminal symbol on the left and a sequence of symbols on the right.
- S - special non-terminal symbol from which all valid sentences in the language can be derived.

Grammar consists of a series of production rules that describe the structure of valid sentences in the language. These rules are used by parsers and compilers to understand and process the language [4].

In our DSL, V_N and V_T are presented as next:

$V_N = \{ \langle \text{Program} \rangle, \langle \text{StatementList} \rangle, \langle \text{Statement} \rangle, \langle \text{VariableDeclaration} \rangle, \langle \text{VariableDeclarator} \rangle, \langle \text{Expression} \rangle, \langle \text{BinaryExpression} \rangle, \langle \text{MultiplicativeExpression} \rangle, \langle \text{PrimaryExpression} \rangle, \langle \text{Literal} \rangle, \langle \text{StringLiteral} \rangle, \langle \text{ParthesizedExpression} \rangle, \langle \text{NumericLiteral} \rangle \}$

$V_T = \{ \text{"NUMBER"}, \text{"STRING"} \}$

$\langle \text{Program} \rangle ::= \text{"MAIN_STRUCT"} \{ \langle \text{StatementList} \rangle \}$

$\langle \text{StatementList} \rangle ::= \langle \text{Statement} \rangle \mid \langle \text{Statement} \rangle \langle \text{StatementList} \rangle \mid \epsilon$

$\langle \text{Statement} \rangle ::= \langle \text{VariableDeclaration} \rangle$

$\langle \text{VariableDeclaration} \rangle ::= \langle \text{VariableDeclarator} \rangle \text{" , "}$

$\langle \text{VariableDeclarator} \rangle ::= \text{"DECLARATOR"} \text{"DECLARATOR_OPERATOR"} \langle \text{Expression} \rangle$

$\langle \text{Expression} \rangle ::= \langle \text{BinaryExpression} \rangle$

$\langle \text{BinaryExpression} \rangle ::= \langle \text{MultiplicativeExpression} \rangle \mid \langle \text{MultiplicativeExpression} \rangle \text{"ADDITIVE_OPERATOR"} \langle \text{MultiplicativeExpression} \rangle$

$\langle \text{MultiplicativeExpression} \rangle ::= \langle \text{PrimaryExpression} \rangle \mid \langle \text{PrimaryExpression} \rangle \text{"MULTIPLICATIVE_OPERATOR"} \langle \text{PrimaryExpression} \rangle$

$\langle \text{PrimaryExpression} \rangle ::= \langle \text{ParthesizedExpression} \rangle \mid \langle \text{Literal} \rangle$

$\langle \text{ParthesizedExpression} \rangle ::= \text{"("} \langle \text{Expression} \rangle \text{"}"$

$\langle \text{Literal} \rangle ::= \langle \text{StringLiteral} \rangle \mid \langle \text{NumericLiteral} \rangle$

$\langle \text{NumericLiteral} \rangle ::= \text{"NUMBER"}$

$\langle \text{StringLiteral} \rangle ::= \text{"STRING"}$

These non-terminal and terminal symbols help us determine how patients should provide their input data based on their illnesses.

Below we provide an example of patient data that could be introduced into the system. The patient completes all the needed info about its analyses for specific illnesses that he has.

```
Obesity {  
    pregnancies: (1+2),  
    diagnosis 2,  
    treatment 2,  
    glucose: 2,  
    bloodPressure: 2,  
    skinThickness: 2,  
    insulin: 2,  
    bmi: 2,  
    diabetesPedigreeFunction 2,  
    age: (2+3)*2,  
}
```

Lexer

A lexer, short for lexical analyzer or tokenizer, is a crucial component in the process of compiling or interpreting code [5]. Its main job is to read the input source code and break it down into meaningful pieces known as tokens. Tokens can represent keywords, identifiers, literals (like numbers and strings), and operators that the programming language syntax defines. Overall, to obtain the lexer we desire and tokenize the input we have to follow simple rules which are described easily in the code:

```
Tokens: list[list[str]] = [  
    [r"\A\s+", "WHITESPACE"],  
    [r"\A,", ",", "  
    [r"\A[(]", "("],  
    [r"\A)]", ")"],  
    [r"\A{[", "{"],  
    [r"\A{]", "}"],  
    [r"\A\bCreate Template\b", "INIT_STRUCT"],  
    [r"\A\bname\b", "STRUCT_NAME"],  
    [r"\A\bparams\b", "STRUCT_PARAMS"],  
    [r"\A\btarget\b", "STRUCT_TARGET"],  
    [r"\A\bdata\b", "STRUCT_DATA"],  
    [r"\A\bdeclare\b", "NEW_STRUCT"],  
    [r"\A\w+\.\w+", "METHOD_CALL"],  
    [r"\A\"\"\"([\s\S]*?)\"\"\"", "BCOMMENT"],  
    [r"\A\#.*$", "COMMENT"],  
    [r"\A:(?!:)", "DECLARATOR_OPERATOR"],  
    [r"\A=(?!=)", "DECLARATOR_OPERATOR"],  
    [r"\A[^\s\W\d]+", "VARIABLE"],  
    [r"\A[+|-]", "ADDITIVE_OPERATOR"],  
    [r"\A[*V]", "MULTIPLICATIVE_OPERATOR"],  
    [r"\A\d+", "NUMBER"],  
    [r"\A\"\"\"*\"", "STRING"],  
    [r"\A\"\"\"*\"", "STRING"]
```

The various components of the input text, including whitespace, punctuation, comments, operators, numbers, and strings, are identified by these patterns. To ensure that the entire input is either tokenized in accordance with the established patterns or stopped if an unmatchable sequence is discovered, the lexer stops upon encountering unrecognized sequences or the end of the input.

Parsing

Parsing involves analyzing text to understand its meaning based on a set of grammatical rules. In the context provided, the goal is to interpret medical test results by identifying the types of tests, their results, and reference ranges according to a predefined grammar. A common approach for parsing context-free grammars like this one is to use a technique called recursive descent parsing [6]. Here is how it could be done for this grammar:

Initially, the process starts by evaluating the <Program> rule, which then progresses into examining a <StatementList>. It determines whether the upcoming token is a <Statement>, a combination of <Statement> <StatementList>, or none, leading to a corresponding function call or an error. For a <Statement>, it further invokes a parsing function dedicated to <VariableDeclaration>, which then calls for <VariableDeclarator>. The <VariableDeclarator> checks for specific operators before moving on to an <Expression> parsing function. Expressions are broken down into binary or multiplicative forms, depending on the operators and tokens encountered, and further into primary expressions, which include literals and parenthesized expressions. The algorithm emphasizes a hierarchical and recursive parsing strategy, ensuring that every component of the program is syntactically valid by matching specific patterns and data types, such as numbers and strings, thereby streamlining the parsing process into an efficient, step-by-step analysis of the program's structure.

Recursive descent parsing works by recursively calling parsing functions for each rule in the grammar until the entire input is parsed [7]. If the input is valid according to the grammar, a parse tree is constructed that represents the structure of the input. If the input is not valid, an error is returned. Using these parsing rules and grammar we have to define the patient's illness we want to check and provide the tokens that represent test results that we have listed already in the code.

Conclusions

In conclusion, the introduction of Domain-Specific Languages (DSLs) into the medical field marks a fundamental change in how medical data is analyzed and interpreted. By tailoring programming language features specifically for healthcare applications, DSLs have streamlined complex data analysis processes, significantly enhancing the accuracy of diagnoses and patient care. This specialization has not only reduced the time and effort involved in managing and analyzing medical data but has also reduced the risk of errors, leading to better patient outcomes and more efficient healthcare delivery. While DSLs have significantly helped with data diversity and system compatibility in healthcare, their integration faces ongoing adoption and improvement challenges, yet their role is set to grow, further transforming healthcare technology and its ability to serve patients better.

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MODELING AND DEVELOPMENT OF AN AUTONOMOUS DRONE SWARM FOR PRECISION AGRICULTURE

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Abstract. *The thesis explores the impact of mass use of UAV (Unmanned Aerial Vehicles) technologies in the agricultural sector and orchard management. It provides research on the existing problems, technologies and products regarding autonomous data gathering in an orchard via a swarm of drones. It iterates over the security aspects of IoT networking providing strengths and weaknesses of the existing security architectures. A thorough analysis of the market of the IoT in the agricultural filed in Republic of Moldova is provided and conclusions are drawn about market state. Lastly, it contains insights about the integration of innovative artificial intelligence into autonomous drone missions.*

Key words: *Drone, IoT, Agriculture, Surveillance, Automation, AI (Artificial Intelligence).*

1. Introduction

Agriculture is fundamental to human survival and economic stability in every country across the globe but in today's world it faces a multitude of challenges that are yet to be solved using innovative approaches that will be sustainable, productive, and efficient. This following chapter we will delve into the current adversity that the agriculture industry is facing, more specifically the imperative for yield and quality optimization. The solution proposed integrates Internet of Things (IoT) technologies, with a specific emphasis on UAV commonly known as drones as a transformative approach to overcoming this specific challenge. Through a comprehensive analysis, this project illustrates how such technologies improve precision agriculture and optimizes crop yields and quality.

2. Problem definition

The main problem addressed by the drone swarm is the ineffectiveness of unassisted humans in agriculture management. Throughout history human beings have been using agriculture only to fulfill their personal needs - a few hundred or thousands of kilograms of crops per year from a small-sized garden. But with the evolution of humanity, farming became extremely loaded, i.e., a single farmer should provide to other people hundreds of thousands of tons of crops per year. Farmers went from the prevalent part of the population to small minorities that still need to somehow feed the entire society. This situation created an acute need to revolutionize technology in agriculture. A farmer now needs some technological assistance to manage thousands of tons of crops without the need of tens of workers.

This shift has necessitated a corresponding evolution in agricultural technology, as the traditional methods of unassisted human labor are no longer sufficient to meet these demands. In regions like the Republic of Moldova, where land resources are relatively limited, the pressure on orchard management is particularly acute.

Orchard management is not an exception. In fact, orchard management is one of the most technology requiring fields in agriculture, especially in the Republic of Moldova, where there is a relative deficit of appropriate land [1]. Orchard management in the Republic of Moldova is pressed

by high local and international concurrency, requiring a high yield rate at a low budget/price for the farmers. A way to automate data collection is essential because permanently supervising hundreds of hectares of orchards is both challenging and expensive for the farmers.

2.1 Domain Analysis

Drones are becoming more popular and reliable in the agricultural industry. Companies all over the world are using drones for increasing production efficiency, managing crop health, and preventing quality issues. The main focus is automatization of the drone processes through operating UAVs (Unmanned Aerial Vehicle) due to their high flexibility, ease of use, adaptability to different terrains and scalability. Different operations can be performed with UAVs such as air sowing, remote sensing detection and information collection [2]. Unlike international companies, it is unpopular to use drones for agriculture in the Republic of Moldova. Judging by the fact that Moldova's economy is based on agriculture, this domain has a lot of potential for the country.

The main agricultural branches where drones can be proven useful are fruticulture and viniculture. These branches are the easiest to develop reliable agricultural UAVs due to the fact that the plants are relatively large, compared for example to certain vegetables. The plants being large means that it will be easier to collect visual information from them. They are also aligned in rows, that means the information of their position is more predictable. Having as much information as possible about the positions of the plants means it is easier to plan missions for the drones. Agronomists have databases containing information about each plant and their coordinates, thus ensuring a scalable development of the drones.

A first step to implementing drone agricultural industry in the country is to develop cheap small drones that inspect the conditions of the plants. By attaching one or two cameras to the drones, a drone would fly by the plants and take pictures of them. Through a trained neural network, certain conclusions will be made based on the conditions of the plants. Cheap drones do not have a long battery life, being able to function in a time span of 15-20 minutes before needing to recharge, which may take double of that. Depending on the time of picture taking, velocity and acceleration of drones, outside conditions, it might take a lot of time to analyze an entire field of agricultural area. Thus, it is an important feature of UAVs to interoperate together to speed up the process of field scanning and gathering of information.

Drones can communicate with a central unit that tells them where they should go next, where they should take a photo, and when to return for a recharge break. Drones can communicate between themselves, though that raises the complexity of the algorithm. It is important to take into consideration the dangerous side of things, and the potential to cause damage to the crops, and to the drones. Programming the drones to not collide with the crops, or in case of using multiple, to not collide with each other, is a priority.

2.2 Existing Systems

The advent of Internet of Things (IoT) technologies, especially Unmanned Aerial Vehicles (UAVs), marks a pivotal shift in agricultural methodologies, introducing a new era of precision farming. This transition is not only reshaping agricultural practices on the global stage but also holds significant potential for local markets, including the Republic of Moldova. Despite a slower adoption rate in Moldova due to factors such as economic constraints, regulatory challenges, and technological accessibility, the trajectory indicates a promising integration path. This chapter delves into the comparative analysis of two pioneering solutions in the AgTech sector, one with an international footprint and another emerging from the local Moldovan context, highlighting their contributions, methodologies, and their impact on the agricultural domain.

UAVs, or drones, equipped with advanced sensors and imaging capabilities, are revolutionizing agricultural practices by enabling precise monitoring, analysis, and management of crops. These technologies facilitate data-driven decision-making, optimizing resources, and improving crop yields while minimizing environmental impact.

In the Republic of Moldova, the agricultural sector is a cornerstone of the economy, yet it faces challenges such as resource inefficiency and access to modern technologies. The gradual embrace of UAV technology signifies a transformative step towards overcoming these obstacles, propelled by both global innovations and local initiatives.

A French Tech Pioneer ClearSpot.ai [3]. ClearSpot.ai, has distinguished itself by specializing in computer vision and developing algorithms for precision farming. Their approach encompasses spectral analysis of crops, enabling farmers to make informed, data-driven decisions. Significantly, the company offers a Robotics as a Service (RaaS) solution, equipping drones with the necessary software for comprehensive agricultural analysis. This model allows for scalability and adaptability to various farming needs.

AgroDron.MD [4], a Moldovan enterprise, offers smart drones tailored for precision agriculture. They state that using their service lowers the cost of crop maintenance by 50%, lowers the amount of water used by up to 90%, lowers the use of chemicals by 30% to 40%, and eliminates diesel usage, while providing a precision on the rate of centimeters. Also, they estimate the productivity to 20 hectares per hour for spraying and 100 hectares per hour for scanning. The analysis and diagnostics are done in 48 hours. A big advantage of using drones, as they state, is the ability to navigate rough, extreme, slopy terrains, and the ability to perform the flights after rain. Those are huge benefits compared to terrestrial vehicles.

In general, the features in the existing products on the market are assessment of the general conditions, conduction of hydrological evaluations, nitrogen level identification, nutritional map development, smart scanning, weed locating, crop density evaluation, plant counting, loss assessment due to climate or pests.

3. Conclusion

By incorporating advanced IoT capabilities and artificial intelligence, drones are positioned to significantly enhance agricultural efficiency and productivity, as these UAVs have a critical role in automated data collection, optimizing resource use and improving crop management through precise monitoring and analysis. Despite the slower technological adoption in the Republic of Moldova it can bring quite the benefit in economic and operational areas.

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IMAGE PROCESSING DSL

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Abstract. *This paper introduces a domain-specific language (DSL) for image processing, that will overcome the limitations of existing tools in batch processing and automation, crucial for data science and machine learning applications. Unlike traditional image manipulation software that requires extensive programming knowledge or fails to efficiently handle multiple files, this DSL simplifies complex operations, enabling seamless batch processing of images. Its intuitive syntax makes it a useful tool for data preprocessing, a vital step in machine learning model development. This DSL stands out by offering a terminal-based interface, which significantly reduces resource consumption, making it accessible on lower-end hardware. This approach not only democratizes advanced image processing tasks but also aligns with the needs of data science professionals, facilitating their workflows without the steep learning curve typically associated with image processing libraries.*

Keywords: *image editing, batch processing, data science, ANTLR.*

Introduction

Image processing is pivotal across diverse sectors, notably in media and machine learning, where efficient data preprocessing is essential. Current tools for image manipulation often fall short in batch processing capabilities and automation, posing challenges to streamlined data handling. Addressing these gaps, this paper presents a novel domain-specific language designed expressly for image processing. This DSL stands apart from conventional software by offering simplified operation commands and robust batch processing features, significantly improving data preprocessing efficiency vital for developing machine learning models.

Role of a DSL for image processing

In the realm of image processing, a DSL plays an important role in addressing the complex challenges and requirements inherent to this domain. A DSL is a programming language specifically designed to tackle a narrow set of problems within a particular domain, offering specialized syntax, semantics, and features tailored to the specific needs of that domain [1]. HIPA^{cc} [2] and magick [3] are other DSLs which showcase the diversity of tools available for image processing tasks. The suggested DSL differs from other libraries in Unix terminals given the folder processing features and the domain-specific focus for data science tasks, that often involve a series of intricate steps, such as filtering, segmentation, feature extraction, and analysis [4].

With a DSL, developers can abstract away the low-level details of these operations, enabling them to focus on the logic and algorithms. In addition, a DSL makes sophisticated image processing capabilities more accessible to a wider audience, including data scientists, researchers, and enthusiasts with varying levels of expertise. Furthermore, the proposed DSL is intuitive because of its clear and concise commands. By providing a focused and accessible programming environment, it provides help in handling complex image data with ease.

Language Overview

The computational model of this domain-specific language is designed with an imperative and command-driven framework to simplify image processing tasks, making them accessible via command-line interfaces. Furthermore, the model supports pipeline processing, enabling the chaining of commands for complex transformations on the same images, thereby enhancing the tool's versatility for various image processing workflows.

In terms of data handling, the language employs strings for specifying image names and command parameters, alongside numerical values for defining dimensions and adjustment levels. Input consists of the system paths to digital images, while the output consists of the modified pictures. Additionally, effective error detection is a crucial component, ensuring resource efficiency, validating user inputs, and providing feedback for troubleshooting.

Commands

In the suggested DSL, functions, which are alternatively referred to as actions or commands, encompass all the possible image modifications that can be applied to the declared image or folder of images. Below are the actions to be implemented:

- `imp` – initiates a new image processing command sequence with the specified image;
- `crop` – crops the image to a specified rectangle;
- `convert` – converts the image to a different format;
- `rotate` – rotates the image by a specified number of degrees;
- `resize` – changes the size of the image to the specified width and height;
- `flipX` – flips the image horizontally;
- `flipY` – flips the image vertically;
- `bw` – converts the image to black and white;
- `colorize` – applies a color filter over the image;
- `contrast` – adjusts the image contrast;
- `brightness` – adjusts the image brightness;
- `negative` – inverts all colors of the image;
- `blur` – applies a blur effect to the image;
- `sharp` – sharpens the image;
- `compress` – compresses the image file to reduce size;
- `ft` – performs a Fourier transform on the image;
- `threshold` – applies a threshold filter to the image;
- `reduceNoise` – reduces image noise;
- `remBg` – removes background;
- `help` – displays help information for commands.

To exemplify, Fig. 1 highlights examples of syntactically correct commands.

```
imp --img="/path/to/image.png" rotate --deg=90
imp --img="./output.png" resize --w=500 h=500 → ft
imp --img="/path/to/dir" --format="png" → compress
```

Figure 1. Examples of correct DSL commands

Reference Grammar

The reference grammar for the proposed DSL is depicted in Fig. 2, along with the notations used. Each command is described using a combination of terminal and non-terminal symbols, allowing a sequence of image manipulation actions to be concisely expressed. The core of the grammar is defined by the `<img_command_sequence>`, which outlines a sequence of image processing operations. Each operation, represented by the non-terminal `<img_command>`, can perform a variety of actions.

Symbol	Meaning
<foo>	non-terminal.
foo	terminal.
[x]	zero or one occurrence of x.
x*	zero or more occurrences of x.
x+	one or more occurrences of x.
	separates alternatives.

```

S → imp <command>
<command> → --img=<image_arg> <img_command_sequence> | help
<img_command_sequence> → <img_command> | <img_command> -> <img_command_sequence>
<img_command> → crop --x=<int> --y=<int> --w=<int> --h=<int>
| convert --format=<image_type>
| rotate --deg=<int>
| resize --w=<int> --h=<int>
| flipX
| flipY
| bw
| colorize
| contrast --lvl=<int>
| brightness --lvl=<int>
| negative
| blur --lvl=<int>
| sharpen --lvl=<int>
| compress
| ft
| threshold--lvl=<int>
| reduceNoise
| remBg
<image_arg> → <file_path> | <folder_path>
<file_path> → "alpha_num*.image_type"
<folder_path> → "alpha*"
<image_type> → png | jpg | jpeg | bmp | gif | tiff | webp
<int> → <digit>+
<alpha_num> → <alpha> | <digit>
<alpha> → a | b | ... | z | A | ... | Z
<digit> → 0 | 1 | ... | 9

```

Figure 2. Reference Grammar of the DSL

Language Recognition

Following the establishment of the grammar, language recognition becomes an essential phase, ensuring that the syntactical structures outlined are adhered to during command execution. This process is underpinned by the integration of ANTLR, which transcribes the specified grammar into a parser that interprets the input commands [5]. The ANTLR v4 extension for Python, particularly its "Preview" component, plays a crucial role in this phase by enabling the generation and visualization of parse trees.

The language recognition stage consists of the Lexer, which serves as the initial filter and transforms the input into a series of tokens, and the Parser which organizes these tokens into a parse tree. This tree represents the hierarchical syntactic structure of the command, enforcing the grammar's rules. To demonstrate this, the following command designed for the DSL – `imp --img="image.png" crop --x=100 --y=100 --w=200 --h=200 -> convert --format=html -> rotate --deg=90`, aims to enact a sequence of image processing actions which include cropping an image, attempting a format conversion, and applying a rotation.

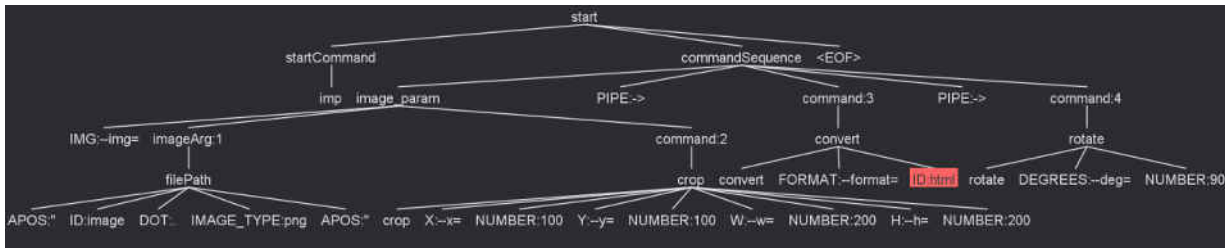


Figure 3. Example of a Parse Tree

Fig. 3 depicts the parse tree generated from the command. The structure elucidates the parsing process, showing each operation as a branch in the tree. It also reveals a critical error at the conversion operation where `--format=html` is flagged. This error is a direct result of 'html' not being a defined image format within the DSL grammar, illustrating the system's ability to validate inputs against the grammar and provide feedback on syntactic correctness.

The development of this DSL is currently ongoing, with Python chosen as the primary language for implementation. This decision leverages Python's extensive array of libraries, particularly those dedicated to the image manipulation field.

Conclusions

In conclusion, the development of a domain-specific language for image processing represents an advancement in the field, particularly for data science and machine learning applications. By addressing the limitations of existing tools in batch processing and automation, this DSL streamlines complex operations and enables efficient data preprocessing. Its integration with Python and terminal-based interface makes it accessible and user-friendly, democratizing advanced image processing tasks and facilitating workflows. Moving forward, further research and development in DSLs for image processing holds promise for enhancing the efficiency and accessibility of image manipulation tasks.

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DOMAIN SPECIFIC LANGUAGE FOR SPECIFYING FORMAL SOFTWARE REQUIREMENTS

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Abstract. *This article represents a comprehensive analysis of developing a Domain Specific Language for specifying formal software requirements. The paper describes the process of the DSL's creation, focusing on its objectives, key features, and governing principles. This analysis outlines the essential components and capabilities that the DSL incorporates, including syntax, semantics, and the grammar's vocabulary. Through the utilization of the ANTLR tool, a parse tree was constructed that precisely illustrates the DSL's structure, offering a clear view of its configuration. The DSL is crafted to facilitate the expression of both non-functional and functional software requirements, through a structured format that encompasses interfaces, specifications, and detailed requirements and functionalities specifications. This new DSL strives to simplify the specification process, bringing forth innovative methods and perspectives for the effective articulation of software requirements.*

Keywords: *DSL, grammar, semantics, syntax, specification, software requirements*

Introduction

Domain-Specific Languages (DSLs) for specifying formal software requirements represent a focused approach to overcoming the traditional challenges encountered in software development. These languages are engineered to offer a high degree of specificity, enabling developers and stakeholders to communicate requirements with unparalleled precision. The essence of DSLs lies in their ability to encapsulate complex software functionalities and requirements within a more intuitive and accessible linguistic framework. This specificity facilitates a deeper understanding among all parties involved in the development process, from business analysts and project managers to the software engineers themselves. By tailoring the syntax and semantics to fit the unique needs of a particular domain, DSLs bridge the gap between the conceptual models of a system and the technical specifications required for its implementation [1, 2].

Domain Analysis

In a world where software is becoming increasingly complex and integrated into the core processes of enterprises and users' lives, it is necessary to ensure a high level of precision and predictability in the solutions being developed.

According to the most recent data from Statista 2024, the software market is expected to witness consistent growth, surpassing \$1 trillion in revenue by 2027. This expanding tendency emphasizes the value of software development economically as well as how society is becoming more and more dependent on technical solutions [3].

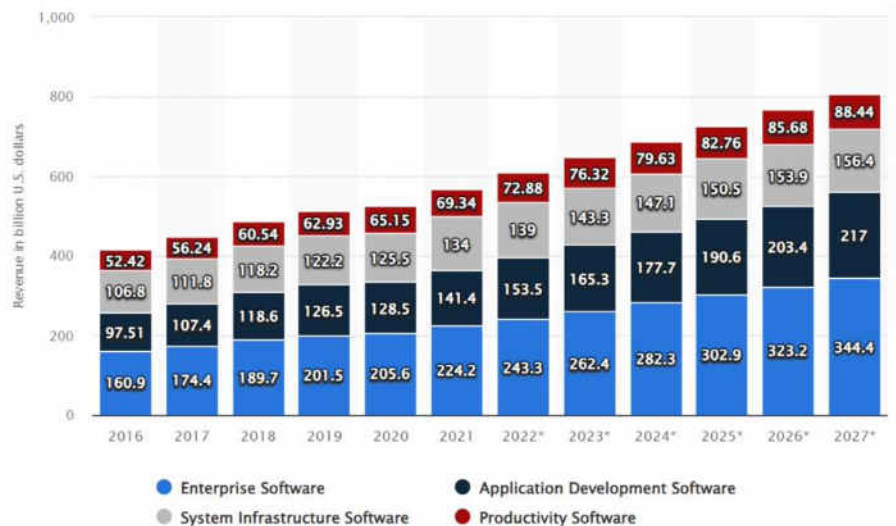


Figure 1. Revenue of the software market worldwide from 2016 to 2027 [3]

A key factor in the creation of a successful software product is the accuracy and clarity in the definition of its requirements.

Software Requirements Specification (SRS) serves as a foundational element in the software development lifecycle, offering a comprehensive description of the software's intended functionalities and operational conditions. Despite its critical role, current SRS practices often encounter significant challenges that can hinder the development process and impact the quality of the final product. These challenges primarily revolve around ambiguity, inconsistency, and a lack of formality, each contributing to potential misunderstandings and misalignments between stakeholders' expectations and the software development outcomes.

Language Overview

"Winx" is proposed as a Domain-Specific Language (DSL) designed to bridge the gap between formal, precise specifications and natural language software requirements. Its methodical development plan began with the establishment of essential technologies, including Angular, and the use of JetBrains' IntelliJ IDEA, complemented by the Antler plugin for advanced grammar development [4].

Users interact with *Winx* by typing in programs using a markdown-like syntax, enabling them to express software requirements clearly and efficiently. The computational model of *Winx* focuses on providing a structured language for requirements expression, akin to markdown, with logical operators like "and" and "or". Basic data structures in *Winx* include variables that can be replaced with arrays or custom data types, enhancing flexibility in data manipulation [5].

Winx enhances the specification and implementation process through its support for control structures like packages, interfaces, and inheritance, which enable effective program flow and structure management. The requirement for complete code input for implementation, coupled with the system's ability to check and output the implementation order, adds a layer of precision and error detection. Moreover, *Winx*'s error handling mechanism is designed to be robust, with a parser that identifies and communicates errors during the compilation phase for timely resolution [6]. The DSL extends its utility with tool support, including a VS Code extension for error highlighting, which aids in a smoother development experience. By leveraging Java as the host language, *Winx* aligns closely with widely used programming paradigms, offering a user-friendly, efficient, and error-resilient platform for formalizing software requirements, thereby facilitating improved communication among stakeholders and streamlining the software development lifecycle.

Grammar

An example of grammar that could be used for a DSL for specifying formal software requirements is given below:

```
<winx> ::= (<package> | <DESCRIPTION>)+
<body> ::= (<interface> | <specification> | <DESCRIPTION>)+

<package> ::= package <ID> { <body> }
<interface> ::= <importance> <access_modifiers> interface <ID> { <interface_body> }
<specification> ::= specification <ID> (implements <ID>)* { <specification_body> }
<interface_body> ::= (<requirementSpec> | <functionSpec>)+
<specification_body> ::= (<requirementSpec> | <functionSpec>)+

<requirementSpec> ::= <description> <importance>? <ID> { <req_specification>*
<result_specification>* }
<req_specification> ::= <importance> @ <ID> (<logical_op> <ID>)* ;
<result_specification> ::= result <importance> <ID> ;
<logical_op> ::= AND | OR

<functionSpec> ::= <description> <importance> <access_modifiers> <ID> (
<input_types>) (implements <ID>)* <functionBody>
<functionBody> ::= { <specificationEntry>* <return_types> }
<input_types> ::= <variable> (, <variable>)*
<return_types> ::= return <variable> (, <variable>)* ;
<specificationEntry> ::= @ <ID> : <STRING> ;

<variable> ::= <type> []? <ID>
<importance> ::= critical | optional
<type> ::= INT | FLOAT | DOUBLE | STRING | BOOLEAN | CHAR | VOID
<access_modifiers> ::= public | protected | private | default
<description> ::= <DESCRIPTION>

<LPAREN> ::= (
<RPAREN> ::= )
<COLON> ::= :
<SEMICOLON> ::= ;
<COMMA> ::= ,
<LBRACE> ::= {
<RBRACE> ::= }
<TILDE> ::= ~
<EXCLAM> ::= !
```

The key components for this grammar include:

1. Packages: Organizational units containing interfaces or specifications.
2. Interfaces and Specifications: Define contracts for software components, detailing requirements and functionalities.
3. Requirement and Function Specifications: Describe specific software needs and functions, incorporating logical operators (AND, OR) and importance levels (critical, optional).
4. Data Types and Variables: Support basic data types and variables for defining function inputs and outputs.

5. Access Modifiers: Control visibility of interfaces and functions (public, protected, private, default).

Code Example

An illustration of code crafted in the described Domain-Specific Language (DSL) is presented within Fig. 2. It defines a high-priority interface in a "Database" package, with a critical method GetUserList that processes an array of floats and is expected to execute within 10 seconds. The method returns a custom data type, highlighting its essential role in the database operations.

```

package Database {
  ~An interface holds an abstract structure~
  critical interface Database {
    // comment
    critical public GetUserList(FLOAT[] input)
  {
    @ExecTime : "10s";
    return "CustomDataType" x;
  }
}
    
```

Figure 2. Code example in Winx

Derivation Tree

The use of ANTLR for parsing, applied to the code example provided earlier, resulted in the generation of a parse tree, which adheres to the established grammar rules (Fig. 3). It shows the hierarchical structure of the language constructs as they would be presented internally by parser after lexing and parsing the input text.

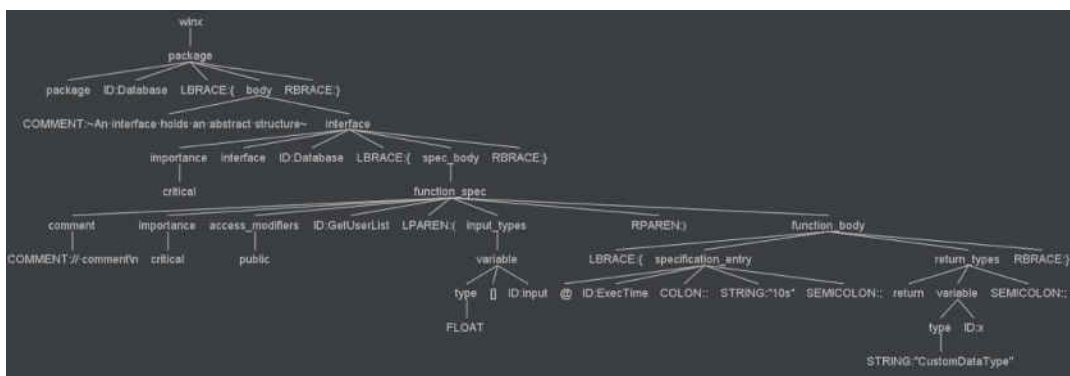


Figure 3. Derivation tree

Conclusions

The development of Winx, a Domain-Specific Language (DSL) for formal software requirements, marks a substantial advancement in converting natural language requirements into precise, actionable specifications. Leveraging tools such as Angular, IntelliJ IDEA, and the Antler plugin, Winx offers a markdown-like syntax for clear and efficient articulation of software needs.

Winx's design is notably user-friendly for developers, closely resembling Java to ensure ease of understanding and use. This similarity facilitates a smooth transition for developers familiar with Java, enhancing comprehension and execution of software requirements. Enhanced by a robust error handling mechanism and tool support, including a VS Code extension, Winx ensures a seamless development process by quickly identifying and rectifying errors.

The initiative behind Winx aims to streamline the software development process, improve software quality, and foster better collaboration among team members. By aligning closely with

Java's semantics, Winx not only improves communication among stakeholders but also significantly benefits the software development lifecycle from requirements gathering to deployment.

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DEVELOPING A DOMAIN-SPECIFIC LANGUAGE FOR GEOMETRY PROBLEMS

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Abstract. *The development of a domain-specific language (DSL) designed for geometric problems aims to streamline the process of formulating and solving mathematical and computational geometry challenges. This paper presents the design, implementation, and applications of DSL, which offers intuitive syntax and functionality to address a wide range of geometric scenarios. The DSL is specifically crafted to accommodate various use cases prevalent in fields such as computer graphics, computational geometry, robotics, and architectural design. The language enables users to express geometric concepts, operations, and algorithms, facilitating rapid prototyping, analysis, and visualization of geometric data. The lexer and parser components handle lexical considerations, providing error handling and efficient parsing of geometric expressions. Furthermore, the language incorporates a rich set of primitives, functions, and operators made for common geometric tasks, including point, line, polygon, and transformation manipulation. This paper details the language's grammar, lexical considerations, lexer, and parser components, offering insights into its design principles and implementation specifics.*

Keywords: *domain-specific, geometry, language, programming, tool, visualization.*

Introduction

A Domain Specific Language (DSL) is a type of programming language that is highly abstract and tailored to address problems within a particular domain effectively. It incorporates the unique concepts and regulations pertinent to that specific field [1].

This DSL is specifically designed to improve geometric problem visualization. This product provides a user-friendly platform for creating and manipulating geometric shapes, making it a unique tool for educational technology and engineering design. Some of the shapes that the tool covers are point, line, segment, triangle, square, rectangle, parallelogram, trapezoid, rhombus, circle, ellipse, etc.

This article will cover the development process of the DSL.

Grammar

Programming language grammar is a set of rules governing how code is structured, akin to grammar in natural languages. It ensures correct arrangement and sequencing of symbols, keywords, and elements. Following grammar rules enables clear communication between developers and computers, reducing syntax errors.

Lexical considerations

In this Geometry DSL, lexical considerations enhance clarity and maintain syntax integrity. Case sensitivity distinguishes entities like 'Shape' and 'shape'. Reserved keywords like 'Circle' are vital and cannot be used as identifiers. Comments improve code readability, supporting both single-line (*//*) and multi-line (*/* */*) annotations.

Whitespace is ignored for parsing, ensuring code layout does not affect execution. Identifiers must start with alphabetic characters and adhere to standard programming conventions.

Numerical literals represent sizes and coordinates, following decimal representation for consistency.

Special characters like '=' and '+' have defined roles, aiding geometric calculations. Adhering to these lexical guidelines maintains order and coherence, crucial for educational use and professional modeling tasks.

Terminal Symbols

Terminal Symbols are indivisible elements in the final string produced by formal grammar, forming the concrete content understood by the language. They cannot be altered by grammar rules and constitute the result of recursive rule application. The Start Symbol, a prime non-terminal symbol, marks the beginning of language parsing, initiating syntax tree construction or derivation sequence.

$S = \{ \langle \text{source code} \rangle \}$

In this geometry DSL, Terminal Elements include:

```
 $V_T = \{$   
'=', '+', '-', '*', '/', '->', 'Point', 'Line', 'Segment', 'Triangle', 'Height',  
'EquilateralTriangle', 'IsoscelesTriangle', 'Square', 'Rectangle',  
Parallelogram', 'Circle', 'Ellipse', 'Rhombus', 'bisector', 'Angle', 'Vertex',  
'{', '}', '(', ')', 'for', 'while', 'if', 'else', 'true', 'false',  
'++', '--', '<', '<=', '>', '>=', '==', '!='  
 $\}$ 
```

Non-Terminal Symbols

Non-terminal symbols are the syntactic variables of your language, representing sequences of tokens and other non-terminals used to define the structure and rules of the grammar. They serve as building blocks for the language's structure. Non-terminal symbols help to organize the grammar into a hierarchy of rules, allowing for the modular design of language constructs. They play a crucial role in facilitating the expansion of the language. As new rules and structures can be added by defining additional non-terminal symbols without altering the existing grammar framework.

Our non-terminal symbols:

```
 $V_N = \{$   
<program>, <statement>, <commentStatement>,  
<functionCallStatement>, <functionCall>, <functionDeclaration>,  
<loopStatement>, <forLoop>, <whileLoop>, <ifElseStatement>,  
<figureDeclaration>, <variableDeclaration>, <expression>, <type>,  
<point>, <comment>, <areaCall>, <perimeterCall>, <diagonalCall>, <areaTriangleCall>,  
<areaCircleCall>, <areaSquareCall>, <areaRectangleCall>, <perimeterTriangleCall>,  
<perimeterCircleCall>, <perimeterSquareCall>, <perimeterRectangleCall>,  
<pointDeclaration>, <lineDeclaration>, <segmentDeclaration>, <triangleDeclaration>,  
<squareDeclaration>, <rectangleDeclaration>, <parallelogramDeclaration>,  
<circleDeclaration>, <ellipseDeclaration>, <rhombusDeclaration>, <aliasVertex>,  
<triangleProperty>, <bisectorDeclaration>, <angleDeclaration>, <heightDeclaration>,  
<forInit>, <forCondition>, <forUpdate>, <argumentList>  
 $\}$ 
```

Production Rules

Production Rules form the grammar's backbone, outlining how strings within the language are built from non-terminal symbols as shown in Table. 1. The goal was to create comprehensible Grammar for all users of our geometry DSL.

Table 1

Meta-notation	
Element	Description
<test>	Indicates that test is a non-terminal element.
test	Indicates that test is a terminal element.
x^*	Zero or more occurrences of x
x^+	Indicates one or more occurrences of x
(x)	Groups elements together to treat them as a single unit in expressions or rules, influencing the scope of operators like $*$, $^+$, and $?$.
→	Used to define production rules in ANTLR, showing that a non-terminal can be derived into other non-terminal or terminal symbols.
;	Ends a declaration or statement
	Separates alternatives
?	Indicates zero or one occurrences of the preceding element, making it optional.
//	Comment section

The following key instructional rules form the basis of our language:

```

P = {
<program> → <statement>+
<statement> → <figureDeclaration> ';' | <variableDeclaration> ';' | <expression> ';' |
<commentStatement>
<figureDeclaration> → <geometryType> <identifier> '(' <argumentList>? ')'
<geometryType> → 'Point' | 'Line' | 'Segment' | 'Triangle' | 'Height' |
'EquilateralTriangle' | 'IsoscelesTriangle' | 'Square' | 'Rectangle' | 'Parallelogram' |
'Circle' | 'Ellipse' | 'Rhombus'
<identifier> → (<letter> | '_') (<letter> | <digit> | '_')*
<letter> → 'a' | 'b' | 'c' | ... | 'z' | 'A' | 'B' | 'C' | ... | 'Z'
<digit> → '0' | <non-zero digit>
<non-zero digit> → '1' | '2' | '3' | '4' | '5' | '6' | '7' | '8' | '9'
<variableDeclaration> → (<type>?) <identifier> ('=' <expression>)?
<type> → 'num' | 'bool' | 'string' | 'int'
<expression> → <expression> (<operator> <expression>) | <identifier> | <number> |
<string> | <boolean> | '(' <expression> ')'
<operator> → '+' | '-' | '*' | '/' | '%' | '<' | '<=' | '>' | '>=' | '==' | '!=' | '++' | '--'
<number> → <numericValue>
<numericValue> → <digits> ('.' <digits>)?
<digits> → <digit> | <digits> <digit>
<string> → "" <string characters>* ""
<string characters> → <characters>*
<characters> → <letter> | <digit> | <special character>
<special character> → any printable character except ""
<boolean> → 'true' | 'false'
<argumentList> → <expression> (',' <expression>)*
<functionCallStatement> → <functionCall> ';'
<functionCall> → <identifier> '-'> <functionDeclaration>
<functionDeclaration> → <areaCall> | <perimeterCall> | <diagonalCall> |
<areaTriangleCall> | <areaCircleCall> | <areaSquareCall> | <areaRectangleCall> |
<perimeterTriangleCall> | <perimeterCircleCall> | <perimeterSquareCall> |
<perimeterRectangleCall>
<loopStatement> → <forLoop> | <whileLoop>
<forLoop> → 'for' '(' <forInit> ';' <forCondition> ';' <forUpdate> ')' '{' <program> '}'
<whileLoop> → 'while' '(' <expression> ')' '{' <program> '}'

```

```
<ifElseStatement> → 'if' '(' <expression> ')' '{' <program> '}' ('else' '{' <program>
}')?
<commentStatement> → '//' <comment> | '/*' <comment> '*/'
<comment> → <characters>*
}
```

Lexer

The process of translating high-level programming languages into executable machine code is facilitated by components such as lexers and parsers. Lexers, often referred to as lexical analyzers, parse source code into tokens, which serve as the foundational units for subsequent analysis.

Techniques for Efficient Lexical Analysis

Almost every lexer technique involves two primary stages: a scanner and an evaluator. First of all, the scanner, is often based on a finite-state machine (FSM). It has encoded information regarding the possible sequences of characters that can be found within any of the tokens it handles, known as lexems. What is a lexeme? The lexeme is simply a sequence of characters recognized as a particular type. To create a token, the lexical analyzer requires a subsequent stage, called the evaluator, which examines the characters of the lexeme to assign a value. It is the combination of the lexeme's type and this value that forms a token, which is then suitable for submission to a parser [2].

Parser

Parser Functionality

Parsing involves crucial functionalities. First, it scrutinizes code syntax provided by the lexer, ensuring adherence to programming language grammatical rules. Second, it constructs a parse tree or an abstract syntax tree (AST) capturing program hierarchical structure. Lastly, it handles error reporting and recovery, conveying syntax issues to developers and attempting error recovery to parse remaining code, enabling multi-error detection in a single pass.

Advanced Parsing Techniques

Various advanced techniques and tools address parsing challenges. Parser generators like Yacc, Bison, and ANTLR automatically generate parser code from formal grammar specifications. Predictive parsing, used by LL parsers, involves looking at upcoming tokens to make parsing decisions efficiently. Generalized parsing approaches, like Generalized LR (GLR) parsing, handle all context-free grammar, producing multiple parse trees in case of ambiguities [3].

Graphical Representation of Parse Trees

Parse trees visually represent code interpretation and structure based on language underlying grammar. For example, the respecting parse trees represent a point declaration (Fig. 1) and a triangle declaration (Fig. 2) within the DSL. These parse trees display the hierarchical nature of language syntax and parsing various statements and declarations within the DSL framework [4]. This method of visualization is crucial for understanding the flow and the logical structuring of code, which can help in debugging and optimizing the code. Moreover, it helps developers in grasping the abstract concepts of a DSL more effectively by providing a clear and concrete representation of how each component relates to others within the program's architecture.

The code *Point B(100, 500);* initializes a point, B, with coordinates (100, 500). This line of code is used to define the position of point B in a two-dimensional space. Below, a parse tree is provided to visually depict the structured analysis of this declaration (Fig. 1)

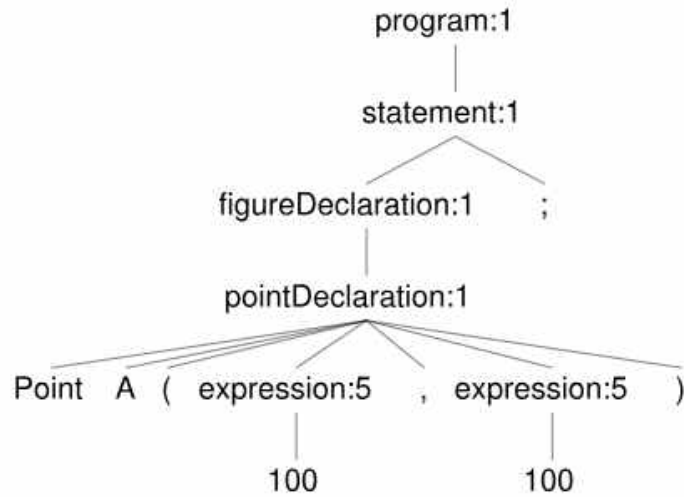


Figure 1. Point Declaration Parse Tree

The code *Triangle t1(S : 200, D : 300, E : 400)* initializes a triangle with specified parameters, where **S**, **D**, and **E** define the properties of the triangle such as side lengths or angles, depending on the context. This code is designed to generate triangles with these attributes. Below, a parse tree is provided to demonstrate the structured analysis of this declaration (Fig. 2)

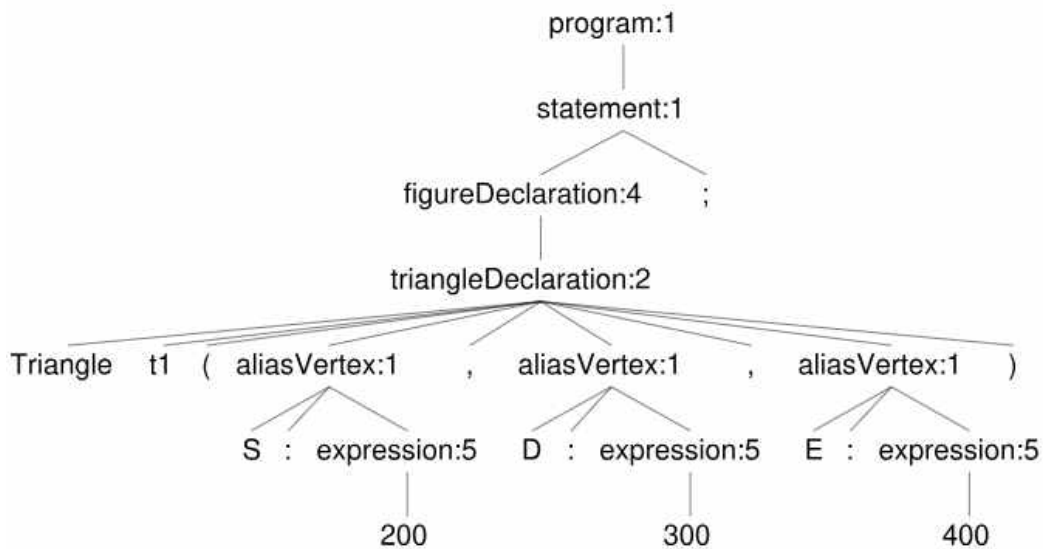


Figure 2. Triangle Declaration Parse Tree

The code *for (int i = 0; i < 10; k++) { Point A(i, i+1); }* generates a loop that iterates as long as *i* is less than 10. During each iteration, a new Point object named A is created with coordinates that incrementally increase by 1. Below is a parse tree (Fig. 3) illustrates the breakdown and hierarchical organization of this loop and the instantiation of Point objects inside it.

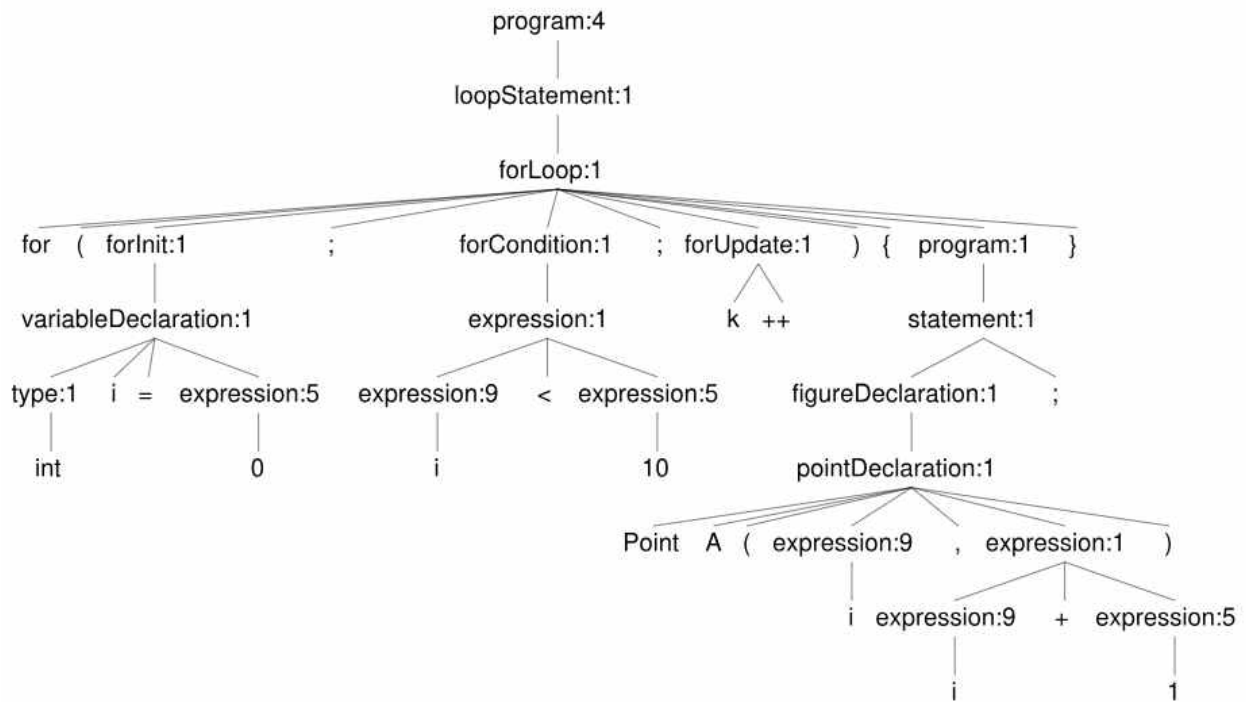


Figure 3. For-loop Declaration Parse Tree

The code `if (k % 2 == 0) { Square sq(k); } else { Rectangle rect(k, k+1); }` creates geometric shapes based on the value of k. If k is even, a square with side length k is created. If k is odd, then rectangle with width k and height k+1 is instantiated. So, this logic demonstrates conditional branching in programming. Below, a parse tree illustrates the hierarchical parsing of this conditional statement (Fig. 4)

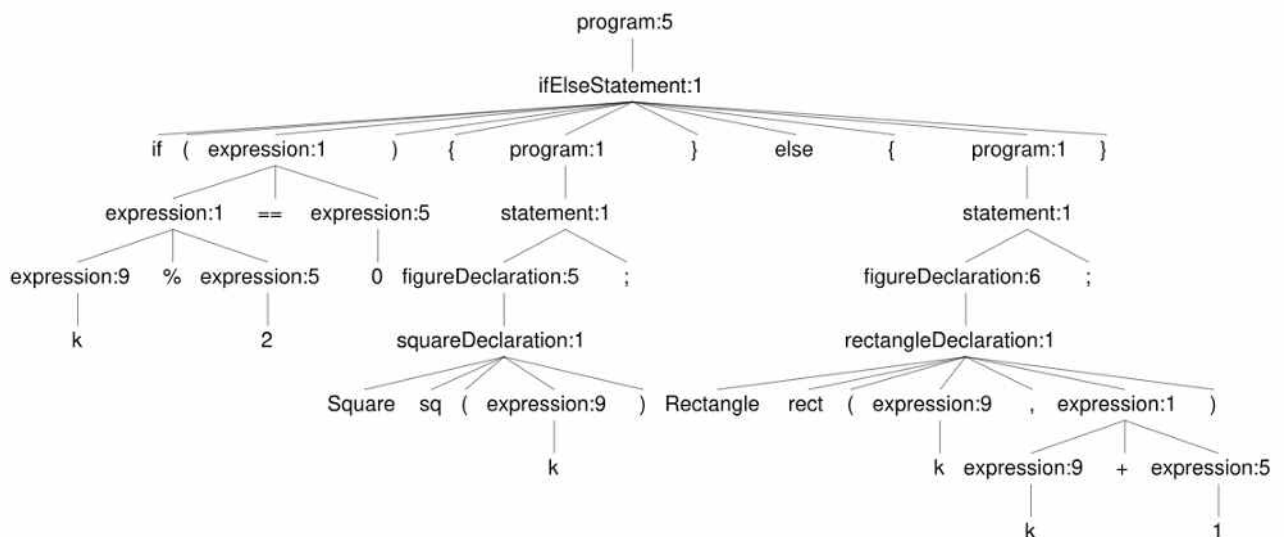


Figure 4. If-else statements Parse Tree

Conclusions

In this paper, we introduced the DSL made for geometric problems. We discussed its intuitive syntax, robust functionality, and diverse applications across fields like computer graphics, computational geometry, robotics, and architectural design. Throughout, we highlighted key features such as its flexible grammar, careful lexical handling, and comprehensive set of geometric tools. By delving into its design and implementation, including lexer and parser components, we emphasized the language's potential to streamline geometric computations. The language offers a

powerful solution for rapid prototyping, analysis, and visualization of geometric data. We believe its adoption will significantly enhance productivity and foster innovation in computational geometry, paving the way for future advancements.

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DEVELOPING A DOMAIN-SPECIFIC LANGUAGE FOR GRAPHS

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Abstract. *This paper introduces the development of a domain-specific language tailored for graph illustration, focusing on its grammar, lexical parser, and functionality. The necessity for specialized tools in graph visualization, particularly in interpreting complex datasets, has led to the creation of this domain-specific language aimed at enhancing user interaction with graphical data. By detailing the implementation of the language's syntax and semantics, a comprehensive overview of how it simplifies the construction and manipulation of graph representations is provided. Furthermore, the practical applications of this domain-specific language in various fields are explored, demonstrating its potential to facilitate clearer data insights and improve decision-making processes. The paper culminates with a conclusion that reflects on the implications and future directions of this domain-specific language in graph illustration.*

Keywords: *Graph, Domain-specific language, Grammar, Syntax, Parser*

Introduction

Graphs serve as a foundational tool in mathematics and computer science, offering a robust framework for representing and analyzing complex relationships within various datasets. This paper focuses on the development of a domain-specific language (DSL) named GraphExpress, aimed at streamlining graph manipulation and analysis. GraphExpress leverages an intuitive syntax and a comprehensive suite of functionalities to make graph operations more accessible to a broader audience, enhancing user interaction with graphical data. The advent of GraphExpress represents a significant stride in graph visualization, particularly in interpreting complex datasets, by simplifying the construction and manipulation of graph representations and demonstrating its potential in facilitating clearer data insights and improving decision-making processes across various fields.

Domain Analysis

In an increasingly interconnected world, the relevance of graph theory transcends a wide array of fields, offering profound insights into the structural and dynamic properties of complex systems. From social networks to biological systems, transportation networks, and beyond, graphs serve as a universal language for modeling relationships and analyzing interconnected data. The advent of the digital age, marked by the exponential growth of the internet and social media, has further amplified the applications of graph theory, making it an indispensable tool in navigating the complexity of modern life [1].

Graph theory, with its roots tracing back to Euler's bridges, has evolved from solving recreational mathematical puzzles to a significant area of mathematical research and application. This evolution reflects the growing complexity of the systems we seek to understand and optimize, from urban planning and logistics to the spread of information and diseases [2].

Graphs come in various forms, each suited to model different aspects of relationships within systems [3]:

- Simple Graphs: offer a foundational model for representing distinct entities and their interactions, widely applied in theoretical and practical domains.
- Multigraphs and Directed Acyclic Graphs (DAGs): cater to scenarios where relationships can vary in context or strength, or where processes with dependencies need to be modeled, such as in task scheduling and data processing pipelines.
- Trees and Forests: symbolize hierarchical structures, foundational in data structures, organizational charts, and decision-making processes.
- Bipartite and k-partite Graphs: useful in scenarios where entities are divided into distinct categories, such as matching jobs to applicants.
- Planar Graphs and Weighted Graphs: essential in geographic mapping and optimizing paths or flows in networks based on various criteria like cost or capacity.
- Hypergraphs: offer flexibility for modeling complex relationships beyond simple pairwise connections, applicable in areas such as co-authorship networks or actor collaborations.

Amidst this utility, DSLs emerge as pivotal in addressing the intricacies of graph-related operations, streamlining the creation, management, and analysis of graph data. DSLs, with their targeted functionality and simplified syntax, cater directly to the domain of graph theory, offering a more intuitive approach for users to engage with complex data structures. This shift towards specialized tools signifies a broader move to make technological solutions more accessible and efficient, particularly in fields where data complexity can quickly become overwhelming.

Despite the utility of graphs, the manual creation, management, and analysis of large-scale graphs present significant challenges. The complexity of these tasks grows exponentially with the size of the graph, introducing inefficiencies, potential for errors, and limitations in the application of graph theory to real-world problems. These challenges underscore the need for automated solutions to efficiently manage and analyze complex graph data.

Solution Proposal

In response to these challenges, GraphExpress is proposed as a DSL designed to simplify the creation, manipulation, and analysis of graphs. By offering an intuitive syntax and a comprehensive suite of functionalities, GraphExpress aims to democratize access to advanced graph operations. Its design focuses on automating the tedious aspects of graph management, incorporating powerful algorithms for analysis, and facilitating data visualization and integration.

Table 1

SWOT Analysis of GraphExpress

Strengths	Intuitive syntax, Comprehensive tools, Automated construction & maintenance, Integrated visualization
Weaknesses	Narrow focus, Initial learning curve, Performance limits for large datasets
Opportunities	Growing data needs, Role in AI and ML applications, Educational resource
Threats	Competitive market, Rapid technological changes, Need for strong user community

Lexical Considerations

In constructing GraphExpress, a set of lexical considerations was meticulously formulated to enhance clarity, ensure consistency, and maintain functionality within the language syntax. These guidelines are crucial for the effective parsing and interpretation of the DSL scripts.

GraphExpress is designed to be case-sensitive. This distinction applies to both keywords and identifiers, which means 'draw' is considered different from 'Draw' or 'DRAW', and similarly, 'Node' differs from 'node'. This sensitivity impacts how keywords are recognized and how identifiers are differentiated, ensuring precise interpretation of language constructs.

Certain terms are reserved as keywords within our grammar, including 'draw', 'Binary', and 'Bipartite'. These keywords play pivotal roles in the language syntax and semantics, thus they are prohibited from being used as identifiers for nodes or other elements within the DSL scripts. This reservation prevents ambiguity and enhances the structural clarity of graph definitions.

In GraphExpress, comments are implemented as single-line comments starting with `//` and extending to the end of the line, allowing for annotations and explanations within scripts. This approach ensures clarity and maintainability, as users can include descriptive notes directly alongside their code.

Identifiers are essential for naming graph nodes and must start with an alphabetic character, followed by a combination of alphanumeric characters. This requirement ensures that all node names are distinguishable and adhere to typical programming naming conventions, facilitating clear and meaningful graph representations.

In our GraphExpress, numerical literals, especially when representing weights in connections between nodes, are restricted to non-negative decimal digits (0-9) and can include decimal points for floating-point values. This approach aligns with the grammar's simplicity and directness, catering to the common use cases in graph specifications.

Specific symbols such as '-', '<', '>', '*', and '!' are endowed with particular roles within our DSL, primarily concerning the definition and attributes of node connections. Their utilization is bound to explicit patterns established in the grammar, ensuring the syntactic integrity and interpretative clarity of the language.

Creating a Grammar

This section details the formal grammar for this DSL, designed to provide a structured way to represent various types of graphs. The grammar is defined using a series of nonterminal and terminal symbols, production rules, and meta-notation to describe how users can construct graph descriptions.

The start symbol of our grammar is `<program>`, which sets the foundation for any graph description. A program comprises a series of commands followed by the draw keyword, indicating the end of the graph specification.

Terminal symbols:

- `<`, `-`, `>`: these symbols are used to establish connections between nodes in the graph. They represent different types of edges, such as undirected (`-`), directed towards (`>`), and directed from (`<`).
- `draw`: this keyword signifies the end of the graph description, prompting the visualization of the defined graph.
- `*`: this symbol indicates that a node is a final node, akin to final states in finite automata, affecting its representation in the graph.
- `-->`: this symbol denotes the starting node of the graph, similar to the initial state in finite automata.
- `Binary`, `Bipartite`: these specify the type of the graph being defined, altering how the graph is interpreted and displayed.
- `.`, representing the decimal point used in floating-point numbers within graph weights.


```

Start = {<program>}
VT = {-, <, >, draw, *, -->, Binary, Bipartite, _}
VN = {<program>, <set of commands>, <type>, <connection list>, <comment>
<connection>, <node>, <start>, <final>, <number>, <alpha>, <digit>, <char>}
P = {
    <program> → <set of commands> draw
    <set of commands> → [<type>] <connection list>
    <type> → Binary | Bipartite
    <connection list> → [<comment>] <connection> [<comment>] [<connection
list>] | ε
    <comment> → // <char>*
    <connection> → [<start>] <node> [<->] [<number>] [<->] <node>
    <node> → <alpha> <char>* [<final>]
    <start> → -->
    <final> → *
    <number> → <digit>+ | <digit>+ . <digit>+
    <alpha> → A | B ... Z | a | b ... z |
    <digit> → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
    <char> → A | B ... Z | a | b ... z | 0 | 1 ... 9
}

```

Figure 1. GraphExpress grammar

Non-terminal symbols:

- <program>: represents the entire graph description, consisting of a set of commands terminated by the draw keyword.
- <set of commands>: may start with a graph type (Binary or Bipartite) indicating the nature of the graph. If no type is specified, the graph is treated as a standard graph. It also includes a mandatory <connection list>, detailing the graph's connections.
- <connection list>: details the user-defined connections between nodes. It allows an arbitrary number of connections and incorporates optional comments. Defined recursively, it enables a sequence of connections, interspersed with comments, ending when the list is empty (denoted by ε).
- <comment>: begins with // and can be followed by any characters except newline, allowing users to include explanatory text within their graph descriptions.
- <connection>: defines the connections between nodes, which may include optional start symbols (-->) and must include two nodes. Connections can represent different types of relationships between nodes, including unidirectional, bidirectional, or weighted edges.
- <node>: represents the identifiers for graph nodes. A node starts with an alphabetic character and can be followed by additional alphanumeric characters. A node can be marked as final by appending *.
- <number>: describes numbers used in the graph, which can be integers or decimals, allowing for the specification of weights in the graph connections.
- <alpha>, <digit>, <char>: represent alphabetical characters, numerical digits, and a combination of both, respectively. These are used in constructing node names and numbers

The production rules (P) define how the nonterminal symbols are constructed from both nonterminal and terminal symbols. They form the core structure of the grammar, dictating how users can combine different elements to describe their graphs.

- The `<program>` rule establishes that a graph description must consist of a sequence of commands followed by `draw`.
- `<set of commands>` allows for an optional graph type followed by a list of connections, defining the graph's structure.
- `<connection list>` facilitates the definition of node connections and supports interspersed comments for clarity and documentation purposes.
- `<connection>`, `<node>`, and related rules specify the syntax for creating and naming graph elements and their interconnections.

Parsing example:

```
A-8-B  
B-->C  
B<-->D*  
  
draw
```

Figure 2. Graph express code example

This code represents a graph definition in GraphExpress. The parsing according to our grammar rules and explain the role of each component is next:

1. `A-8-B`: this line defines a connection between two nodes, A and B, with a weight of 8. In terms of our grammar:
 - A and B are recognized as `<node>` elements.
 - `-8-` between A and B specifies the weight of the connection using the `<number>` nonterminal.
 - The entire structure `A-8-B` follows the `<connection>` rule, representing a weighted undirected edge between nodes A and B.
2. `B-->C`: this line defines a directed connection from node B to node C. According to our grammar:
 - B and C conform to the `<node>` definition.
 - `-->` between B and C indicates a directed edge starting from B and pointing towards C.
3. `B<-->D*`: this line represents a bidirectional connection between nodes B and D:
 - Again, B and D are identified as `<node>` elements.
 - The `<` and `>` around the `-` symbol indicate a bidirectional connection.
 - The `*` at the end of D indicates that D is a final node.
4. `draw`: this terminal symbol marks the end of the graph definition.

Starting with the `<program>` nonterminal, the parser recognizes a sequence forming `<set of commands>` followed by the terminal `draw`. The `<set of commands>` for this example does not explicitly define a graph type (e.g., Binary or Bipartite), so the default assumption is a general graph structure.

The <connection list> within <set of commands> comprises three <connection> entries, separated by newlines. Each connection utilizes different aspects of the <connection> grammar, demonstrating the versatility of our grammar in defining various types of node relationships.

The parsing process follows the formal rules set by the grammar, ensuring that the input code correctly represents a graph according to the language's syntax and semantics. The result of this parsing process would be an internal representation of the graph described by the input, ready for further processing, such as visualization or analysis.

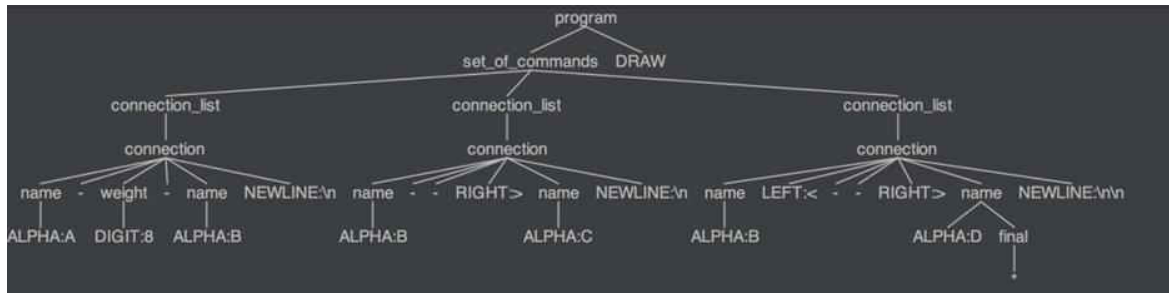


Figure 3. Parsing tree example

Conclusions

GraphExpress, as a DSL tailored for graphs, embodies an advancement in the field of graph analysis. Its development is a response to the evident need for specialized tools capable of simplifying graph management and analysis tasks. By integrating intuitive syntax, automated graph management, advanced analysis tools, and dynamic visualization, GraphExpress has significantly reduced the barriers to engaging with complex graph data. Its introduction promises to enhance productivity, foster deeper insights, and facilitate innovation in various domains where graph analysis is essential.

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FORMALIZATION OF DISTRIBUTED SYSTEMS WITH SEMANTIC INTEROPERABILITY

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Abstract. *Distributed software systems have been designed, studied, and implemented for decades, yet problems with their development, deployment, and maintenance persist even today. Attempts at formalizing the crucial concepts of distributed systems often lead nowhere or fail outright, as is demonstrated in this article.*

A hypothesis is then proposed: using mathematical models dealing with semantics of interoperability of systems it is possible to develop a better understanding of distributed computing using not the objects within the system, but the relations between these objects. The article describes a use case for applying semantic analysis to solve persisting problems with industrial systems.

Viable solutions to these problems are then suggested, borrowed from well-formalized mathematical theories, such as domain theory and category theory. The article attempts to partially answer the questions it poses using “semantic interoperability” – the property of a notation to have different formal definitions of the same concept be fully interchangeable in the context of a unifying formal description.

Keywords: *denotational semantics; category theory; distributed systems; network architecture.*

Introduction

On March 5th, 2024, Facebook, Instagram, Threads, and several other communication services developed by Meta suffered a global outage, resulting in millions of people losing access to their accounts for the duration of the outage [1]. It is speculated that the core issue lied with the company’s internal network infrastructure. This was not the first time such an event took place. On October 4th, 2021, a massive outage disrupted Meta’s services globally. In a post-mortem [2] Meta’s engineers narrowed down the issues to an error with DNS configuration. Such episodes are not specific to Meta, nor are they rare. Distributed systems “are hard” [3].

The problem here is not with the systems themselves. Engineers dedicate a lot of man-hours making sure such systems stay available and reliable. Rather, the problem is the over-reliance on private systems for global communication, oftentimes in critical moments [4]. The Internet was initially developed as an open network, and communication was and still is its primary function. Communication channels should not be gated by private entities. Specifically, international communication should be subject to international law. It is difficult to police private companies outside of one’s authority in cases when said companies fail to comply with local laws, especially since it is much easier for private entities to deny their services rather than litigate. Global communication relies almost entirely on independent entities, critical infrastructure that millions depend on is out of most people’s reach.

When large companies like Amazon, Meta etc. cannot fix the issues with stability of their systems, it is a good indicator that these problems cannot be fixed just with money. Networks created on top of the Internet must be aware of the underlying infrastructure and replicate its most important properties.

Centralized networks in a decentralized architecture

The World Wide Web was initially devised as a network for exchanging texts between scientific institutions [5]. But even then, its designer Tim Berners-Lee considered it just an initial step, and the future of the network to be in machines communicating with other machines [6]. XML was one of the formats intended to bridge that gap. But instead, social networks took over and are still omnipresent. Even though the phenomenon, which is today known under the name “Web 2.0”, came about as the result of multiple efforts to democratize the process of publishing content on web sites [7], its arguably biggest impact lies in concentrating most human communication within several private centralized networks; the other important aspect of this process is the noticeable effect that mainstream advertising practices have on the nature of content published on the biggest social networks [8].

As illustrated in “The Semantic Web” [6], the future of the World Wide Web looked different to its creators and early adopters. That future was based on evolving the way various entities within the Web exchanged information (a good example of that view is Szabo’s seminal work on secure information exchange on public networks [9]), closer in its architecture to a huge peer-to-peer network. Today, most of the Web’s communication is orchestrated by huge centralized systems. All the while peer-to-peer networks are reserved for hobbyists; federated communication networks outside email are considered niche.

One would expect a significant shift in this paradigm with the advent of the Internet of Things. This model seems to mimic the kind of architecture described in “The Semantic Web.” It is often just a replication of already existing architectures (most of which originate in social networks; for example, Software-as-a-Service monetization schemes being prevalent in IoT solutions, with companies denying services at their convenience [10, 11, 12]). On the surface, IoT should be an integral part of the Internet, seemingly inseparable. If Internet service is available, the device should be fully functional. Currently, when the company ceases to service or update their product, it becomes unusable.

There are attempts at changing the status quo. Several protocols and implementations have been proposed in the last 5-10 years, with their adoption lagging behind. ActivityPub is one such example [13], its mission being rebuilding the Web as a decentralized system, as it was imagined before “everything got locked down into a handful of walled gardens”. Notable implementations are Mastodon and Blue Sky. Another example, which aims to “radically change the way Web applications work today, resulting in true data ownership as well as improved privacy”, is Solid – a project headed by Berners-Lee himself [14].

An alternative approach to solving this problem would be to change the underlying software in a way that would *compel users to change their behavior*. This can be traced in how such changes in behavior were happening before: a new way to interact with the system would be identified, adopted by a small group of people, gain critical mass and then explode in popularity¹. Web 2.0 is a good illustration of this process. From an engineering perspective developing a new system for enacting a similar shift would be an insurmountable task even for a group of developers, let alone one person. A different strategy needs to be adopted. Instead of creating an unproven system and then expecting it to eventually do what it was designed to do, another approach would be to first prove that such a system is:

- a) viable;
- b) capable of changes expected of it;
- c) will work according to its specification.

A rigorous proof would require a precise formal description (existing or new). Considering the nature of distributed systems, describing a proof concerning relations between objects in such a system would require either developing a new general formal language or finding a way of unifying existing formalisms (syntactic models) for describing distributed systems (e. g. Erlang’s

1 This process is sometimes referred to as “Crossing the Chasm”, a phrase coined by G. A. Moore.

“Actor” model [15]). One possible approach could be based on generalizing different models using a more abstract notion of relations between objects.

Computation and storage

Distributed systems research revolves around computation and storage. A lot of mainstream research is focused on large text processing, consensus protocols, data replication, and performance². In the curriculum the gap between early research papers and modern research topics is noticeably large (this could be attributed, at least in part, to COVID-19). Still, a lot of effort has been spent over the decades to formalize certain aspects of distributed systems, sometimes with unexpected results.

One rather contentious topic in distributed systems design is the CAP³ theorem [16]. The original conjecture [17] states, in plain terms, that it is possible to “have at most two of these properties for any shared-data system:

- consistency;
- availability;
- tolerance to network partitions.”

The theorem garnered a lot of exposure and critique [18], [19]. Famously, Kleppmann once noted that, “the CAP theorem is too simplistic and too widely misunderstood to be of much use for characterizing systems. Therefore I ask that we retire all references to the CAP theorem, stop talking about the CAP theorem, and put the poor thing to rest” [20]. Invariant Confluence [21] is proposed by many as a viable alternative.

Both approaches formalize data consistency when synchronized over a network. The other important topic is network consensus. Two major results in this domain are Paxos [22] and Viewstamped Replication [23]. While the former is more widely known, there are well-documented attempts at making it “more approachable” for developers, garnering the algorithm a reputation of being difficult to implement. The more recent Raft algorithm implements Viewstamped Replication with several new features [24] and should be considered over older consensus algorithms.

The research discussed above shows that distributed systems formalization is an important topic, and that there are many problems in distributed systems design, that are still unsolved. One of the preliminary conclusions of this paper is the assumptions that the Internet’s properties and processes need to be formalized to make their replication and adoption in higher-level architectures more widespread and systematic. The focus, then, is on how distributed systems orchestrate communication between its actors, depending on the architecture (decentralized, federated, peer-to-peer, or hybrid). The intuition is: to see how that could work it would be beneficial to look at distributed systems from “a bird’s eye view” – one level of abstraction higher.

Semantic interoperability

The “semantics” of a system is its behavior. From a broad point of view, semantics and realization are aspects of the same situation: semantics is the problem of system analysis; while realization is the problem of system synthesis [25]. In general, semantics are separated into three major classes:

1. **Operational.** Meanings for program phrases defined in terms of the steps of computation they can take during program execution.
2. **Axiomatic.** Meanings for program phrases defined indirectly via the axioms and rules of some logic of program properties.
3. **Denotational.** Concerned with giving mathematical models of programming languages. Meanings for program phrases defined abstractly as elements of some suitable mathematical structure.

2 This assumption is based on MIT’s 2023 curriculum for the “Distributed Systems” course, which is available at <https://pdos.csail.mit.edu/6.824/schedule.html>.

3 CAP is an acronym that stands for “consistency, availability, partitions”.

When attempting to look at concrete things closely, having a formal way of abstracting all the details would help immensely. Researchers often turn to formalization while looking for viable solutions to concrete problems. When formalizing distributed informational systems one important property that needs to be preserved is semantic interoperability – “what is sent is what is understood” (for the purposes of this text semantic interoperability is defined as in [26]).

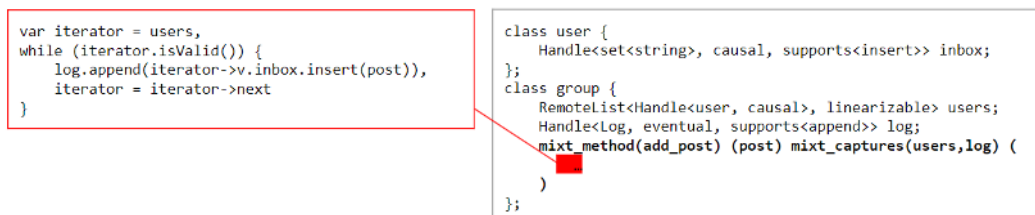
Consider the issues that could arise from fragmenting distributed networks along the connections inside them. Such division will inevitably make a network heterogeneous, which immediately leads to several problems that need to be addressed [27]: data incompatibility, the need for APIs at each point of connection, new metadata schemas etc.

One concrete example would be the Internet of Things. While each device can be connected to the internet and have a well-defined human-machine interface, things can quickly break down when attempting to make two devices communicate with each other (see “smart objects” [28] for one proposed solution).

Another example is programming language interoperability. Languages have the extra burden of syntactic interoperability and semantic interoperability. Existing solutions often revolve around creating a language extension or a language framework to overcome this issue. Other solutions attempt to formalize the higher-level concepts of a language (see “linear language interoperability” [29] for one proposed solution).

One example of an interoperable formal description of a property of a distributed system is MixT [30] – a C++-derived transaction language for concurrent computations, that enables its type system (and the compiler by extension) to catch incorrect formalisms. It is partially based on the concept of full abstraction borrowed from denotational semantics.

Fig. 1 represents a language embedding designed to solve issues with concurrent mutation – the iterator in the fragment on the left can be invalidated by one thread while another is accessing its value. To combat this, a “transaction block” is introduced with the `mixt_method` declaration. Such blocks are context-aware, which allows them to safely merge concurrent operations, ensuring causal consistency (see [30]).



```

var iterator = users,
while (iterator.isValid()) {
  log.append(iterator->v.inbox.insert(post)),
  iterator = iterator->next
}

class user {
  Handle<set<string>, causal, supports<insert>> inbox;
};
class group {
  RemoteList<Handle<user, causal>, linearizable> users;
  Handle<Log, eventual, supports<append>> log;
  mixt_method(add_post) (post) mixt_captures(users,log) (
  )
};
  
```

Figure 1. Unsafe C++ code (left); code embedded within a MixT structure for safety [30]

To summarize, denotational semantics serve “to specify programming language constructs in as abstract and implementation-independent way as possible: in this way one may gain insight into the fundamental concepts underlying programming languages, their inter-relationships, and (sometimes) new ways of realising those concepts in language designs [31].”

Categories

Another mathematical theory that deals in abstractions and uses mathematical concepts to describe all sorts of entities is category theory. It is being widely used in modern research to explain different phenomena that were hard or impossible to describe using other methods.

It is outside of the scope of this paper to include a section on the basics of category theory, for a detailed illustrated introduction refer to [32]. Below is a diagram describing three main mathematical properties of an object that qualify it as a category (see Fig. 2).

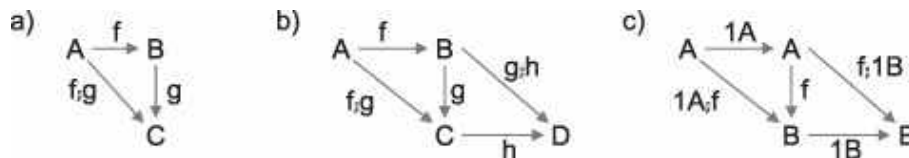


Figure 2. Illustration of three basic properties of a category: composition (left), associativity (center), unit/identity (right) [32]

Even though category theory is often called “abstract nonsense,” it has real application in many domains. One example is using the Yoneda lemma – one of the foundational theorems of category theory. To understand the core of the Yoneda lemma: in simple terms, imagine a deck of playing cards. If one person picks a random card and asks another person to guess it by asking questions about it, it would be possible to pin down the card in a finite number of questions (for example, questions like “is it a spade?”, “is it higher than a 10?” etc. will eventually lead to the correct card by elimination). In even plainer terms, it is possible to define an object by its relation to other objects definitively. Figure 3 presents a visual reference for the “Inverted spectrum” problem [33].



Figure 3. Illustration of the “inverted spectrum” problem [33]

If two people look at the same set of objects and are asked to name the objects’ colors, both will name the same colors, even when one of the persons has color vision deficiency. That person will have grown up with knowing a certain color as “red,” even though it would not necessarily qualify as “red” on the color spectrum. The Yoneda lemma gives a solution to this. Figure 4 shows the illustrated solution to the “Inverted spectrum” problem.

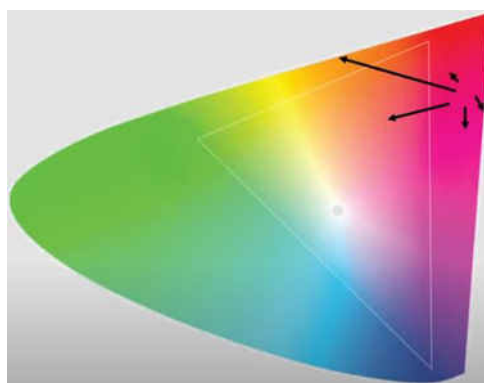


Figure 4. Human color perception as a distorted space [34]

By transforming the color spectrum into a distorted space, the problem can be reframed as a mathematical problem. Any point of that space can be determined in terms of its relations with all other points of the space. Any point considered being in the red spectrum will have only one way of defining it in terms of all other points. Thus, any person not seeing it in the red part of the spectrum can be identified.

Conclusions

Another important concept of category theory is that of a functor. Without going into too much detail, a functor represents transformations between categories in the same way that functions are transformations between objects within a category (in this case – a set). Functors have one important property that is pertinent to this paper’s subject. Applying a functor to a composition of two transformations is equivalent to applying a functor to each transformation separately and then composing the results. This is illustrated as a diagram in Fig. 5 below.

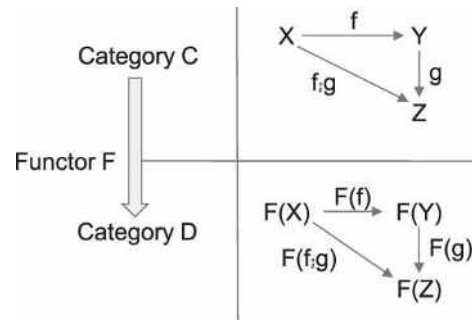


Figure 5. Functor preserving commuting and composition [35]

This can be applied to describing how two heterogeneous systems interface with each other. If there are two systems that are connected to each other somehow, having some operations available in one system, it should give the same result in both cases:

- Operations are combined (read, performed one immediately after another “piping” the intermediate result between them), and then the end result is transported to the other system.
- Operations themselves are transported into the other system and combined there.

Meaning, that if both systems formally guarantee that the operations and objects possess certain properties, functors have the explanatory power to guarantee consistency of data between heterogeneous systems.

This is just one example of how category theory could be leveraged for designing and describing complex interconnected systems. In that the author of this paper agrees with Joseph Goguen, “computing science is very fragmented, with many different sub-disciplines having many different schools within them. Hence, we badly need the kind of conceptual unification that category theory can provide [36]”.

Of course, the path to unification need not lie in category theory necessarily. But it would be a good first step, because concepts developed using category theory are easily generalized and can rely on many mathematical proofs to ensure that what they describe they do with enough precision. To quote Scott and Strachey again, “there are many different languages adequate for conveying the same concepts (e.g., binary, octal, or decimal numerals). Even in the same language many different expressions can denote the same concepts (e.g., $2+2$, 4 , $1+1+1+1$, etc.). The problem of explaining these equivalences of expressions (whether the same or different languages) is one of the tasks of semantics and is much too important to be left to syntax alone. Besides, the mathematical concepts are required for the proof that the various equivalences have been correctly described [31].”

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DOMAIN SPECIFIC LANGUAGE FOR CREATING API DOCUMENTATION

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Abstract. *This article introduces a Domain-Specific Language (DSL) designed for the management and display of API documentation, aiming to ease the documentation process and enhance the quality of API guides. The common approach to documenting APIs often involves manual processes that are time-consuming and vastly different across different sources, because of the variety in either company practice or industry standards. The proposed DSL addresses these challenges by offering a structured, simple format to understand the complexities involved in describing API endpoints, parameters, request and response models, and perhaps even examples of such use. The main goal of this work lies in understanding and getting rid of the struggles developers face when having to deal with new API documentation. The specific aim of the DSL is to allow for quick adaptation by developers and technical writers without requiring extensive, dreadful research and understanding of the different interfaces and classifications of various sources. By combining theoretical design principles and practical implementation strategies, this work aims to demonstrate the effectiveness of using a DSL for API documentation. It will provide a comprehensive solution that will reduce the effort needed for using and understanding API documentation, by making it more consistent and accurate, therefore enhancing developer experience when having to use APIs.*

Keywords: *complexity reduction, consistency, documentation quality, domain-specific language.*

Introduction

A Domain-Specific Language is a programming or specification language dedicated to a particular problem domain, designed to simplify tasks within that domain. DSLs are often created to enable more intuitive and efficient solutions compared to general-purpose languages when dealing with specific types of problems or processes [1].

An API, or Application Programming Interface, consists of a set of communication protocols and subroutines that allow different software programs to interact with each other. APIs can be developed for various systems such as operating systems, database systems, hardware, JavaScript files, or other object-oriented files to facilitate this interaction. API documentation refers to a set of technical instructions on how to use and integrate it properly [2].

In our article on creating a Domain-Specific Language for API documentation, we have divided the content into three primary sections: domain analysis, grammar definition, and a sample program.

Domain Analysis

The evolution of API documentation experienced many changes, similar to the shifts in software development practices, going from boring manuals to interactive online resources. With the introduction of web APIs, it led to more standardized documentation, made possible by tools like Swagger (now OpenAPI) and RAML. These tools improved the accessibility and usability of

API documentation, making it more understandable for humans and processable by machines, helping to create a more integrated digital ecosystem [3].

Nonetheless, API documentation faces several difficulties, including maintaining consistency and clarity across different APIs, ensuring accessibility and usability for both novice and expert developers, and keeping the documentation up to date. To address these problems, the concept of a Domain-Specific Language for API documentation has been proposed. A DSL could streamline and standardize documentation practices, ensure updates and even include accurate API guides, thus improving efficiency and reducing the work developers must put in.

Potential users of this DSL include API developers, technical writers, software development teams, and quality assurance engineers, who would all benefit from this product in their respective fields. Furthermore, people outside of this specialized domain could make use of it, like project managers and product owners that could use the DSL to improve project scoping and team performance. Educators and independent students could also find value in a DSL, using it as a learning platform and promoting collaboration between students.

The introduction of a DSL for API documentation would be a great improvement in creating and maintaining API guides, aiming to enhance the developer experience and support more efficient API integration within software ecosystems. This would create a more intuitive, accessible, and effective documentation ecosystem for everyone involved.

Language Overview

The Domain-Specific Language (DSL) for API documentation is made to simplify the creation and maintenance of API docs through a structured computational approach. The idea starts with parsing, where user-written DSL commands are converted into a more manageable internal format, known as an Abstract Syntax Tree (AST). This structure organizes the commands related to API elements and makes it easier to handle everything.

After the AST is fully fleshed out, the DSL taps into this structured data to craft API documentation in various formats, according to user preferences. The parsing process is supported by ANTLR, a powerful tool that helps in creating grammars and generating parsers in programming languages, in this case Python. By employing patterns like listeners or visitors, it becomes easy to traverse the AST and extract the necessary details needed to generate precise and comprehensive API documentation [4].

Input-wise, the DSL is quite accommodating, accepting commands directly in its own syntax or via structured data files, adding to its user-friendly nature. The language itself is declarative, emphasizing what the documentation should cover rather than how to assemble it. This approach makes the documentation process easier and minimizes errors by making sure data inputs stick to the expected formats and by conducting syntax checks right at the parsing stage.

In essence, the DSL makes it possible to generate efficient, structured, and error-free API documentation. This process not only ensures accuracy but also keeps the documentation aligned with the latest API specifications, greatly improving clarity and utility for developers.

Semantic Rules

For the user to be able to efficiently use the language without getting any errors, there is a set of rules put in place that he needs to follow:

- Keywords and identifiers are case-sensitive, distinguishing between similar terms.
- Supports only single-line comments, marked with a hashtag #, to simplify annotations.
- Spaces, tabs, and newline characters are used to separate tokens, making sure formatting errors don't affect interpretation.
- Enclosed in double quotes and can include escaped characters, used for specifying paths, descriptions, and text content.
- Must start with a letter or an underscore, can include letters, digits, and underscores, but cannot start with a digit.

- Keywords are reserved for defining and structuring documentation and cannot be used as identifiers.
- Uses symbols for specific syntactic roles such as defining routes, specifying methods, or delineating code blocks.
- Recognizes numeric literals for use in contexts like specifying versions or limits.
- Uses semicolons to end declarations, to make documentation clearer and separate statements.

Grammar

The grammar of a programming language is an important part that dictates how programs are written and understood by a compiler or an interpreter. It is made up of a set of production rules, which are guidelines for generating valid sequences of symbols and constructing a good program structure. These production rules are expressed using a combination of terminal and non-terminal symbols, special characters, and notations that determine how elements in the language are combined and interpreted.

Table 1

Grammar description

Symbol	Meaning
<notation>	Non-terminal
notation	Terminal
x*	x occurs 0 or multiple times
	Separate alternatives
→	Derives
#	Comment
<notation>+	Must be one or more notations
<notation>?	Notation is optional

Sample Program

Here we can see, through the representation of a parse tree, a possible case generated with the help of the grammar rules stated previously:

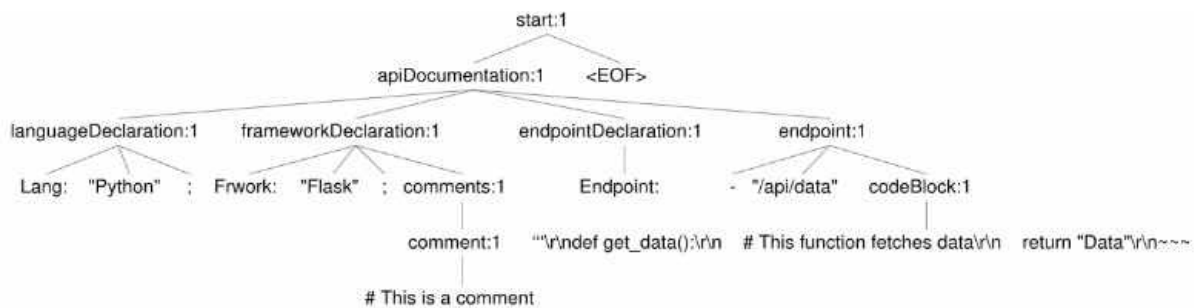


Figure 1. Parse tree

Conclusion

To conclude, creating a Domain-Specific Language (DSL) for API documentation marks an important step toward how we handle API interfaces. By implementing this specialized DSL, both developers and technical writers can overcome the usual problems related to traditional documentation methods. This approach brings a much-needed clarity, ensures a consistent style across various APIs, and cuts down on the time and effort needed to keep documentation fresh and accurate. With its well-defined grammar, semantic rules, and versatile output options—ranging from HTML and Markdown to PDF—the DSL allows for systematic documentation production that adapts easily to different needs. The introduction of this DSL could change the way developers

and companies approach API documentation, making it a more intuitive and productive part of the software development lifecycle, and allowing their resources to be diverged towards other problems. This change does not only benefit technical users but also educators, project managers, and others involved in the broader scope of the field of documentation and API use.

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ENHANCING SPORTS PERFORMANCE ANALYSIS: AN AI APPROACH FOR BASKETBALL AND VOLLEYBALL

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Abstract. Artificial intelligence is increasingly being used in all areas of human activity, from the familiar text editor to the cutting-edge satellite that has just entered Earth's orbit. Modern team sports also need to implement AI to analyze the results of matches, in order to identify the strengths and weaknesses of each player, as well as to develop a right strategy for subsequent games against a specific opponent. Our study investigates the process of data collection and processing for sports analytics using basketball and volleyball games as examples. Data for analysis was sourced from the official FIBA YouTube channel "FIBA - The Basketball Channel" and the Baller TV replay library, which archives matches from various youth sports. The obtained videos were segmented into individual frames. A portion of these frames were manually labeled to create training and validation datasets. The remaining frames formed the unlabeled test dataset, crucial for evaluating the accuracy of the YOLOv8 model chosen as the foundation for this study. Our focus was on identifying players through jersey number recognition, detecting the ball and its location on the court, classifying game situations, and processing the score and timer using OCR technology. The fine-tuned YOLOv8 achieved an accuracy of 93% based on the mAP50-95 metric, which evaluates the overlap between predicted and actual bounding boxes.

Keywords: computer vision, machine learning, object detection, YOLOv8

Introduction

The AI industry is rapidly and confidently entering every domain of human activity. Nowadays, we have drones that can detect plant illnesses and determine when a crop is ready for harvest, along with autonomous greenhouses. Millions of people are benefiting from generative AI in their daily job and education. Additionally, modern cars are equipped with autopilots that rely on AI technology.

The challenge in sports performance analysis lies in extracting insights from vast data volumes together with diverse factors affecting athletic outcomes. Our goal is to use AI-driven technology to transform player evaluation and enhancement in basketball and volleyball. Knowing the experience of the prior studies, we embrace complex sporting conditions, utilizing advanced AI models like You Only Look Once (YOLOv8) for precise real-time analysis. Our empirical data supports these claims, showcasing improved performance analysis. Our approach modifies AI models for various sports contexts, guaranteeing accurate analysis in a range of specific circumstances. By using sophisticated algorithms and careful data annotations, we create a comprehensive framework that may be easily implemented in any business related to the sport analytics field.

Data Gathering

Any data-driven analysis starts with the collection of data. This data usually comes from match recordings that could be found on resources like *Baller TV* and *FIBA - The Basketball Channel*. It is essential to collect data with a variety of features in order to guarantee reliable and

broadly applicable AI models. This covers changes in scene lighting, video quality, camera angles, and stabilisation.

An effective performance analysis depends on the AI model being able to learn a richer collection of features, which is made possible by diverse data. For example, if a model is trained just on static shots, it may miss information relating to player positioning and movement relative to the court. For this reason, data should contain video from a range of camera perspectives, including baseline cameras, standard broadcast views (Fig. 1), and even fisheye lenses (Fig. 2), which provide a broader field of view.



Figure 1. Standard broadcast camera view (Basketball)



Figure 2. Camera with fisheye lens (Volleyball)

Recordings from different locations with different lighting configurations and court layouts should be taken into consideration to further enhance the data collection. Video from both indoor and outdoor courts may be included in it to show the impact of various playing conditions. Additionally, a range of video quality levels, from high-definition broadcasts to lower-resolution recordings, should be gathered into the dataset. Finally, in terms of lighting, the data should contain footage shot in a variety of lighting scenarios, ranging from intensely lit training facilities to brightly lit professional venues.

Once the diverse data is collected, the video recordings are segmented into individual frames. Then, particular interesting game moments are found and labeled for additional examination. These labeled game moments serve as the foundation for extracting relevant performance statistics, such as the number of successful passes leading to a shot, shooting accuracy, player speed, and point tallies from scoring sequences.

Data Labeling

Data labeling is a critical and time-consuming step in AI research, especially for tasks involving object recognition and analysis. Data labeling in the context of sports performance analysis is the process of carefully locating and annotating objects of interest within video frames. LabelMe, a popular annotation tool (Fig. 3), can be used to create bounding boxes around specific

objects in each frame [1]. In fact, these bounding boxes specify the object's size and location within the image. Examples of objects commonly labeled in basketball and volleyball data include the ball, players identified by jersey numbers or body features, jerseys themselves, and the score bug.

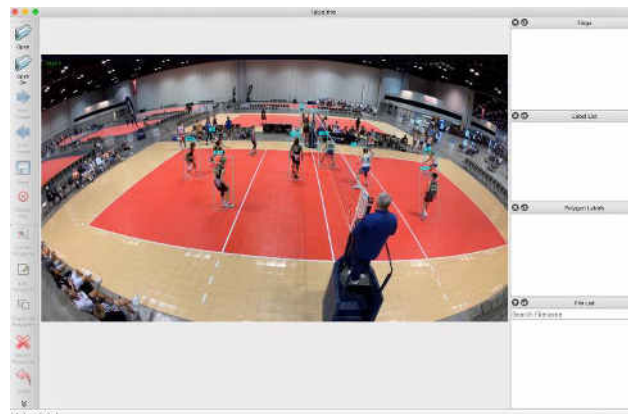


Figure 3. LabelMe interface

An additional technique employed for data labeling is the use of homography masks (Fig. 4). In essence, these masks are specialized overlays that precisely delineate the region of the playing court in the video frame. The AI model needs this data in order to distinguish between activities that take place on and off the court [2].

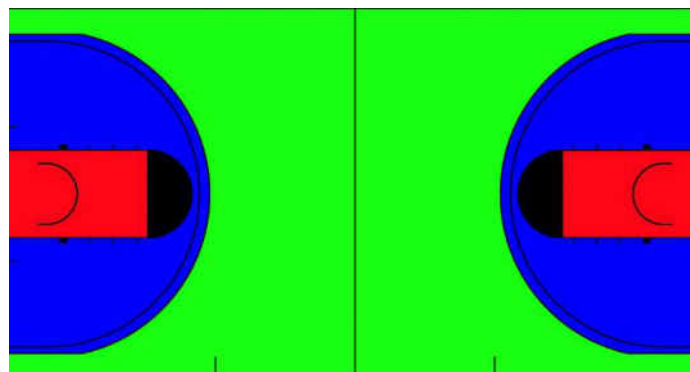


Figure 4. Basketball court homography mask

Through the combined use of bounding boxes and homography masks, three distinct datasets are typically created: training, validation and test. Training dataset consists of labeled video frames used to train the initial AI model. The labels define the location and type of each object within the frame. A different labeled dataset called the validation dataset is used to assess how well the model performed during training. This allows for adjustments to the model and prevents overfitting on the training data. After the training phase is finished, an unlabeled test dataset is used to evaluate the accuracy of the model. This dataset provides a realistic measure of how well the model performs on unseen data [3].

Model Training

Any AI model's ability to function depends on the hardware configuration that is chosen with care. We selected an efficient configuration with an Intel Core i7-13700K processor and a powerful NVIDIA GeForce RTX 4070 Ti graphics card for our experimental AI analyzer. On such a combination of hardware components, any model will perform fast and efficiently.

You Only Look Once (YOLOv8) [4] is a cutting-edge deep learning model designed especially for real-time object detection. Instead of using multiple neural networks for detection, YOLOv8 uses a single neural network to analyze the entire image at once. The image is divided into a grid of regions

by this network, which then forecasts bounding boxes and probabilities for each region, indicating the kind and quantity of objects that are present there. YOLO's simplified methodology results in remarkable processing speeds, which makes it perfect for a range of real-time applications.

The model training procedure is led by a carefully written Python script. Importing the pre-defined YOLOv8 model architecture is the first step in the script's setup. Next, crucial training parameters should be set and the version of YOLOv8 being used should be specified. Data is one of these parameters. The number of epochs (the number of times the entire training dataset will be passed through the model for learning), the batch size (the number of samples used in one epoch to train a neural network), the number of workers in pool (the number of parallel worker processes to leverage for data loading and preprocessing, accelerating the training process), and the augmentation (enhances the size and quality of machine learning training datasets) are all important details about the training data.

Figure 5 shows a training batch example. This batch consists of video frames where the ball has been manually labeled with an ID of 0 representing its object class. Following 500 training epochs, the YOLOv8 model learns to predict the ball's location within each frame.



Figure 5. Training batch

Figure 6 shows the graphical representation of this prediction. We can easily evaluate the model's accuracy in locating the ball's bounding box thanks to the visual format.



Figure 6. YOLOv8 predictions

Additionally, AI models can be trained to detect and locate score bugs within a video frame. Convolutional Neural Networks (CNNs) are highly effective in recognizing particular patterns in images. A CNN, in our case YOLOv8, trained on labeled video frames can identify distinctive visual characteristics of score bugs. It is able to identify the areas that contain these on-screen graphics by examining the pixel data of every frame. A well-labeled dataset is essential for training any object detection model, including score bug recognition. The location of various data points, such as the clock and the score, must be precisely labeled on every frame that contains a score bug during the training process. By labeling the various elements within the score bug, the model is able to distinguish between them more precisely, leading to the accurate extraction of the desired information.

Optical Character Recognition (OCR) techniques are used once the CNN has successfully located the score bug. Converting visual text into a format that is readable by machines is the speciality of OCR technology. When used in this way, OCR enables us to retrieve important game information from the score bug, including team names, scores, and remaining game time (Fig. 7) [4-5].



Figure 7. Score bug

Results

Our research produced a unified method for re-identifying players throughout different video sequences, detecting jerseys/players, and classifying teams. This strategy takes advantage of team sports' consistency. While the number of players on the court differs (ten in basketball, twelve in volleyball), identifying players relies on unique visual cues like their jersey numbers and team colors.

However, sports do have specific visual elements that require model adjustments. For example, the way the ball looks in different sports like basketball, volleyball and football can differ dramatically. In such cases, the YOLOv8 model requires re-training on brand-new labeled video frames containing the specific ball type. Similar to this, because courts vary in size, zones, markings, and fixed objects (baskets, nets, gates, etc.), court homography masks should be modified for each sport.

Training the model with a large enough dataset can achieve an overall prediction power of approximately 91.8%, even with these sport-specific variations. Out of all the components, the ball detection had the highest accuracy. Based on the mAP50-95 metric, which takes into account the overlap between the ball's predicted and actual bounding boxes, the refined YOLOv8 model achieved an accuracy of 93%. The single ball on the court eliminates the need for difficult re-identification tasks like those needed for players and becomes the reason for high accuracy results.

Conclusions

In conclusion, our study has effectively examined the problem of improving sports performance analysis by utilizing AI techniques. We have offered a solid answer to the challenges involved in evaluating volleyball and basketball performance through rigorous validation, sophisticated AI algorithms, and careful data collection. Our results validate the success of our methodology in obtaining significant insights from various match settings, consequently providing coaches, experts, and players with invaluable resources to enhance their on-court performance.

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DSL FOR AI PROJECTS ARCHITECTURE

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Abstract. *This paper addresses the complexity of Artificial Intelligent (AI) system design and deployment by advocating for a Domain-Specific Language (DSL) specifically designed for AI projects architecture. This research clarifies the possible advantages and difficulties of implementing a DSL for AI projects through creating an opportunity for organizations to stimulate innovation, shorten development cycles, and take advantage of the growing opportunities in the AI landscape by adopting a DSL designed specifically for AI.*

Keywords: *Machine Learning, architecture, Domain-Specific Language, AI, Speech-to-Text, Optical Character Recognition*

Introduction

In the swiftly evolving landscape of AI, navigating the intricacies of designing and deploying AI systems presents formidable challenges. As development of numerous products incorporating Machine Learning (ML) and other AI components continues to progress, various challenges have been encountered, particularly concerning communication and alignment among team members. These teams have typically been multidisciplinary, encompassing profiles beyond traditional developers and software engineers, including data scientists, psychologists, and AI experts [1].

This paper advocates for the adoption of SOLeAI, a Domain-Specific Language (DSL) meticulously crafted for AI project architecture. SOLeAI leverages cutting-edge technologies such as Speech-to-Text (STT) and Optical Character Recognition (OCR), enabling seamless integration of spoken and written language processing capabilities into AI projects. By using SOLeAI, organizations can enjoy many benefits like increased productivity, smoother teamwork, automated processes, and faster development [1].

Grammar

In the realm of programming languages, understanding the interplay between semantics and syntax is paramount. A programming language is described by the combination of its semantics and its syntax. The semantics provide the meaning of every construction that is possible in the chosen programming language [2]. Complementing semantics, syntax provides the structural rules governing the arrangement and composition of language elements.

A grammar transforms the program, which is normally represented as a linear sequence of ASCII characters, into a syntax tree [2]. Central to the comprehension and manipulation of programming languages is the notion of grammar. By encapsulating the syntactic rules and constraints of a programming language, grammar plays a pivotal role in enabling software developers to express their ideas effectively and concisely. The presented DSL's grammar notations are precisely outlined in Tab. 1.

Table 1

Grammar notations

Notation	Description
$\langle \text{foo} \rangle$	foo is a non-terminal symbol
foo	foo is a terminal symbol
$[x]$	zero or more occurrences, x is an optional parameter, '[' and ']' are terminal symbols.
x^*	zero or more occurrences of x
x^+	one or more occurrences of x
$\{ \}$	a grouping, '{' and '}' in quotes are terminal symbols
	alternative option

$$G = (S, V_n, V_t, P)$$

S - start symbol

V_n - finite set of non-terminal symbols

V_t - finite set of terminal symbols

P - finite production rules

$$S = \{ \langle \text{prog} \rangle \}$$

$$V_n = \{ \langle \text{prog} \rangle, \langle \text{sorb} \rangle, \langle \text{block} \rangle, \langle \text{ifBlock} \rangle, \langle \text{statement} \rangle, \langle \text{pipeStream} \rangle, \langle \text{varAssignment} \rangle, \langle \text{varName} \rangle, \langle \text{value} \rangle, \langle \text{function} \rangle, \langle \text{functionName} \rangle, \langle \text{inputData} \rangle, \langle \text{comment} \rangle, \text{ALPHANUM} \}$$

$$V_t = \{ \text{NEWLINE}, \{, \}, \text{if}, (,), =, \rightarrow, //, \text{STRING}, \text{COMMENT_STRING} \}$$

$$P = \{ \langle \text{prog} \rangle \rightarrow \langle \text{sorb} \rangle^* \text{EOF}$$

$$\langle \text{sorb} \rangle \rightarrow \text{NEWLINE}^* \langle \text{statement} \rangle^* \text{NEWLINE}^+ \mid \text{NEWLINE}^* \langle \text{block} \rangle \text{NEWLINE}^*$$

$$\langle \text{block} \rangle \rightarrow \{ \langle \text{sorb} \mid \text{NEWLINE} \rangle^* \}$$

$$\langle \text{ifBlock} \rangle \rightarrow \text{'if' } (\langle \text{value} \mid \text{pipeStream} \rangle) \langle \text{statement} \mid \text{block} \rangle$$

$$\langle \text{statement} \rangle \rightarrow \langle \text{varAssignment} \mid \text{ifBlock} \mid \text{pipeStream} \mid \text{comment} \rangle$$

$$\langle \text{pipeStream} \rangle \rightarrow \langle \text{function} \mid \text{inputData} \rangle (\rightarrow \langle \text{function} \rangle)^*$$

$$\langle \text{varAssignment} \rangle \rightarrow \langle \text{varName} \rangle \text{'=' } \langle \text{value} \mid \text{pipeStream} \rangle$$

$$\langle \text{varName} \rangle \rightarrow \text{ALPHANUM}$$

$$\langle \text{value} \rangle \rightarrow \text{STRING} \mid \langle \text{varName} \rangle$$

$$\langle \text{function} \rangle \rightarrow \langle \text{functionName} \rangle \langle \text{value} \rangle^*$$

$$\langle \text{functionName} \rangle \rightarrow \text{ALPHANUM}$$

$$\langle \text{inputData} \rangle \rightarrow \text{'messageText' } \mid \text{'messageImage' } \mid \text{'messageAudio'}$$

$$\langle \text{comment} \rangle \rightarrow \text{COMMENT_STRING}$$

$$\text{STRING} \rightarrow \text{' ' } \sim [\text{"\r\n"}]^* \text{' '}$$

$$\text{COMMENT_STRING} \rightarrow \text{'/' } \sim [\text{"\r\n"}]^*$$

$$\text{ALPHANUM} \rightarrow [\text{a-zA-Z}]^+ [\text{a-zA-Z0-9}]^*$$

$$\text{NEWLINE} \rightarrow (\text{'r' } \text{"\n"})^+$$

$$\text{WHITESPACE} \rightarrow (\text{' ' } \mid \text{'t' })^+ \rightarrow \text{skip}$$

Assignment

In SOLeAI, assignments follow a straightforward process. As long as the user provides valid data input, the program interprets that value and assigns it to the respective keyword, following the structure of the grammar. The only user-defined assignment function allowed in the grammar is `<varAssignment>`, a function which enables the user to create a variable, storing either a `<value>` a `<pipeStream>` in memory, granting the ability to reuse it later. The restriction for assigning is that variables must be declared and assigned before they're used. This ensures that variables are properly initialized before being utilized within the program.

Used technologies

STT technology, also referred to as automatic speech recognition (ASR), is a transformative tool converting spoken language into written text, finding applications across diverse industries. Acoustic Analysis initiates the process by capturing audio input via microphones, analyzing the audio signal to extract features like frequency, amplitude, and duration [3]. Language models refine STT output by considering word sequence probabilities in natural language, aiding in disambiguation and improving accuracy. Post-processing techniques like grammar checking and error correction further enhance transcription accuracy.

STT technology enhances accessibility for individuals with disabilities, facilitates transcription services for audio recordings, enables hands-free operation of devices via virtual assistants, and powers interactive voice response systems and call center automation. It also supports real-time translation services and voice-enabled search engines. Whisper, an ASR system that will be used in further implementation, stands out with its robustness to accents, background noise, and technical language, enabled by training on a large and diverse dataset, facilitating transcription in multiple languages and translation into English [4].

OCR is the process that converts an image of text into a machine-readable text format [5]. This technology serves as a transformative solution for converting various document formats, including scanned paper documents, PDF files, and digital images, into editable and searchable data. OCR systems undertake a series of preprocessing steps, including noise reduction, binarization, and deskewing, to enhance the quality and accuracy of the document image. Following preprocessing, OCR systems employ pattern recognition and ML algorithms to locate and segment text regions within the document image. One of the significant advantages of OCR technology is its ability to digitize paper documents, such as books, newspapers, and archival materials, thereby facilitating electronic storage and accessibility [5].

PyTesseract, a Python wrapper for Google's Tesseract-OCR Engine, stands out as a prominent tool to be used for integrating OCR capabilities into Python applications. With Tesseract's robust open-source OCR engine at its core, PyTesseract offers a seamless and versatile solution for incorporating OCR functionality into diverse projects and workflows.

Other DSLs

Several process modeling languages exist, including Business Process Model and Notation (BPMN) [6] and Software & Systems Process Engineering Metamodel (SPEM) [7], along with their extensions. While SPEM serves as an Object Management Group (OMG) [8] standard for delineating software development processes, it deliberately lacks distinct features tailored to specific domains or disciplines, such as AI. To the authors' knowledge, none of the existing process modeling languages offer AI-specific extensions. In the realm of DSLs for AI, various languages cater to modeling specific AI activities, such as OptiML [9], Arbiter [10], or Pig Latin [11]. However, none of these DSLs prioritize process-related aspects.

Conclusions

In conclusion, the development and deployment of AI systems present multifaceted challenges in today's dynamic technological landscape. Throughout this paper, it has been explored the significance of adopting Domain-Specific Languages tailored specifically for AI projects architecture. By delving into the complexities of SOLeAI, the document has elucidated the potential advantages it offers in addressing the complexities of AI system design and deployment. Through the investigation, the paper highlights the potential of SOLeAI to enhance productivity, foster collaboration among multidisciplinary teams, and expedite development cycles in AI projects.

As organizations endeavor to fully leverage the capabilities of AI technologies, the adoption of specialized DSLs such as SOLeAI stands out as a strategic necessity. Through the integration of OCR and STT functionalities, SOLeAI empowers organizations to streamline the development of AI systems tailored to image and audio data processing. Looking ahead, continued research and experimentation will be essential to refine and expand the capabilities of SOLeAI, driving transformative advancements in AI system architecture and deployment.

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DOMAIN SPECIFIC LANGUAGE FOR EMAIL AUTOMATION

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Abstract. *The purpose of this article is to explain how a domain-specific language may be useful in marketing. The benefits of using a domain-specific language in email automation are examined in the article, including increased precision, quicker processing times, reduced error rates, etc. DSL-based automation improves the client experience and makes the workflow more seamless. The DSL's functionality, grammatical characteristics, and other details are covered in the article along with the processes that were used to design it. By focusing on key components such as campaign management, personalization, automation, integration, and analytics, this new language equips users with the tools and capabilities they need to elevate their email marketing efforts in an increasingly digital world. The abstract syntax tree was created using a formal grammar as its foundation. The ANTLR 4 parser generator is used as the front-end for the DSL built as explained in this article. Python is used to implement the back end.*

Keywords: ANTLR, formal grammar, marketing, federated networks.

Introduction

A domain-specific language (DSL) is a programming language or executable specification language that offers, through appropriate notations and abstractions, expressive power focused on, and usually restricted to, a particular problem domain [1].

According to statistics, in the year 2023, 374.3 billion emails were sent and received per day and by the end of the year 2025, it is predicted that the number of emails sent per day will be 376.4 billion [2]. Without a doubt, email still remains a crucial tool for connecting and engaging in today's fast-paced digital world. With so many communication channels available, it can be overwhelming for marketers to break through the noise and stand out.

Email marketing is a very efficient way to expand the brand, interact with existing consumers, acquire new ones, and increase sales. Furthermore, according to at least 80% of professionals, email marketing promotes client acquisition and retention. As a result of marketing mail, 60% of consumers have made a purchase [3]. However, sending emails manually takes a lot of time and effort, and is not sustainable in the long term.

Email automation refers to the process of using technology to execute automated, personalized, and contextual email campaigns to targeted recipients based on predefined triggers, conditions, or schedules, in order to improve accuracy and save time [3]. Email automation is a powerful marketing automation tool that allows delivery of the correct message to the right people at the right time. This is particularly useful for lead nurturing and, eventually, to increase sales from both current and new customers. Research from the Annuitas Group reveals that marketing automation users experience a staggering 451% increase in qualified leads, with nurtured leads making purchases 47% larger than non-nurtured leads [4].

Existing email automation softwares

Since email marketing has been among the best ways for businesses to get the word out, there are already some softwares specified for email automation on the market, such as Mailchimp,

Brevo and Campaigner. Even though all of them have the same goal, each of them focus on specific features.

Mailchimp is a widely recognized and popular email marketing platform known for its user-friendly interface and comprehensive features. It is particularly favored by beginners and small businesses due to its ease of use and accessibility. Mailchimp offers a range of features including email campaign creation, customizable templates, audience segmentation, A/B testing, and analytics. Mailchimp is ideal for users who are new to email marketing and prefer an all-in-one marketing solution [5].

Brevo is another email automation platform that focuses on providing unlimited email sending capabilities for businesses. Unlike some other email marketing platforms that charge based on the number of contacts or emails sent, Brevo offers flat-rate pricing plans that allow users to send emails to an unlimited number of contacts, which make it suitable for businesses with large contact lists or those that send high volumes of emails regularly. The platform is suitable for businesses looking for a scalable email marketing solution that can accommodate their growing subscriber base without incurring additional costs based on usage [5].

Campaigner is a comprehensive email marketing platform designed for advanced marketers who require sophisticated features and functionality. The platform offers a wide range of advanced features including advanced segmentation, dynamic content personalization, A/B testing, automated workflows, and integrations with third-party tools. It also offers dedicated support and training resources for users, making it well-suited for businesses that require assistance in maximizing the effectiveness of their email marketing campaigns. In addition to this, Campaigner may have a steeper learning curve compared to some other platforms [5].

Consequently, choosing an email automation software becomes difficult, since having so many platforms with their advantages and disadvantages is hard to find a software that will cover all needs of an organization.

Benefits of email automation DSL

Considering the advantages and the limitations of the existing email automation softwares, the DSL has the following benefits:

More Seamless Workflow

Along with optimization, email automation also offers efficiency, since it allows specialists to send emails quickly and keeps customers satisfied. According to statistics, 49% of sales and marketing professionals consider that time saving of repetitive tasks is one of the most important aspects of sending emails [6].

Customization and Flexibility

Users can easily modify and expand their automation logic to accommodate new campaigns, audience segments, or marketing objectives, without the need for extensive reconfiguration or redevelopment. It allows organizations to adapt and evolve their automation workflows as their business grows or their marketing needs change. Moreover, DSLs can be designed to handle large volumes of data, including contact lists with an unlimited number of entries.

Collaboration and Knowledge Sharing

By using a shared vocabulary and syntax, team members can more effectively collaborate on designing, reviewing, and refining automation strategies. This cooperative method supports communication and coordination among various departments or teams engaged in email marketing, resulting in more unified and successful campaigns.

Ease of Maintenance

With a DSL, email automation workflows and configurations are expressed in a structured and semantically meaningful way. This clarity makes it easier to understand, maintain, and modify automation logic over time.

Testing and Quality Assurance

Email automation DSL enables the expression of test scenarios, including edge cases and boundary conditions, directly within the DSL itself. This allows automated testing frameworks to validate the correctness of automation logic, ensuring that emails are sent accurately and reliably to recipients, and minimizing the risk of errors or inconsistencies in campaign execution.

Grammar

A formal grammar is a set of formation rules for strings in a formal language. The rules represent how the strings will be formed from the language's alphabet that have to be valid according to the language's syntax [7]. A formal grammar is defined as $G = (V_n, V_t, P, S)$, where:.

- V_n is a finite set of nonterminal symbols
- V_t is a finite set of terminal symbols
- P is a finite set of production rules
- S is the start symbol.

To specify the grammar representation for the email automation language we need to use the Extended Backus–Naur form. In table 1, there are the metanotations.

Table 1

Metanotations	
Symbol	Definition
< >	Non-terminal symbol
*	Zero or more occurrences
+	One or more occurrences
	Separate the alternative symbols
→	Derivation
(...)	Grouping elements
[...]	Optional element

$S = \{ \text{lower_case} \}$
 $V_t = \{ "a", "b", \dots, "z", "A", "B", \dots, "Z", "0", "1", \dots, "9", "/", ":", "!", "-", "@", "!", "01", "02", "12", "31", "\n", "=", "!", "<", ">", "<=", ">=", "send_email", "loop", "end", "if", "else", "def", "and", "or", "CC:", "BCC:" \}$

$V_n = \{ \text{lower_case, upper_case, letter, digit, integer, character, string, name, file_path, directory, file_name, email_address, string_with_dots, domain, date, year, month, day, time, hour, minute, second, text, symbol, special_character, subject, attachment, recipient, cc_recipient, bbc_recipient, signature, header, function_definition, parameter, parameters, data_type, email_script, email_statement, email_body, body, statement, send_email_statement, email_details, wait_statement, time_value, time_unit, if_statement, condition, comparison, comparison_operator, logical_operation, logical_operator, loop_statement, assignment_statement, variable_name, expression, value, function_call, arguments} \}$

$P = \{$
 $\text{<lower_case> ::= "a" | "b" | ... | "z"}$
 $\text{<upper_case> ::= "A" | "B" | ... | "Z"}$
 $\text{<letter> ::= <lower_case> | <upper_case>}$
 $\text{<digit> ::= "0" | "1" | ... | "9"}$
 $\text{<integer> ::= <digit> | <digit> <integer>}$
 $\text{<character> ::= <letter> | <digit> | "/" | ":" | "."}$
 $\left. \right\}$

```
<string> ::= <character> | <character> <string> | <string> <character>
<name> ::= <string> | <string> <name>
<file_path> ::= "/" <directory> "/" <file_name>
<directory> ::= <string> | <string> "/" <directory>
<file_name> ::= <string>
<email_address> ::= <string_with_dots> "@" <domain>
<string_with_dots> ::= <string> | <string> "." <string_with_dots>
<domain> ::= <lower_case> "." <lower_case> | <lower_case> <domain> | <domain>
<lower_case>
<date> ::= <year> "-" <month> "-" <day>
<year> ::= <digit> <digit> <digit> <digit>
<month> ::= "01" | "02" | ... | "12"
<day> ::= "01" | "02" | ... | "31"
<time> ::= <hour> ":" <minute> ":" <second>
<hour> ::= <digit> <digit>
<minute> ::= <digit> <digit>
<second> ::= <digit> <digit>
<text> ::= <symbol> | <symbol> <text>
<symbol> ::= <letter> | <digit> | <special_character>
<special_character> ::= "!" | "@" | ... | "\n"
<subject> ::= <text>
<attachment> ::= "Attachment:" <file_path> "\n"
<recipient> ::= <email_address> | <email_address> <recipient>
<cc_recipient> ::= "CC:" <recipient>
<bcc_recipient> ::= "BCC:" <recipient>
<signature> ::= <text>
<header> ::= "From:" <email_address> "\n" "Date:" <date> "\n" "Subject:" <subject> "\n"
    "To:" <recipient>
    "\n" <cc_recipient>? <bcc_recipient>? "\n"
<function_definition> ::= "def" <function_name> "(" <parameters> ")" ":" <body> "\n"
<function_name> ::= <string>
<parameters> ::= <parameter> | <parameter> "," <parameters>
<parameter> ::= <name> ":" <data_type>
<data_type> ::= "string" | "integer" | "email_address" | "file_path" | "date" | "time"
<email_script> ::= <function_definition> | <email_statement>
<email_statement> ::= <header> <email_body> <attachment>?
<email_body> ::= <text> | <statement> | <statement> <body>
<body> ::= <text> | <statement> | <statement> <body>
<statement> ::= <send_email_statement> | <wait_statement> | <if_statement> |
    <loop_statement> |
    <assignment_statement>
<send_email_statement> ::= "send_email(" <email_details> ")"
<email_details> ::= <header> <body> <attachment>?
<wait_statement> ::= "wait(" <time_value> ")"
<time_value> ::= <integer> <time_unit>
<time_unit> ::= "seconds" | "minutes" | "hours" | "days"
<if_statement> ::= "if" <condition> ":" <body> "else:" <body> "end"
<condition> ::= <comparison> | <logical_operation>
<comparison> ::= <expression> <comparison_operator> <expression>
<comparison_operator> ::= "==" | "!=" | "<" | ">" | "<=" | ">="
<logical_operation> ::= <condition> <logical_operator> <condition>
```



```

<logical_operator> ::= "and" | "or"
<loop_statement> ::= "loop" ":" <body> "end"
<assignment_statement> ::= <variable_name> "=" <expression>
<variable_name> ::= <string>
<expression> ::= <value> | <variable_name> | <function_call>
<value> ::= <string> | <integer> | <email_address> | <file_path> | <date> | <time>
<function_call> ::= <function_name> "(" <arguments> ")"
<arguments> ::= <expression> | <expression> "," <arguments>

```

Parse tree

ANTLR (ANother Tool for Language Recognition) is a parser generator for reading, processing, executing, or translating structured text or binary files. From a given grammar, ANTLR generates a parser that can build and walk parse trees and also generates a listener interface (or visitor) that makes it easy to respond to the recognition of phrases of interest [8].

Parse tree (also known as derivation tree or concrete syntax tree) is a hierarchical structure that represents the syntactic structure based on a given grammar [9].

```

def func(to:email_address,subject:string,content:string):
  send_email(
    From:send@gmail.com
    Date:2023-03-15
    Subject:subject
    To:to
    content
  )
end

func(test@gmail.com,"Test subject","This is a test body")

```

Figure 1. Email automation code example

According to the defined grammar of the email automation DSL and the code snippet in fig. 1, a parse tree for the email automation DSL is represented in figure below.

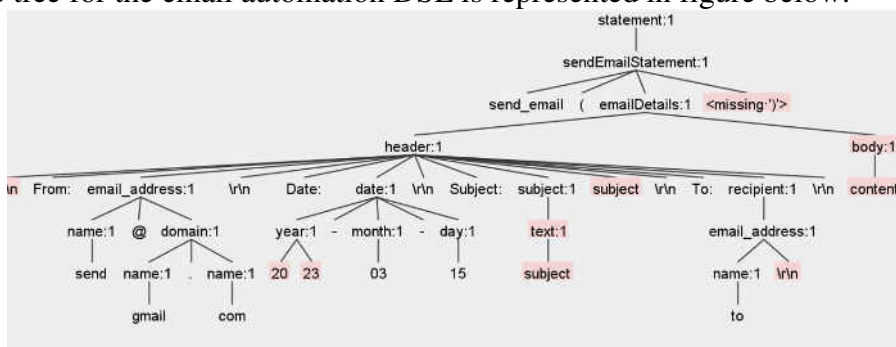


Figure 2. Parse tree for email sending

Conclusions

In summary, the need for a new language in the domain of email automation arises from the limitations of existing solutions and the growing complexity of modern email marketing. Platforms like Mailchimp, Brevo, and Campaigner have useful functions and tools, but in many situations, they fall short of giving a really smooth and customized email automation experience.

With the flexibility to build domain-specific constructions, rules, and conventions, users may precisely customize their email automation processes to meet the demands of their organizations. DSLs also provide a mechanism that may support teamwork and shared work efficiently by their enhanced communication and the sharing of the knowledge.

Scalability and ease of maintenance are further characteristics of email automation DSL. With such an organized and language-oriented syntax, maintenance and modification of automation logic over time are much more manageable, hence allowing organizations to adjust their workflow according to the growth of the business or the changes required for their marketing campaign.

Furthermore, the email automation DSL aids in the testing and quality assurance of complete workflows. This is because, in this language, one may express test scenarios directly, making sure that the logic of automation is correct and reliable to minimize chances for errors and inconsistencies.

In essence, the introduction of a domain-specific language for email automation represents a step forward towards empowering businesses to navigate in competitive markets with ease by using a user-friendly platform designed specifically for their needs, making email marketing challenges easier to navigate with precision.

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DEVELOPMENT OF A DELTA ROBOT FOR SORTING ITEMS IN INDUSTRIAL CONDITIONS

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Abstract. *This article was created as part of a Problem Based Learning (PBL) project in which we investigated delta robots, CNC machines and embedded systems. In response to the imperatives of Industry 4.0, this research introduces "DeltaSort", a delta robot system poised to revolutionize agricultural sorting processes. Through the integration of advanced gripping mechanisms and artificial intelligence-driven object recognition, DeltaSort meticulously assesses and categorizes harvested fruits and vegetables, ensuring judicious force application for gentle handling and precise sorting. Beyond the confines of agriculture, the system presents a plethora of advantages, encompassing heightened productivity, superior precision, elevated safety standards, increased production speeds, and non-stop operational capability, rendering it an instrumental solution in contemporary automated processes.*

Key words: *delta robot, industry 4.0, agricultural sorting, advanced gripping mechanisms.*

Introduction

In the rapidly advancing landscape of modern technology, the creation of machines capable of mimicking human movements has become a hallmark of innovation. Defined by the Oxford English Dictionary as "machinery resembling a human being and able to replicate certain human movements and functions automatically," robots, particularly those with parallel kinematics, have garnered significant attention from various industries and researchers [1]. The inherent advantages of parallel kinematic mechanisms, such as higher precision, rigidity, dynamic performance, and loading capabilities compared to serial robots, have positioned them as transformative elements in the realm of automation.

A prominent representative of parallel kinematics is the Delta robot, renowned for its versatility in mimicking human arm movements and executing tasks requiring precision. However, it is crucial to acknowledge that Delta robots are not universally applicable; they excel in high-speed pick-and-place applications involving lightweight parts with simple geometries. Notwithstanding, limitations arise in scenarios where products cannot withstand such high speeds and accelerations.

This article delves into the nuanced landscape of Delta robots, exploring their applications across diverse industries. While their proficiency in pick-and-place operations is well-acknowledged, Delta robots exhibit capabilities beyond this realm, encompassing assembly, material handling, palletizing/packaging, and other specialized functions.

The subsequent sections elaborate on the vision-based material classification, the robotic system's components, and the crucial role played by the vacuum gripper. Additionally, the article discusses the benefits of incorporating robotics and automation in CNC machining operations, emphasizing increased productivity, enhanced precision, improved safety, higher production speeds, flexibility, and 24/7 operation. While acknowledging the advantages, the article also

addresses the potential challenges associated with the implementation of robotics in CNC machining.

The integration of Delta robots and advancements in CNC machining, coupled with the infusion of technologies like Big Data, AI, IoT, and 3D printing, marks a paradigm shift in manufacturing and automation [2]. The subsequent sections of this article delve into specific applications, technical details, and implications of these advancements, offering a comprehensive exploration of their impact on industrial processes and efficiency.

Use Cases

Delta robots are highly demanded nowadays in industries, due to the fact that there are many functionalities that they can execute. Further, some of the applications of delta robots will be listed, along with the percentage of the robots used specifically for each purpose [3]:

- Assembly (10%)
- Pick and place (32%)
- Material handling (14%)
- Palletizing/packaging (32%)
- Others (12%)

Functionalities stated above, make delta robots an indispensable tool in various industries. We will discuss the primary use cases for our project - using delta robots in agriculture: Delta robots, known for their speed and precision in manufacturing, have found innovative applications in the realm of farming and agriculture. These robots are increasingly being utilized to enhance efficiency and productivity in various agricultural processes. In precision agriculture, delta robots are employed for tasks such as planting, seeding, and harvesting with unmatched accuracy, minimizing waste and optimizing crop yields. Their rapid and precise movements make them well-suited for delicate operations like fruit picking and sorting. Additionally, delta robots can be integrated into automated systems for packaging and handling of agricultural products, streamlining post-harvest processes. The deployment of delta robots in agriculture not only improves operational efficiency but also contributes to sustainable practices by reducing resource usage and increasing overall crop quality [4].

DeltaSort

In the realm of robotic applications, our project, aptly named "DeltaSort", stands as a pioneering endeavor to harness the capabilities of Delta robots for transformative purposes. While Delta robots have traditionally been associated with high-speed pick-and-place operations, "DeltaSort" extends their utility into the critical domain of agricultural sorting. Leveraging advanced gripping mechanisms, computer vision technology, and sophisticated algorithms, our project seeks to revolutionize the sorting processes for fruits and vegetables, ensuring precision and efficiency.

Key Components of DeltaSort

- **Object Recognition.** Central to the success of DeltaSort is its utilization of cutting-edge AI algorithms trained on extensive datasets. This enables the system to recognize various types of fruits and vegetables based on their size, shape, and color, laying the foundation for efficient and accurate sorting.
- **Sorting Criteria.** DeltaSort categorizes produce according to user-defined parameters such as size and color. This intelligent sorting ensures that each item is directed to the appropriate destination, whether for packaging or further processing.
- **Gentle Handling.** Recognizing the delicate nature of fruits and vegetables, DeltaSort's movements are meticulously programmed to be gentle, preventing any damage during the sorting process.

- Feed Streaming and Distant Control. The project incorporates a user-friendly web interface for feed streaming, allowing real-time monitoring of the sorting process from any location. Additionally, DeltaSort offers distant control, enabling users to modify sorting processes, define product placement, or halt operations with a simple tap.
- On-Screen Display. Real-time updates and statistics are displayed on the web interface, offering a comprehensive view of the progress in sorting, assembly, or packaging tasks.

Feedback Forms

To ensure the delta robot operates smoothly and sorts correctly, implement a feedback system for user alerts when issues arise. This system can take various forms:

- - Visual Feedback:

The main visual feedback will be obtained by real-time updates and stats on a monitor or touchscreen

- - Remote Monitoring and Alerts:

Remote Access is provided with a monitor and receives alerts from anywhere with internet access.

- - User Interface Feedback:

Intuitive Interfaces are user-friendly design for error reduction. Error Messages guide operators in resolving issues effectively.

Benefits of using system

The incorporation of delta robot systems into sorting, assembling, and packaging tasks yields significant advantages across diverse industries and applications:

- Enhanced Productivity: Employing delta robots diminishes downtime and enhances productivity compared to human labor. Robots operate continuously without breaks or fatigue, resulting in heightened output and improved operational efficiency.
- Augmented Precision and Accuracy: Delta robots exhibit exceptional precision and repeatability, ensuring consistent and accurate machining processes. They achieve stringent tolerances and mitigate human errors, thereby enhancing part quality and minimizing scrap or rework.
- Elevated Safety Standards: Automation eliminates manual intervention in hazardous or physically demanding tasks, mitigating the risk of accidents, injuries, and exposure to harmful environments. This fosters a safer working environment for operators.
- Accelerated Production Rates: Delta robots execute machining operations at significantly faster speeds than human operators. Their capacity for swift execution of complex movements and tool changes translates into reduced cycle times and heightened production rates.
- Flexibility and Adaptability: Robotic systems possess the capability to be programmed for a wide spectrum of tasks, facilitating enhanced flexibility. They seamlessly transition between diverse machining operations or workpieces, facilitating efficient batch production and swift product changeovers.
- Continuous Operation: Automated systems operate round-the-clock, including beyond regular working hours, without necessitating human supervision. This maximizes machine utilization and enables uninterrupted production, thereby bolstering overall production capacity.

System requirements

Functional Requirements:

- Interface for Setup and Configuration: This requirement entails providing a user-friendly interface through which operators can configure and set up the delta robot system according to specific sorting requirements. The interface should offer intuitive

controls and options for adjusting parameters such as sorting criteria, sensitivity levels, and sorting algorithms. A well-designed setup interface ensures efficient deployment of the system and facilitates customization to suit varying sorting needs across different batches of produce.

- **Error Detection and Correction Mechanisms:** The system must incorporate robust error detection and correction mechanisms to minimize sorting errors and maintain high accuracy levels. This involves implementing algorithms and sensors capable of identifying discrepancies between the expected and actual sorting outcomes. Upon detecting errors or anomalies, the system should promptly initiate corrective actions, which may include recalibration, repositioning of objects, or triggering alarms for manual intervention. Reliable error detection and correction mechanisms are crucial for ensuring consistent sorting quality and reducing the need for manual oversight.
- **Operational Data Logging and Analysis:** Operational data logging is essential for capturing relevant performance metrics and operational parameters during sorting tasks. The system should log data such as sorting speed, accuracy rates, error occurrences, and equipment utilization. This accumulated data serves as a valuable resource for conducting in-depth analysis to identify trends, patterns, and areas for improvement. By analyzing operational data, operators can gain insights into system efficiency, optimize sorting processes, and make informed decisions to enhance overall performance and productivity. Effective data logging and analysis contribute to continuous refinement and optimization of the delta robot system for achieving optimal sorting outcomes.

Non-functional Requirements:

- **Compliance with Safety Standards and Regulations:** Ensuring compliance with relevant safety standards and regulations is paramount to safeguarding operators and maintaining a secure working environment. This requirement involves adhering to established guidelines governing the design, operation, and deployment of robotic systems in agricultural and waste management settings. Safety measures may include incorporating protective barriers, emergency stop mechanisms, and safety interlocks to prevent accidents or injuries during system operation. Compliance with safety standards demonstrates a commitment to workplace safety and minimizes the risk of legal liabilities associated with non-compliance.
- **Compatibility with Standard Communication Protocols:** The system should be compatible with widely adopted communication protocols to facilitate seamless integration with existing infrastructure and third-party systems. Compatibility with standard protocols such as Ethernet/IP, Modbus TCP, or OPC UA enables interoperability with other equipment, control systems, and data management platforms commonly used in industrial environments. This interoperability enhances the system's flexibility, scalability, and interoperability, allowing for streamlined data exchange, centralized monitoring, and coordinated control across interconnected systems. Compatibility with standard communication protocols fosters an ecosystem of interconnected technologies, enabling efficient collaboration and data sharing for enhanced operational efficiency and decision-making.
- **Energy Efficiency and Environmental Impact:** Designing the system with energy-efficient components and operational modes is essential to minimize power consumption and reduce its environmental footprint. This requirement involves optimizing the selection of motors, actuators, and control systems to maximize energy efficiency without compromising performance. Additionally, implementing power-saving features such as sleep modes, variable speed drives, and intelligent power management strategies helps minimize energy waste during system operation. By prioritizing energy efficiency, the system not only reduces operational costs but also contributes to sustainability goals by conserving resources and mitigating

environmental impact. Efficient energy management aligns with environmental stewardship principles and enhances the system's overall sustainability credentials, making it an environmentally responsible choice for agricultural and waste management applications.

Architectural Design

System Components:

- Video Camera:
- Optical Sensor: Hardware component capturing visual data, utilizing CCD or CMOS technology.
- AI Processing Core: Computational unit analyzing visual data for object recognition, size estimation, and color detection, often employing CNNs.

Delta Robot:

- Microcontroller Unit (MCU): Controls robot movement and sorting logic based on grabbing sensor input and AI-processed data.
- Grabbing Sensor: Detects item presence and location, providing timing feedback for precise picking operations.
- Delta Object Picker: End-effector picking and placing items securely using suction cups, guided by MCU instructions.

UI Components:

- Dashboard Interface: Central control panel offering real-time system status and access to various functionalities.
- Camera Feed Display: Live video feed showcasing sorting process, with options for zooming and camera views.
- Parameter Configuration Panel: Allows user adjustment of sorting parameters such as size and color thresholds for tailored sorting criteria.

Below, in the Fig.1 are presented all these architectural components of the system, in a diagram:

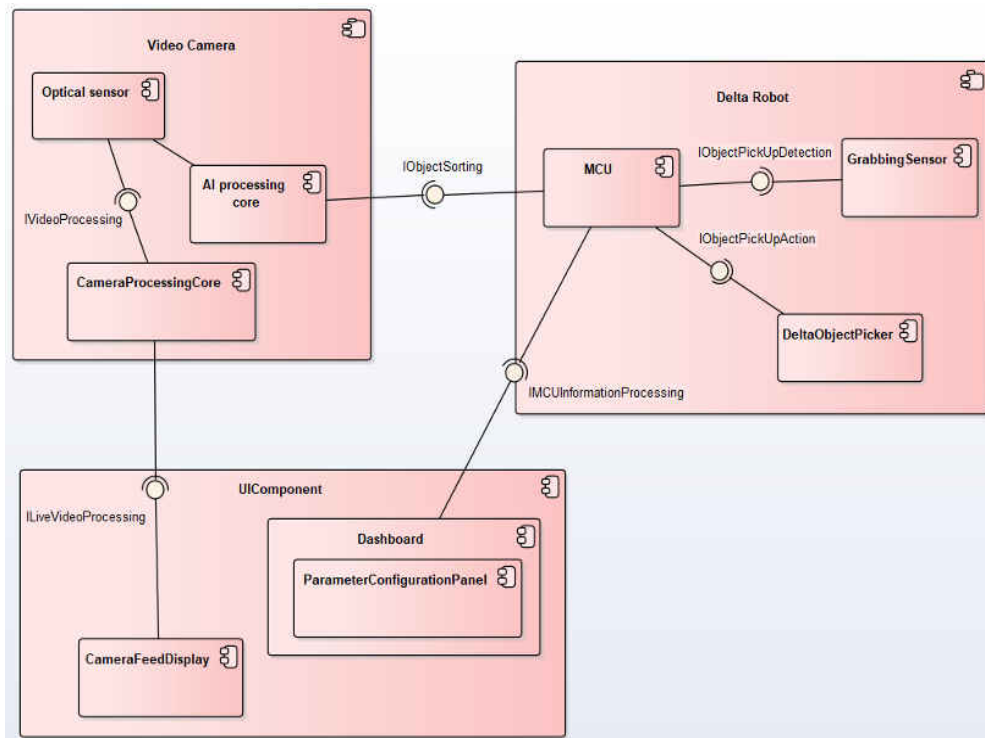


Figure 1. Architectural Design of the System

Conclusion

In summary, the development of a delta robot tailored for industrial sorting tasks marks a significant advancement in automation technology. Engineered with precision and efficiency in mind, this innovative system seamlessly integrates cutting-edge components to meet stringent industrial demands. Its versatility promises enhanced productivity and operational flexibility across various sectors. Looking ahead, further advancements in robotics technology hold the potential to elevate efficiency and versatility, reinforcing the role of automation in modern manufacturing. In essence, the delta robot exemplifies the transformative impact of automation on industrial processes, driving progress and competitiveness in the ever-evolving landscape of manufacturing.

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SUBSECȚIA INTERDISCIPLINARĂ ÎN LIMBA FRANCEZĂ
INTERDISCIPLINARY SUBSECTION IN FRENCH

CRÉER LE FUTUR AVEC LES SYSTÈMES EMBARQUÉS

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Sommaire: *L'intelligence artificielle intervient dans les systèmes embarqués. Actuellement, le nombre de systèmes embarqués a largement dépassé celui des ordinateurs. Cette révolution constitue à la fois une opportunité et un défi. Sa mise en œuvre soulève de nombreuses interrogations. Pourtant, la plupart d'individus ne sont pas pleinement conscients de l'omniprésence de ces technologies et des implications qui en découlent. Les systèmes informatiques embarqués sont essentiels au fonctionnement des appareils et systèmes électroniques dans un grand nombre de secteurs. Par la suite, ils sont au cœur de nombreux produits, machines et opérations intelligentes, comme les applications d'apprentissage automatique et d'intelligence artificielle. Dans cet article de recherche, on analyse l'architecture, les avantages, les inconvénients et les défis des systèmes embarqués. De plus, dans cet article on examine les systèmes embarqués face à la révolution de l'intelligence artificielle. D'ailleurs, on analyse le champ varié d'application des systèmes embarqués, afin qu'on comprenne mieux leur impact sur divers secteurs.*

Mots Clés: *systèmes embarqués, intelligence artificielle, automatisation, sécurité, IoT, microcontrôleur, performance, fiabilité, optimisation des ressources, apprentissage automatique.*

Introduction :

Savez-vous quel est le point commun entre une imprimante, un satellite, une console de Jeu vidéo, un four à microonde, un smartphone et un ascenseur? Ils ont tous des systèmes embarqués, un des secteurs de technologies de l'information les plus porteurs.

Les systèmes embarqués occupent une position centrale dans de nombreux produits, dispositifs et applications intelligentes, y compris celles liées à l'apprentissage informatique et à l'intelligence artificielle. Leur utilité est étendue et essentielle dans divers domaines, contribuant de manière vitale au fonctionnement quotidien de véhicules, appareils ménagers, équipements médicaux et autres dispositifs interactifs omniprésents dans notre routine. Leur souplesse et leur capacité d'adaptation en font des éléments incontournables dans tous les aspects de notre vie moderne, étant désormais omniprésents dans chaque appareil intelligent. Il est difficile de trouver une seule portion de la vie moderne qui n'implique pas cette technologie. Par la suite, les systèmes intégrés sont un moteur majeur dans le développement du monde numérique, connecté et automatisé d'aujourd'hui.

Les systèmes embarqués sont partout, dans le domaine médical, dans les télécommunications, dans le transport, la consommation électronique, dans le militaire et l'aviation. Mais quelles sont les avantages et les inconvénients des systèmes embarqués? Est-ce que dans l'ère digitale il existe encore des défis liés de ce domaine?

L'architecture des systèmes embarqués :

Un système embarqué est un système informatique et électronique autonome ayant comme objectif l'exécution d'une tâche spécifique en temps réel. La première différence avec un ordinateur standard c'est le fait que l'ordinateur permet d'exécuter de nombreux types d'applications. Quand même, le système embarqué n'exécute qu'une seule fonction spécifique. Le

système embarqué est souvent invisible à l'utilisateur puisqu'il est intégré au sein d'une machine ou d'un appareil qui va lui-même remplir une fonction.

En outre, un système embarqué est initialement conçu pour exécuter un ensemble de fonctions spécifiques, allant de tâches simples telles que la surveillance de l'état d'un interrupteur électrique, à des missions plus complexes comme la gestion des mouvements d'un robot industriel de haute flexibilité [1].

En l'occurrence, les systèmes embarqués sont devenus une partie essentielle de nos vies, en fonctionnant avec une intervention humaine minimale. Leur taille compacte, leur conception simple et leur faible coût montrent que cette technologie est primordiale dans des secteurs comme l'aérospatiale, l'automobile, la santé et même les villes intelligentes. Il est nécessaire que les systèmes embarqués soient capables de s'intégrer dans des équipements et aient un prix convenable. D'ailleurs, ces systèmes sont souvent limités en termes de mémoire et de puissance de traitement disponibles. Le matériel et le logiciel sont donc développés pour répondre de manière précise aux exigences spécifiques [2].

En termes d'architecture, un système embarqué est constitué d'un microcontrôleur qui permet de résoudre un problème spécifique, souvent lié à des contraintes de temps et de taille. Le microcontrôleur est conçu afin qu'il réalise une opération spécifique, pour cela, il inclut un processeur. Le processeur fournit une puissance de calcul. En outre, le microcontrôleur a une mémoire, souvent assez limitée, contenant le programme et les données. Il a des capteurs jouant le rôle d'entrée pour recevoir une information concernant la température, les vibrations, l'humidité, la pression, de proximité ou de contact. Par la suite, les capteurs mesurent les grandeurs physiques caractéristiques de l'environnement afin de déterminer son état courant [3]. Ces données sont numériquement transformées afin d'être analysées par le système informatique, lequel générera un résultat en fonction des conditions environnementales. Ensuite, on va avoir des actionneurs jouant le rôle de sortie permettant aux systèmes embarqués de produire les actions prises au niveau du logiciel sur l'environnement extérieur. Alors, ce sont des laids, des écrans d'affichage, des haut-parleurs, des systèmes d'alarmes. Enfin, les systèmes embarqués ont des moyens de communications afin qu'ils communiquent via Internet avec l'extérieur. Ce phénomène s'appelle IoT (internet des objets) [4].

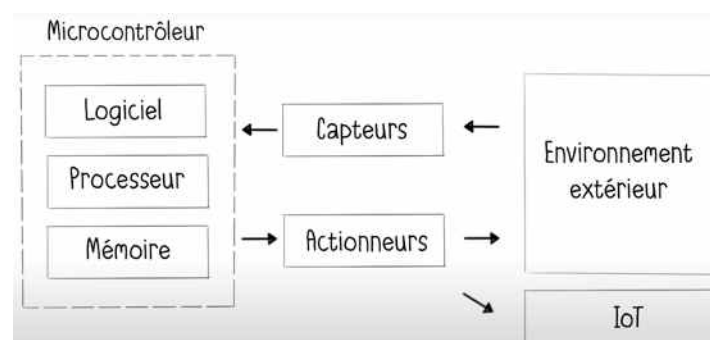


Figure 1. L'architecture des systèmes embarqués [4]

Les types de systèmes embarqués :

Il existe aujourd'hui une grande différence entre les différents systèmes embarqués en fonction de l'appareil dans lequel il est embarqué et de la complexité de la tâche du système embarqué. D'une cote, on a les systèmes embarqués de petite taille, avec du hardware et du software très simple, suffisant pour des taches basiques. On les retrouve par exemple dans la machine à café qui va transformer notre capsule en café. D'une autre coté, on a celui sophistiqués. Un exemple ou ils sont utilisés est l'avion, dont le système embarqué facilite le pilotage et améliore la sécurité.

Les systèmes embarqués les plus utilisés peuvent être classés en quatre catégories en tenant compte de leurs performances et de leurs exigences fonctionnelles. Tout d'abord, il y a les systèmes

"en temps réel", qui sont configurés et intégrés pour accomplir des tâches spécifiques dans des délais prédéfinis. Des exemples pour ce type sont le système de sonorisation d'un ordinateur et le système de contrôle d'un avion. Ensuite, on a le «**stand-alone**» - des systèmes autonomes capables d'accomplir des tâches sans nécessiter de système hôte tel qu'un processeur ou un ordinateur.

Ce sont les Fours à micro-ondes, machines à laver, les consoles de jeux vidéo. Outre cela, on a le système «**en réseau**» qu'il soit câblé ou sans fil, pour réaliser les tâches qui lui sont attribuées et transmettre les résultats aux appareils connectés. Ce sont les Distributeurs automatiques de billets, les systèmes de sécurité domestique et les machines à glisser les cartes. Dernièrement, on a le système «**Mobile**» - qui est de taille réduite et qui est facile à utiliser. Des systèmes de contrôle embarqués mobiles sont les appareils photos numériques, les téléphones portables, les montres intelligentes, le traqueur de fitness [5].

D'ailleurs, voilà un exemple d'un contrôleur d'ascenseur simple. Le « résolveur de requête » résout les différentes demandes d'étage en un seul étage demandé. « L'unité de contrôle », déplace l'ascenseur à l'étage demandé. Une description partielle en français sera : « Déplacez l'ascenseur vers le haut ou vers le bas pour atteindre l'étage demandé. Une fois arrivé à l'étage demandé, ouvrez la porte pendant au moins 10 secondes et laissez-la ouverte jusqu'à ce que l'étage demandé change. Veillez à ce que la porte ne soit jamais ouverte pendant le déplacement. Ne changez pas de direction à moins qu'il n'y ait pas de demandes plus élevées lorsque vous montez ou de demandes plus basses lorsque vous descendez... » [6].

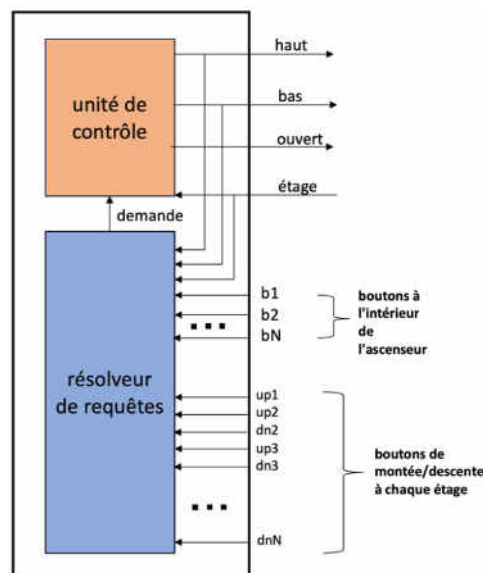


Figure 2. Un contrôleur d'ascenseur simple [6]

Les avantages des systèmes embarqués:

Les technologies embarquées se retrouvent au cœur d'une vaste gamme d'équipements et améliorent les performances à faible coût. Actuellement, les systèmes embarqués assistent et contrôlent des domaines importants de notre vie. Ils permettent aux entreprises d'être plus performantes et rendent la vie des citoyens plus pratique et plus satisfaisante. Certains systèmes, notamment pour le contrôle des automobiles et des avions, les systèmes médicaux et l'alimentation en énergie nucléaire, sont déjà essentiels à la vie humaine. Leur évolution sera si radicale que les générations futures connaîtront une omniprésence de "l'intelligence embarquée" qu'il est difficile d'imaginer aujourd'hui. On trouvera littéralement des systèmes intelligents intégrés, la vie et le bien-être des citoyens dépendront de ces systèmes dans une mesure inconcevable [7].

En l'occurrence, sûrement, les systèmes embarqués facilitent énormément la vie des personnes. Par la suite, ils sont utilisés pour automatiser diverses fonctions dans la maison, telles que l'éclairage, le contrôle de la température et la sécurité. D'ailleurs on les utilise pour automatiser les processus industriels, tels que les chaînes de montage, les systèmes de contrôle et les systèmes

de surveillance. En outre, ils sont utilisés dans les applications de santé, telles que les dispositifs médicaux, la surveillance à distance des patients et les systèmes d'administration de médicaments.

De plus, on les utilise dans les applications de transport, telles que les systèmes de navigation, les systèmes de contrôle des véhicules et les systèmes de surveillance des conducteurs, en nous facilitant exceptionnellement la conduite. Les systèmes embarqués représentent des majeurs avantages dans l'agriculture, on les applique dans les applications agricoles, telles que les capteurs d'humidité du sol, les systèmes d'irrigation automatisés et les systèmes d'agriculture de précision [7].

Concernant les avantages sur le fonctionnement de ces systèmes, on pourrait dire que, tout d'abord, les systèmes embarqués sont souvent très efficaces en termes de matériel et de logiciel. Ils sont adaptés aux exigences spécifiques de l'application et n'utilisent que les ressources nécessaires. Ensuite, ils sont généralement conçus pour être compacts et pour avoir un petit facteur de forme. C'est un avantage dans les applications où l'espace est limité. De nombreux systèmes embarqués sont également conçus pour fonctionner avec une consommation d'énergie minimale, ce qui les rend adaptés aux appareils alimentés par batterie et à faible consommation d'énergie. En plus, de nombreux systèmes embarqués sont conçus pour fonctionner en temps réel, en réagissant aux entrées et en produisant des sorties dans des délais précis. Ils présentent des niveaux élevés de fiabilité, une fois déployés, les systèmes embarqués ont souvent un cycle de vie plus long que les dispositifs informatiques à usage général [7].

Les défis, les systèmes embarqués face à la révolution de l'intelligence artificielle :

Ce qui est primordial de souligner c'est que le nombre d'appareils connectés dans le monde augmente exponentiellement chaque année, selon la statistique. Les développeurs de solutions embarquées sont confrontés à de nombreux problèmes spécifiques.

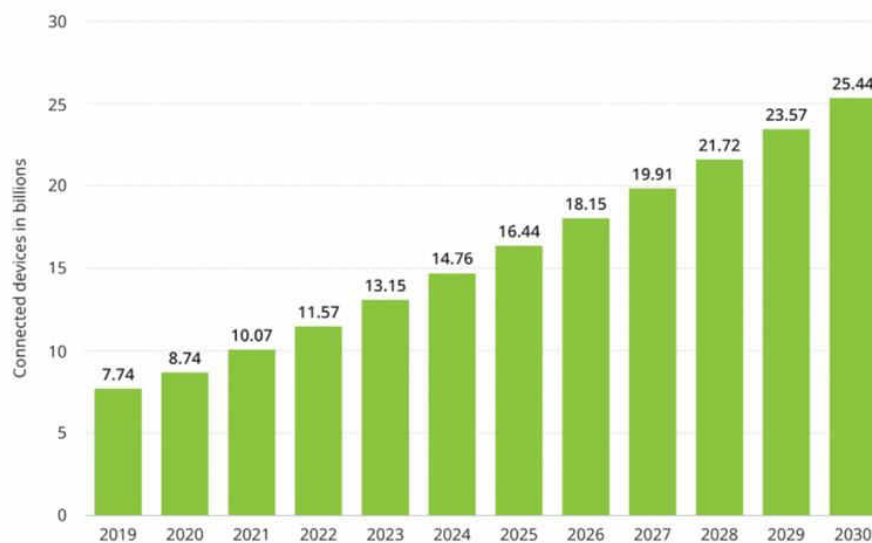


Figure 3. Le nombre d'appareils connectés dans le monde [8]

Premièrement, les systèmes embarqués peuvent être complexes et difficiles à développer et à entretenir. Deuxièmement, étant de plus en plus connectés, la demande en matière de sécurité augmente. Les systèmes embarqués sont souvent vulnérables aux cyberattaques, car ils disposent souvent de ressources limitées et ne sont pas conçus en tenant compte de la sécurité. En outre, ces systèmes peuvent être coûteux à développer et à fabriquer. D'ailleurs, les systèmes embarqués ont souvent des ressources limitées en énergie, ce qui peut limiter leur fonctionnalité. Il n'existe pas de normes uniques pour les systèmes embarqués, ce qui peut compliquer également le développement et la maintenance de systèmes complexes qui fonctionnent ensemble [9].

Conclusions

Pour clôturer, on pourrait affirmer que les systèmes embarqués sont des composants essentiels de la technologie moderne, et leur importance ne fera que croître à l'avenir. La conception et le développement de ces systèmes nécessitent une approche multidisciplinaire qui combine la conception de matériel et de logiciel. Il est nécessaire qu'on tire parti d'une évolution majeure dans les systèmes intelligents, un monde où tous les systèmes, toutes les machines et tous les objets sont intelligents, ou ils ont une présence dans le cyberspace, exploitent les informations et les services qui les entourent, communiquent entre eux, avec l'environnement et avec les personnes, et gèrent leurs ressources de manière autonome. Elles changeront notre façon de vivre en tant que citoyens et la manière dont nous faisons des affaires dans la nouvelle économie numérique. C'est une tendance qui s'accélère et son impact sur notre société deviendra plus profond que jamais.

Les systèmes intelligents embarqués seront littéralement partout dans l'avenir, la vie et le bien-être des citoyens dépendront de ces systèmes dans une mesure inconcevable.

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LA SÉCURITÉ DES DISPOSITIFS. PRÉVENIR LES CYBERATTAQUES

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Sommaire. *Actuellement, la protection des données dans l'Internet des Objets est essentielle pour garantir la sécurité des informations échangées et stockées au sein de l'écosystème interconnecté des appareils. Généralement, les facteurs critiques incluent une authentification robuste des appareils, le cryptage des données, la gestion sécurisée des accès, et des mises à jour logicielles régulières pour corriger les vulnérabilités. En outre, renforcer la sensibilisation des utilisateurs et promouvoir les normes de sécurité sont indispensables pour assurer un environnement IoT sûr et inspirer confiance à l'ère d'une société numérique interconnectée. Cependant, les cyberattaques sont courantes et représentent un sujet d'intérêt populaire, en particulier lorsqu'elles sont rapportées par les médias. De plus, il convient de souligner que la plupart de ces cyberattaques ont touché des milliers, voire des millions de personnes dans le monde. Il s'agit notamment de cyberattaques contre des plateformes de réseaux sociaux, des sites web hébergeant des données personnelles et d'autres.*

Mots clés: *confidentialité, intégrité, authentification, surveillance, risqués*

Introduction

Les environnements virtuels créés par les cyberinfrastructures sont actuellement omniprésents dans notre vie quotidienne, tant sur le plan personnel que professionnel. Cependant, l'émergence des nouvelles technologies nous expose à des risques accrus qui peuvent gravement nuire aux individus et aux organisations. Malheureusement, la question de la cybersécurité est souvent négligée [1].

Il est essentiel que les organisations reconnaissent les risques liés à l'utilisation des technologies et à la gestion des données et qu'elles réagissent de manière proactive en sensibilisant leurs employés. Comprendre les différentes menaces et vulnérabilités associées à l'environnement numérique est essentiel pour mettre en place des contrôles efficaces.

La mise en œuvre de contrôles internes visant à sécuriser de manière adéquate les actifs informationnels d'une organisation nécessite une planification minutieuse et une définition claire des objectifs. Toutefois, pour être efficaces, ces contrôles doivent impliquer l'ensemble du personnel, et pas seulement les spécialistes des technologies de l'information.

Il est important de souligner que la sécurité de l'information ne peut être garantie par les seules mesures techniques. Un personnel qualifié et formé joue un rôle crucial dans ce processus. En effet, la plupart des incidents de sécurité sont souvent le résultat d'une mauvaise gestion et organisation et, dans une moindre mesure, de faiblesses dans les mécanismes de sécurité.

Le fonctionnement et les perspectives d'évolution de la cybersécurité

La cybersécurité fonctionne en combinant plusieurs mesures de protection pour empêcher la perturbation des processus, l'accès non autorisé aux informations, leur modification, leur destruction ou leur utilisation abusive. Ces mesures comprennent l'utilisation de pare-feu, de logiciels antivirus, de systèmes de détection des attaques, le cryptage des données, des politiques de sécurité strictes et des formations régulières pour sensibiliser les employés aux bonnes pratiques en matière de sécurité informatique [2].

En plus, la cybersécurité implique une surveillance constante de l'environnement numérique afin de détecter les nouvelles menaces et d'y répondre dès qu'elles apparaissent. Il peut s'agir d'analyser les journaux d'activité, de contrôler le trafic réseau, d'utiliser des technologies d'intelligence artificielle pour détecter les comportements suspects et de collaborer avec d'autres organisations et experts en sécurité pour partager des informations sur les menaces.

Actuellement, il n'existe pas de solution unique de cybersécurité pour les entreprises. Au lieu de cela, diverses mesures de protection sont combinées pour prévenir la perturbation des processus et de l'accès aux informations, leur modification, leur destruction ou leur conservation en vue d'obtenir un résultat. Cette protection doit évoluer en permanence pour contrer de manière proactive les nouvelles cybermenaces [3].

Tous les aspects de la cybersécurité sont en constante évolution. Avec l'introduction de nouvelles technologies, de nouvelles vulnérabilités apparaissent. Les cybercriminels continuent d'innover dans leurs méthodes d'attaque, ce qui entraîne des conséquences de plus en plus graves.

Les avancées telles que l'intelligence artificielle et les réseaux 5G peuvent être à la fois une bénédiction pour la cybersécurité, car elles offrent des opportunités aux experts en sécurité tout en fournissant de nouvelles avenues aux cybercriminels. Bien que les menaces futures soient difficiles à prévoir, il est clair que la cybersécurité doit adopter une approche proactive pour faire face à l'évolution constante des menaces.

État actuel des cyberattaques : complexité croissante et impact sur la société

Les cyberattaques représentent des actions frauduleuses effectuées par des cybercriminels pour compromettre des systèmes informatiques, des réseaux et des appareils électroniques dans le but d'obtenir des avantages financiers, des informations sensibles ou de causer des dommages à des organisations et à des particuliers. Ces attaques peuvent prendre diverses formes, du phishing (méthode de cyberfraude par laquelle les criminels tentent d'obtenir des informations sensibles) [4] aux logiciels malveillants, en passant par l'exploitation des failles de sécurité et les attaques par déni de service distribué (DDoS) [5].

Ces dernières années ont vu une augmentation significative de la complexité et de la fréquence des cyberattaques. En outre, les technologies émergentes telles que l'intelligence artificielle et l'internet des objets ont ouvert aux cybercriminels de nouvelles possibilités de commettre des attaques de manière innovante.

Les statistiques montrent que le nombre et l'impact des cyberattaques ont considérablement augmenté ces dernières années, entraînant des pertes financières considérables et portant atteinte à la réputation et à la confiance des organisations touchées. L'évolution rapide des technologies et la dépendance croissante à un environnement numérique ont fait des cyberattaques une menace de plus en plus grande pour la société [6].

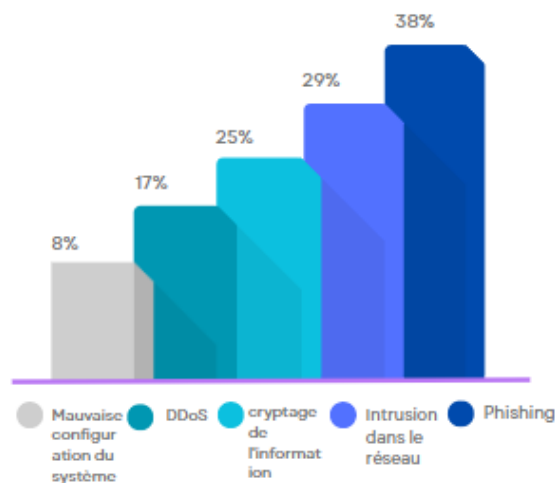


Figure 1. Statistiques sur les cyberattaques pour l'année 2023

Pour faire face à cette évolution des cyberattaques, il est essentiel d'adopter une approche proactive et globale de la cybersécurité. Cela inclut la mise en œuvre de solutions de sécurité avancées, la mise à jour régulière des systèmes et des logiciels, la formation et la sensibilisation continues des employés, ainsi que la surveillance constante de l'activité du réseau et des utilisateurs afin de détecter les menaces et d'y répondre rapidement.

Aussi, la coopération entre les organisations et les gouvernements est cruciale dans la lutte contre les cyberattaques. Le partage d'informations sur les menaces et les vulnérabilités peut contribuer à renforcer la sécurité et à réduire l'impact des cyberattaques sur la société dans son ensemble [7].

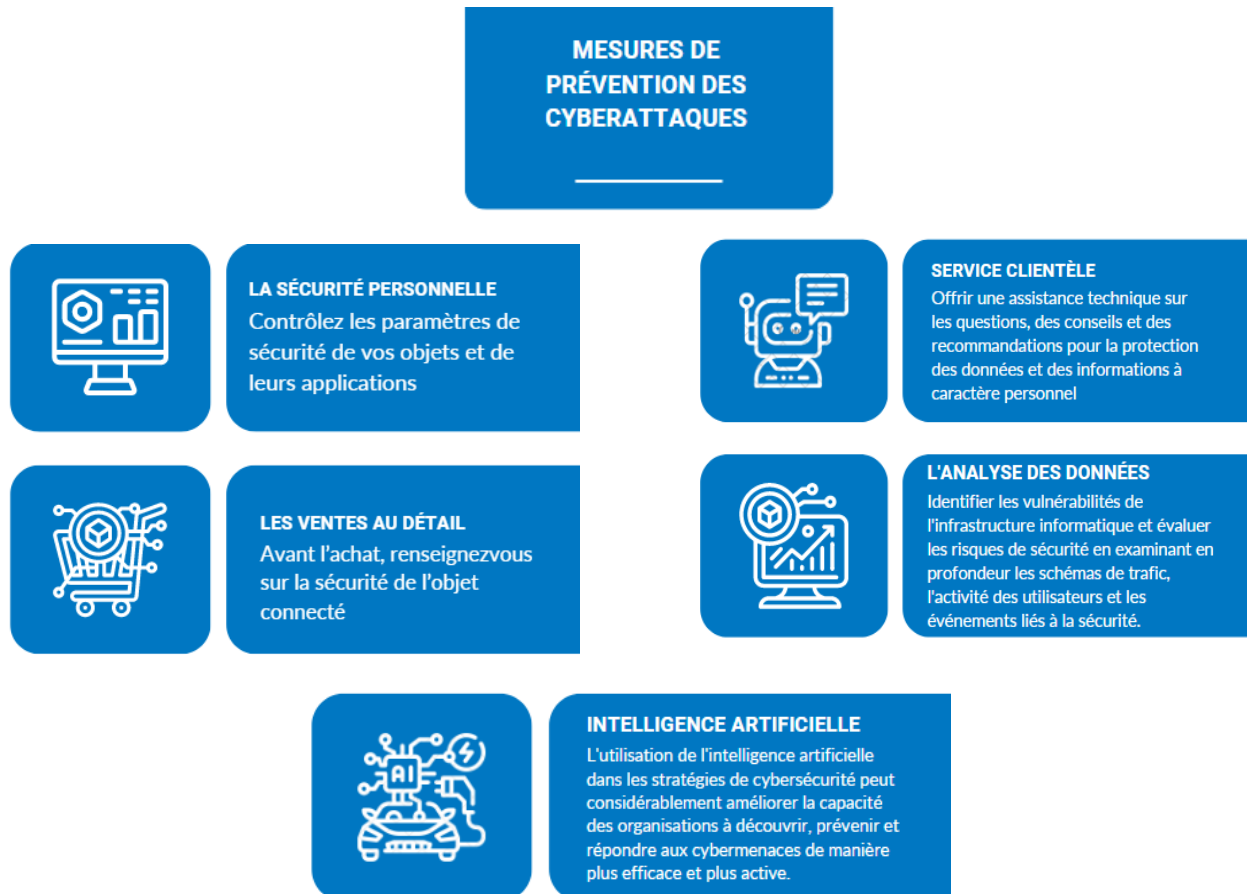


Figure 2. Mesures de prévention des cyberattaques

Conclusions

La cybersécurité est essentielle à l'ère numérique pour protéger les informations confidentielles se protéger contre les cybermenaces, préserver la confiance, respecter les réglementations et garantir la résilience et la continuité des opérations en ligne. Il s'agit d'un processus continu qui nécessite une surveillance permanente, des mises à jour régulières et des initiatives proactives afin de rester en avance sur les nouvelles menaces cybernétiques émergentes.

Les cyberattaques constituent une menace croissante et sérieuse pour les systèmes informatiques, les réseaux et les personnes. Avec l'évolution rapide des technologies et l'apparition de nouveaux moyens pour les cybercriminels de compromettre les systèmes, il est devenu important que les organisations et les individus adoptent des mesures proactives pour se protéger contre ces attaques.

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ANALYSE EXPLORATOIRE DU DEGRÉ DE CONCORDANCE DES DONNÉES AVEC LA DISTRIBUTION BINOMIALE ET GÉOMÉTRIQUE SIMULÉE STATISTIQUEMENT EN PYTHON

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Résumé. L'article présente les résultats d'une analyse exploratoire du degré de concordance des données de simulation statistique dans PYTHON par rapport aux distributions binomiale et géométrique, le volume des données simulées étant choisi en fonction de la précision et de la probabilité de confiance données pour la moyenne de sélection en tant qu'estimateur de la moyenne théorique. L'analyse est basée sur la comparaison graphique de la distribution de sélection des données avec la distribution théorique, mais aussi des caractéristiques numériques de sélection les plus représentatives avec les caractéristiques théoriques (moyenne, médiane, écart-type, coefficients d'asymétrie et d'aplatissement, etc.)

Mots-clés: analyse exploratoire, distribution binomiale, distribution géométrique, statistiques descriptives, simulations statistiques.

Introduction

Les données jouent un rôle central dans la théorie des probabilités et les statistiques, car elles constituent la base sur laquelle on modélise et on comprend la complexité des phénomènes. Par exemple, les distributions binomiale et géométrique sont souvent utilisées pour modéliser des phénomènes discrets, des processus biologiques aux études de marché, mais aussi dans divers domaines scientifiques et d'ingénierie. Ces distributions fournissent des modèles mathématiques pour les phénomènes aléatoires qui sont fondamentaux pour comprendre les processus et les événements discrets. Cependant, l'application de la théorie dans la pratique nécessite une validation par la simulation et l'analyse exploratoire des données.

Même si ces distributions se ressemblent, elles modélisent des scénarios différents avec des caractéristiques et des utilisations différentes, allant de la modélisation des processus à la théorie de la décision. La distribution géométrique décrit le comportement probabiliste du nombre d'essais nécessaires pour obtenir le premier "succès", tandis que la distribution binomiale indique le nombre de "succès" dans un nombre fixe d'essais indépendants. Cette caractéristique implique des différences significatives dans l'interprétation et l'utilisation de ces distributions dans la modélisation statistique et l'analyse des données.

Description des distributions

La distribution binomiale est une distribution de probabilité pour une variable aléatoire binomiale (a.v.), qui définit la probabilité d'obtenir un nombre fixe de succès dans un nombre fixe d'essais indépendants n , chacun avec la même probabilité p de succès. Cette distribution est souvent utilisée dans des situations où il n'y a que deux résultats possibles "succès" ou "échec" pour chaque essai, comme tirer à pile ou face, tester la qualité d'un produit, etc. Ces tests sont généralement appelés tests de Bernoulli [1].

La distribution binomiale est représentée par la formule (1), qui décrit la probabilité que le nombre total X de "succès" obtenus dans n essais de Bernoulli avec une seule et même probabilité de "succès" p dans chaque essai soit égal à k :

$$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}, \text{ pour } n \text{ importe quel } k=0,1,2,\dots,n. \quad (1)$$

La distribution binomiale est applicable dans les situations où les événements sont indépendants, où la probabilité de “succès” est constante dans chaque essai et où l'intérêt réside dans le comptage des “succès”

La distribution géométrique (tronquée à zéro) décrit le nombre total X d'essais nécessaires pour obtenir le premier “succès” dans une série d'essais de Bernoulli avec une seule et même probabilité de “succès” p dans chaque essai [1]. C'est la seule distribution de type discret qui possède la propriété “sans mémoire” en ce sens que la probabilité que le premier “succès” soit enregistré dans l'échantillon avec $n+k$, sachant que n échantillons précédents étaient des “échec”, ne dépend pas de n , mais seulement de k , et est calculée selon la même formule (2) pour la distribution géométrique :

$$P(X = k) = (1 - p)^{k-1} p, \text{ pour } n \text{ importe quelle } k=0,1,2,\dots \quad (2)$$

Processus de simulation

Afin de comprendre et d'analyser le comportement probabiliste de la v.a. à travers le prisme du traitement de données simulées, on prendra 3 cas pour chaque distribution (Tab. 1), en faisant varier les paramètres n et p pour la distribution binomiale et p pour la distribution géométrique, où n est le nombre total d'essais, d'échantillons ou d'expériences, et p est la probabilité de “succès” dans chaque essai.

Tableau 1

Paramètres variables des distributions simulées

No.	Cas / Paramètres	Distribution binomiale		Distribution géométrique
		n	p	p
1	Cas 1	10	0,01	0,01
2	Cas 2	30	0,5	0,5
3	Cas 3	50	0,99	0,99

Après avoir choisi les valeurs des paramètres pour les trois cas de chaque distribution, calculez le nombre minimum de simulations nécessaires pour obtenir une estimation avec une certaine précision ($\epsilon=0,001$) et une probabilité de confiance (par exemple 0.95), en utilisant la formule dérivée du théorème central limite, qui est donnée par la formule (3), où z est la valeur du score z associée au niveau de confiance souhaité (par exemple, 1,96 pour 95 %), σ est l'écart type de l'a.v. X , et ϵ est la précision souhaitée (la distance maximale autorisée par rapport à la vraie moyenne de la population) :

$$n = \left(\frac{z \cdot \sigma}{\epsilon} \right)^2 \quad (3)$$

En fait, ce nombre minimum de simulations coïncide avec la partie entière du nombre n augmenté d'une unité, puisque n peut être non entier. Pour appliquer cette formule, il faut estimer σ , l'écart-type de la population statistique de v.a. X , pour chaque distribution. Pour la distribution binomiale, l'écart-type (σ) est donné par la formule (4), où n est le nombre d'échantillons et p la probabilité de “succès”.

$$\sigma = \sqrt{n \cdot p \cdot (1 - p)} \quad (4)$$

L'écart-type d'une distribution géométrique est donné par la formule (5).

$$\sigma = \sqrt{\frac{1-p}{p^2}} \quad (5)$$

Par conséquent, on calcule le nombre minimum de simulations (tableau 2) pour chacun des trois cas de figure des deux distributions.

Tableau 2

Nombre de simulations			
No.	Cas	Distribution binomiale	Distribution géométrique
1	Cas 1	380 318	38 031 840 000
2	Cas 2	28 812 000	7 683 200
3	Cas 3	1 901 592	39 196

Ces valeurs reflètent la nécessité d'ajuster le nombre de simulations en fonction des spécificités de chaque distribution et de ses paramètres afin d'atteindre le niveau souhaité de précision et de confiance dans l'analyse statistique. Le nombre significativement plus élevé de simulations requises pour la distribution géométrique avec $p=0,01$ souligne la sensibilité de ce type d'analyse aux paramètres de la distribution et à la précision souhaitée.

Afin de comprendre le comportement et les caractéristiques des distributions, il est nécessaire d'analyser non seulement la tendance centrale (identification de la ou des valeurs qui caractérisent le centre ou le point typique d'une distribution de données), mais aussi le coefficient d'asymétrie et de kurtosis.

Le coefficient d'asymétrie indique si la distribution est asymétrique d'un côté et à quel point [2]. Pour la distribution binomiale, le coefficient d'asymétrie (γ_1) est donné par la formule (6), qui donne une mesure de la symétrie de la distribution autour de sa moyenne.

$$\gamma_1 = \frac{1-2p}{\sqrt{n \cdot p(1-p)}} \quad (6)$$

Pour la distribution géométrique, le coefficient d'asymétrie est donné par la formule (7), illustrant l'asymétrie de la distribution des essais nécessaires pour obtenir le premier succès.

$$\gamma_1 = \frac{2-p}{\sqrt{1-p}} \quad (7)$$

Le coefficient de kurtosis indique le degré de concentration des données autour de la moyenne par rapport à une distribution normale [2]. Dans le cas d'une distribution binomiale, le coefficient (γ_2) est calculé selon la formule (8).

$$\gamma_2 = \frac{1-6p(1-p)}{n \cdot p(1-p)} \quad (8)$$

Pour la distribution géométrique, la valeur du coefficient est calculée selon la formule (9), indiquant la forme spécifique de la distribution des essais jusqu'au premier succès [2].

$$\gamma_2 = \frac{6+p^2}{1-p} \quad (9)$$

Le langage Python a été utilisé pour générer les simulations, à l'aide des bibliothèques NumPy, Matplotlib Pyplot et SciPy, qui fournissent des fonctions permettant de générer des nombres aléatoires selon des distributions binomiales et géométriques [3].

Analyse exploratoire et comparaison des distributions

Le traitement et la compréhension des ensembles de données sont rendus possibles par l'analyse exploratoire des données simulées, qui implique une série de techniques et de processus

d'exploration des données afin d'extraire des informations utiles. Pour chaque ensemble de données simulées, une analyse exploratoire est effectuée, en calculant : la moyenne, la médiane, la dispersion, l'asymétrie et le coefficient d'aplatissement pour chaque cas (Tab. 3 et Tab. 4) et en comparant ces valeurs avec les valeurs théoriques [4].

En analysant les données du tableau 3, on compare les moyennes et médianes théoriques avec les valeurs empiriques pour les distributions binomiale et géométrique, ce qui permet d'évaluer la précision et la fiabilité des simulations.

Tableau 3

Comparaison de la moyenne et de la médiane théoriques avec les valeurs simulées pour les distributions binomiale (1) et géométrique (2)

Nr.	Cas	Média		Médiane	
		<i>théorique</i>	<i>empirique</i>	<i>théorique</i>	<i>empirique</i>
1	Cas 1	0.1	0.0972	0.1	0.0
	Cas 2	15.0	15.0316	15.0	15.0
	Cas 3	49.5	49.4963	49.5	50.0
2	Cas 1	100	101.9626	69	70.5
	Cas 2	2.0	2.0247	1	2.0
	Cas 3	1.0101	1.0113	1	1.0

Dans le cas de la distribution binomiale, il n'y a que dans le premier cas qu'il y a une petite différence entre la moyenne et la médiane théoriques et la moyenne et la médiane empiriques, ce qui suggère une grande dispersion des données pour le petit nombre d'essais. Les cas 2 et 3 démontrent la précision des simulations entre toutes les valeurs théoriques et empiriques, avec un léger écart entre la médiane théorique et la médiane empirique.

Pour la distribution géométrique, le premier cas révèle une légère différence entre les moyennes théoriques et empiriques, mais une plus grande variance entre les médianes théoriques et empiriques, soulignant la variation naturelle du nombre d'essais requis pour un premier succès à faible probabilité. Dans les cas 2 et 3, des différences non significatives entre les valeurs théoriques et empiriques sont observées, ce qui indique l'efficacité de la modélisation de la distribution géométrique dans les scénarios avec des probabilités de succès modérées et élevées.

Le tableau 4 compare les valeurs théoriques de la dispersion, du coefficient d'asymétrie et du coefficient d'aplatissement avec celles obtenues à partir des simulations.

Tableau 4

Comparaison des valeurs théoriques avec les valeurs simulées: distributions binomiale (1) et géométrique (2)

Nr.	Cas	Dispersion		Coeff. d'asymétrie		Coeff. d'aplatissement	
		<i>théorique</i>	<i>empirique</i>	<i>théorique</i>	<i>empirique</i>	<i>théorique</i>	<i>empirique</i>
1	Cas 1	0.099	0.0969	3.1146	3.1871	9.5010	10.0013
	Cas 2	7.5	7.4658	0.0	-0.0389	-0.0667	-0.0448
	Cas 3	0.495	0.5074	-1.3929	-1.4305	1.9002	2.0804
2	Cas 1	9900.0	10722.8272	2.0000	2.1781	6.0607	7.6098
	Cas 2	2.0	2.0823	2.1213	2.1194	12.5	6.4327
	Cas 3	0.0102	0.0114	10.1	9.4933	698.0099	91.1076

En analysant les données de la distribution binomiale, on observe que le cas 1 présente des valeurs simulées proches des valeurs théoriques pour la dispersion et les coefficients d'asymétrie et d'aplatissement, bien qu'une asymétrie positive et un aplatissement plus élevé soient observés dans les données simulées. Le cas 2 est le plus proche des valeurs théoriques par rapport aux

valeurs simulées, ce qui indique la précision de la modélisation dans le cas d'une distribution équilibrée ($p=0,5$). Le cas 3 montre une légère différence entre la dispersion empirique et théorique, ainsi que de petites différences dans l'asymétrie et l'aplatissement, soulignant l'impact d'une forte probabilité de succès sur la forme de la distribution.

Pour la distribution géométrique, le cas 1 montre une faible différence entre la dispersion théorique et empirique, avec une asymétrie et un aplatissement plus élevé, reflétant la variabilité intrinsèque de la distribution lorsque la probabilité de succès est faible. Le cas 2 montre un alignement étroit entre les valeurs simulées et théoriques, indiquant la précision des simulations à une probabilité de succès modérée. Le cas 3 suggère que les extrêmes de la distribution géométrique peuvent être plus prononcés à des probabilités de succès très élevées ($p=0,99$). Les coefficients d'asymétrie et d'aplatissement augmentent de manière significative lorsque p s'approche de 1, ce qui indique une plus grande concentration des probabilités autour de valeurs faibles et la présence de rares valeurs aberrantes [5].

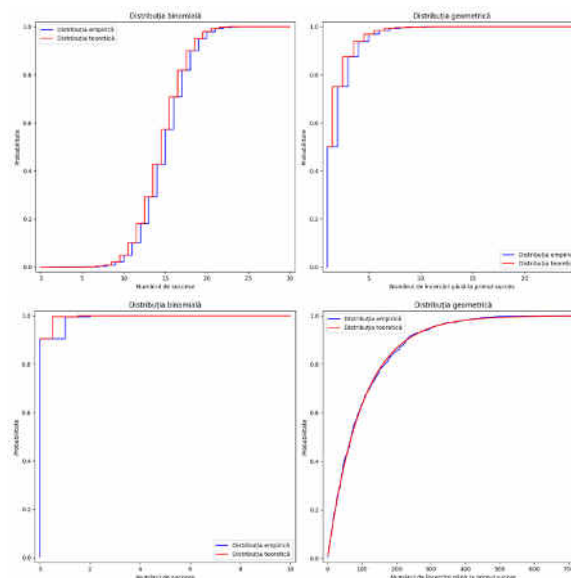


Figure 1. Graphique des fonctions de distribution binomiale et géométrique théoriques et simulées (1) cas $n=30, p=0,5$ et (2) $n=10, p=0,01$

La comparaison de la distribution cumulative théorique avec la distribution empirique basée sur un grand nombre d'essais permet de voir dans quelle mesure les données simulées correspondent aux prédictions théoriques. Ainsi, la figure 1 démontre la validité des modèles théoriques dans la description des phénomènes aléatoires, ainsi que la capacité d'utiliser des simulations pour approcher les caractéristiques de ces distributions.

Dans la figure 1 (2) $n=10$ et $p=0,01$ sur le graphique de la distribution binomiale, on observe des étapes correspondant à la fonction de distribution cumulative théorique et empirique. Les lignes se chevauchent presque, ce qui indique que les échantillons simulés correspondent bien à la distribution théorique attendue, étant donné que la distribution binomiale est bien définie pour un nombre fixe d'essais n et une probabilité de succès p pour chaque essai. Sur le graphique de la fonction de distribution géométrique, on voit que la distribution empirique suit la courbe de la distribution théorique. Le volume de données simulées est très important et le graphique tend déjà à s'aligner (les marches sont moins visibles). Comme p est très petit, on s'attend à ce que la plupart des valeurs soient concentrées vers le côté gauche du graphique, ce qui est également observé.

La Fig. 2 indique que les simulations reflètent les distributions théoriques correspondantes, ce qui démontre la fiabilité des simulations réalisées avec NumPy [3] pour modéliser des phénomènes aléatoires discrets.

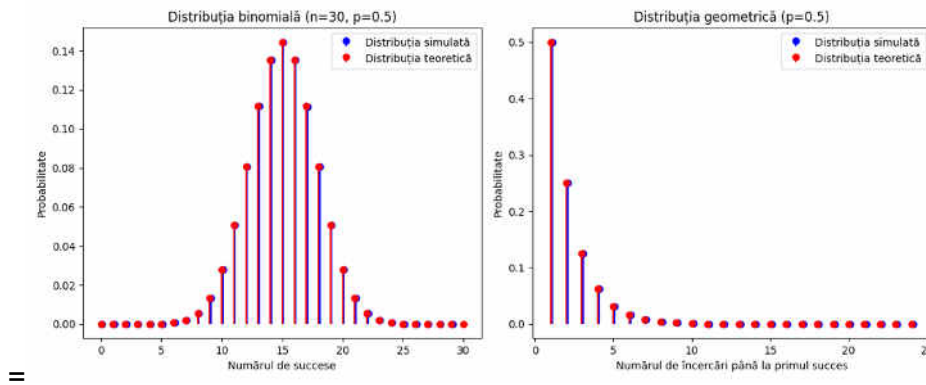


Figure 2. Représentation graphique des distributions binomiale et géométrique théoriques et simulées (cas $n=30$, $p=0,5$)

Par rapport à la distribution binomiale, la distribution géométrique présente un comportement différent, mis en évidence par l'asymétrie et la forme du pic, en raison de la nature différente des processus qu'elle modélise. Cette analyse souligne l'importance de choisir le bon modèle de distribution en fonction de la nature des données et des phénomènes étudiés.

Conclusions

La comparaison des distributions binomiale et géométrique permettra non seulement d'explorer les propriétés spécifiques de chaque distribution, mais aussi d'apprécier l'importance de l'analyse exploratoire et des simulations dans la compréhension des phénomènes aléatoires. Ces observations soulignent la complexité de l'étude des probabilités et des statistiques, et leur applicabilité dans divers domaines. Les simulations permettent de comprendre le comportement des distributions et de vérifier la théorie mathématique par des expériences numériques. En outre, cet article présente une base pour une future comparaison de la qualité des générateurs pour différentes distributions de probabilité dans le contexte de leur mise en œuvre dans différentes applications (Python, R, Excel, Mathematica, Matlab, etc.) afin d'attirer l'attention sur l'amélioration de ces générateurs, éventuellement en proposant de meilleurs algorithmes de simulation statistique.

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SÉCURITÉ DES APPLICATIONS DANS AWS : CONFIGURATION ET GESTION DES SERVICES SANS SERVEUR

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Résumé: Dans un monde numérique en pleine évolution, les services sans serveur proposés par AWS sont de plus en plus populaires auprès des développeurs d'applications. Cependant, une préoccupation majeure associée à l'adoption de ces services est la sécurité des applications. Cet article se concentre sur l'importance de configurer et de gérer correctement les services serverless dans AWS pour garantir un niveau de sécurité élevé. Tout d'abord, nous explorons les avantages offerts par l'architecture serverless, tels que l'évolutivité automatique et l'absence de gestion de l'infrastructure. Cependant, ces avantages s'accompagnent de risques de sécurité spécifiques, tels que l'octroi excessif de privilèges, l'injection de code, l'exposition de données sensibles, et plus encore. Pour faire face à ces risques, nous allons examiner les meilleures pratiques pour configurer et gérer les services sans serveur dans AWS.

Mots-clés: Amazon Web Services (AWS), Gestion des identités et des accès (IAM), serverless, infrastructure, chiffrement.

Introduction

Ces dernières années, le cloud est devenu un élément central de l'infrastructure informatique de nombreuses organisations, offrant d'importantes opportunités d'innovation et d'efficacité. Dans cet environnement numérique en constante évolution, Amazon Web Services (AWS) a acquis une position dominante, en proposant une gamme diversifiée de services cloud pour répondre aux divers besoins des clients. Parmi ces services (Figure 1), l'architecture sans serveur est devenue de plus en plus populaire, permettant aux développeurs de créer et d'exécuter des applications sans gérer l'infrastructure sous-jacente [1].

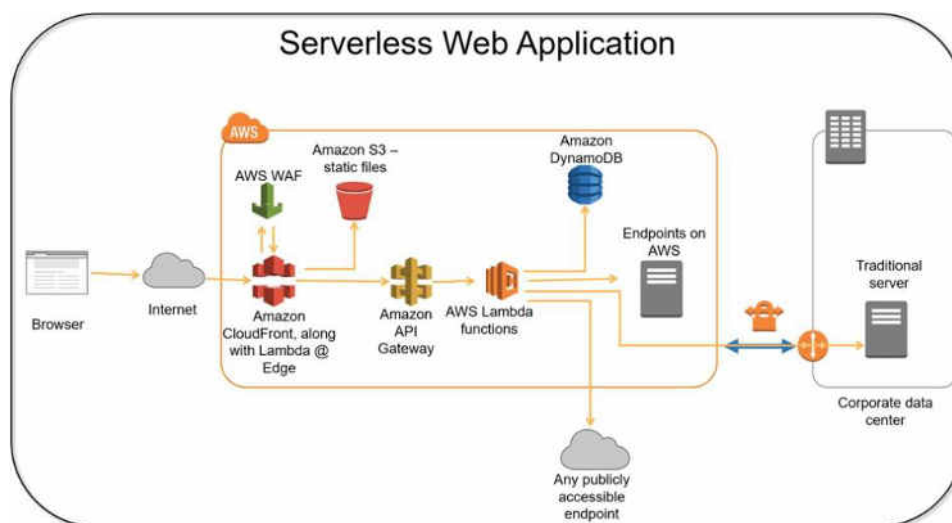


Figure 1. Principe des services sans serveur [1].

Cependant, une préoccupation majeure associée à l'adoption d'une architecture sans serveur est la sécurité des applications. Une configuration et une gestion appropriées de ces services deviennent essentielles pour garantir un environnement sécurisé et protégé contre les cybermenaces. Par conséquent, cet article vise à explorer en profondeur l'importance de la sécurité des applications dans AWS, en se concentrant sur la configuration et la gestion appropriées des services sans serveur.

Nous étudierons ensuite les risques de sécurité spécifiques associés à l'architecture sans serveur, explorerons les meilleures pratiques de protection des applications et passerons en revue les outils et technologies disponibles pour mettre en œuvre des solutions de sécurité efficaces. Ce faisant, nous visons à fournir aux lecteurs une solide compréhension des aspects clés de la sécurité des applications dans l'environnement AWS et à faciliter le développement de stratégies robustes pour protéger les données et l'infrastructure cloud [1].

1. Qu'est-ce qu'AWS et à quoi sert-il ?

AWS, ou Amazon Web Services, est une suite de services cloud fournis par Amazon. Ces services sont conçus pour fournir une large gamme de fonctionnalités de calcul, de stockage et autres pour aider les organisations à développer et à exécuter leurs applications sans avoir à gérer l'infrastructure physique.

L'architecture sans serveur est un modèle de développement et de déploiement d'applications dans lequel les développeurs se concentrent uniquement sur le code de l'application sans avoir à gérer l'infrastructure sous-jacente. En d'autres termes, dans un environnement sans serveur, le fournisseur de cloud s'occupe de la gestion de l'infrastructure et de la mise à l'échelle automatique des ressources, et les développeurs peuvent concentrer leurs efforts sur le développement du code et la logique des applications.

AWS propose un certain nombre de services sans serveur qui facilitent le développement et le déploiement d'applications sans avoir besoin de gérer des serveurs ou une infrastructure. Parmi les services sans serveur les plus populaires proposés par AWS figurent:

1. AWS Lambda, c'est un service qui permet au code de s'exécuter sans avoir besoin de gérer des serveurs. Les développeurs peuvent charger des fonctions Lambda et les exécuter en fonction d'événements ou de requêtes HTTP.
2. Amazon API Gateway, c'est un service qui permet la création, la publication, la gestion et la protection des API. Il est couramment utilisé avec AWS Lambda pour créer des API sans serveur.
3. Amazon DynamoDB, il s'agit d'un service de base de données NoSQL entièrement géré qui peut être intégré à des services sans serveur pour stocker et accéder aux données d'application.
4. AWS Step Functions, il s'agit d'un service qui permet aux développeurs de coordonner et de gérer les interactions entre différentes fonctions Lambda ou d'autres composants d'application.
5. AWS AppSync, il s'agit d'un service entièrement géré qui permet aux développeurs de créer rapidement des applications basées sur les données avec des données hors ligne et des fonctionnalités en temps réel.

En utilisant les services sans serveur fournis par AWS, les développeurs peuvent créer et déployer des applications plus rapidement sans avoir à se soucier de la gestion de l'infrastructure. Ce modèle peut également contribuer à réduire les coûts et à faire évoluer automatiquement les ressources en fonction des besoins des applications [2].

2. Que signifie un service sans serveur et comment est-il configuré ?

Un service sans serveur au sein d'AWS signifie créer et déployer des applications sans avoir à se soucier de la gestion de l'infrastructure sous-jacente. Essentiellement, ce modèle de

développement vous permet de vous concentrer uniquement sur le code de votre application, tandis qu'AWS s'occupe de la gestion et de la mise à l'échelle de vos ressources de calcul.

Les principaux composants d'un service sans serveur incluent les fonctions de calcul, les événements et les déclencheurs, le stockage et les bases de données, ainsi que API Gateway pour exposer les fonctions en tant que points de terminaison d'API [2].

Mettre en place un service sans serveur dans AWS implique avant tout de créer et de définir des fonctions de calcul, qui sont des unités de code qui seront exécutées de manière réactive à des événements spécifiques. Ensuite, vous devez configurer les événements et les déclencheurs qui déclencheront l'exécution des fonctions de calcul. Il est également important d'accorder les autorisations appropriées aux fonctions de calcul pour accéder à d'autres services AWS, tels que le stockage ou la base de données.

De plus, si les fonctions de calcul doivent être exposées en tant que points de terminaison d'API, vous devrez créer et configurer une passerelle API pour gérer les routes et les requêtes HTTP.

Une fois toutes ces configurations terminées, l'application peut être testée et déployée en production pour être utilisée par les utilisateurs, AWS prenant en charge la gestion de l'infrastructure et mettant automatiquement à l'échelle les ressources en fonction des besoins de l'application [3].

Par conséquent, l'utilisation de services sans serveur au sein d'AWS facilite le développement et le déploiement d'applications, supprimant la complexité de la gestion de l'infrastructure et permettant aux développeurs de se concentrer sur la création de valeur via le code d'application.

Pour configurer un service sans serveur à l'aide d'AWS (figure 2), les étapes typiques incluent :

Création de fonctions Lambda, les développeurs doivent écrire et télécharger le code de la fonction Lambda sur la console AWS Lambda ou utiliser les outils de développement CLI et SDK pour créer et télécharger les fonctions.

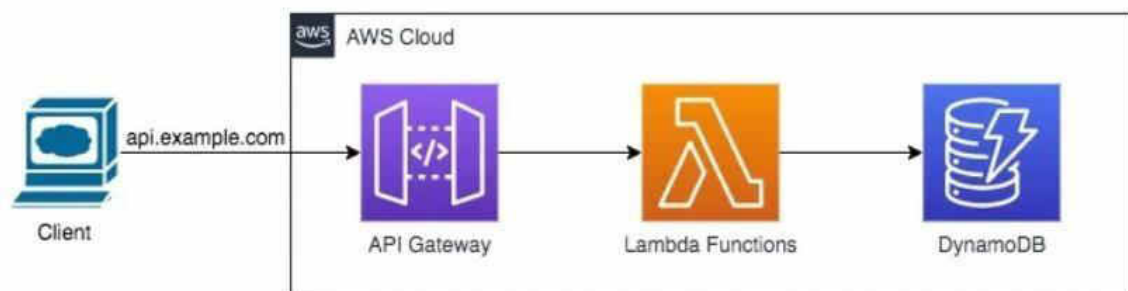


Figure 2. Modèle d'architecture sans serveur – Service API back-end [3].

Définition du déclencheur de fonction, c'est l'étape où les développeurs précisent les événements qui déclencheront l'exécution de la fonction Lambda. Cela peut être configuré à l'aide de la console AWS Lambda ou de l'API Lambda.

Configuration de la stratégie d'autorisations IAM, il est important d'accorder aux fonctions Lambda les autorisations nécessaires pour accéder à d'autres services AWS, tels qu'Amazon S3 ou Amazon DynamoDB. Ceci peut être réalisé en définissant correctement les politiques d'autorisation IAM.

Créer et configurer API Gateway (si nécessaire) si les fonctions Lambda doivent être exposées en tant que points de terminaison d'API, les développeurs doivent créer et configurer une API Gateway pour gérer les routes et les requêtes HTTP.

Test et déploiement, après avoir configuré les fonctions Lambda et les autres ressources associées, il est important de tester l'application pour s'assurer que tout fonctionne comme prévu.

Après les tests, l'application peut être déployée et mise en production pour être utilisée par les utilisateurs [3].

3. Défis de sécurité des applications dans AWS

Les défis en matière de sécurité (Figure 3) des applications au sein d'AWS peuvent être variés et complexes compte tenu de l'environnement dynamique et distribué des services cloud. Voici quelques-uns de ces défis :

1. Accès non autorisé, une bonne gestion des accès et des autorisations est essentielle dans AWS. Les utilisateurs ne doivent avoir accès qu'aux ressources et fonctionnalités requises pour leur rôle spécifique. Un accès non autorisé peut entraîner une exposition des données ou une compromission des systèmes.
2. Mauvaises configurations, les mauvaises configurations des services AWS peuvent créer des vulnérabilités de sécurité. Par exemple, une stratégie d'accès ou des paramètres de groupe de sécurité incorrects peuvent permettre un accès non autorisé ou une exposition des données.
3. Inspections et audits de sécurité insuffisants, le manque de surveillance et de journalisation détaillées peut faire passer des activités suspectes inaperçues. Il est important de mener des inspections et des audits réguliers pour détecter et enquêter sur les incidents de sécurité potentiels.
4. Cryptage des données insuffisant, les données stockées dans le cloud peuvent présenter un risque d'accès non autorisé ou d'interception en cours de transit. Le chiffrement des données au repos et en transit est essentiel à la protection de la confidentialité des informations.
5. Vulnérabilités des applications, les applications développées et déployées dans AWS peuvent être vulnérables à divers types d'attaques, telles que l'injection de code, le cross-site scripting (XSS) ou l'exploitation de vulnérabilités de sécurité connues.
6. Problèmes de conformité, les organisations doivent se conformer à diverses réglementations et normes en matière de sécurité et de confidentialité des données lorsqu'elles utilisent les services AWS. Le non-respect de ces normes peut entraîner des amendes et d'autres conséquences juridiques.
7. Réponse inadéquate aux incidents, une fois qu'un incident de sécurité a été détecté, il est essentiel de réagir rapidement et efficacement pour limiter l'impact et remédier aux vulnérabilités. L'absence d'un plan de réponse aux incidents ou d'une capacité de surveillance adéquate peut entraîner des retards dans la détection et la résolution des incidents [4].

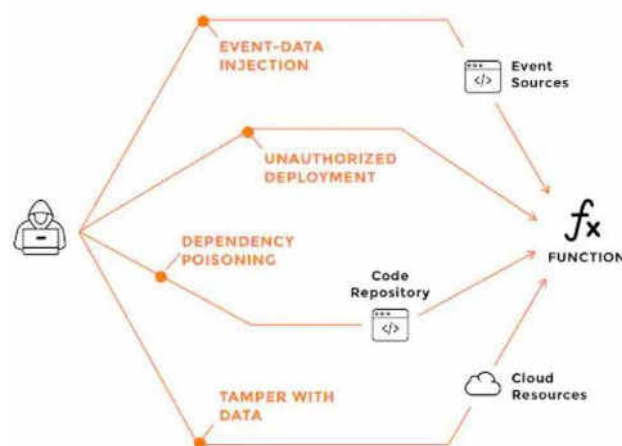


Figure 3. Surface d'attaque par injection de données d'événement [4].

La sécurité des applications dans AWS implique la gestion d'un large éventail de menaces et de défis, et y répondre nécessite une attention constante aux détails, la mise en œuvre de politiques et de pratiques de sécurité solides et l'utilisation d'outils appropriés pour surveiller et gérer les risques de sécurité.

4. Meilleures pratiques pour la sécurité des applications dans AWS

La sécurisation des applications au sein d'AWS est une tâche complexe et essentielle à la protection des données et de l'infrastructure contre les cybermenaces. La mise en œuvre des meilleures pratiques est cruciale pour créer un environnement cloud sécurisé et fiable.

L'une des pratiques les plus importantes consiste à gérer l'accès avec des stratégies IAM, ce qui implique de définir et d'appliquer des stratégies d'accès granulaires pour les utilisateurs et les rôles. La surveillance et la journalisation des activités sont également essentielles pour détecter et enquêter sur les activités suspectes ou indésirables. Le cryptage des données est une autre mesure cruciale pour protéger la confidentialité des informations, tandis que la maintenance des mises à jour et des correctifs est importante pour corriger les vulnérabilités connues. L'utilisation des services de sécurité fournis par AWS, tels que WAF et Shield, complète l'arsenal de sécurité d'une application [5].

Il est également essentiel de mettre en œuvre un modèle de sécurité dès la conception, qui implique d'intégrer les principes de sécurité dès le début du développement des applications. Un examen régulier de la configuration et des politiques de sécurité est également important pour garantir la conformité et résoudre les problèmes de sécurité.

En appliquant ces bonnes pratiques et en adoptant une approche proactive en matière de sécurité, les organisations peuvent créer un environnement sécurisé et protégé pour leurs applications sur AWS [5].

Conclusion

L'article souligne l'importance cruciale de sécuriser les applications dans l'environnement en constante évolution d'Amazon Web Services (AWS), en mettant particulièrement l'accent sur la configuration et la gestion appropriées des services sans serveur. Alors que le cloud computing devient la norme pour de nombreuses organisations, l'adoption croissante des services sans serveur offre une agilité et une évolutivité inégalées, tout en déplaçant la responsabilité de la gestion de l'infrastructure vers le fournisseur de services cloud. Cependant, cette évolution rapide pose des défis significatifs en matière de sécurité des applications.

L'article explore en profondeur les risques spécifiques associés à l'architecture sans serveur, allant de l'octroi excessif de privilèges à l'exposition de données sensibles. Face à ces défis, il est impératif de mettre en œuvre des pratiques de sécurité rigoureuses. Cela comprend une gestion précise des accès avec des politiques IAM bien définies, une surveillance active des activités pour détecter les comportements suspects, le cryptage des données pour protéger leur confidentialité, et une maintenance rigoureuse des mises à jour et des correctifs pour remédier aux vulnérabilités connues.

En suivant ces meilleures pratiques, les organisations peuvent renforcer la sécurité de leurs applications dans AWS, réduisant ainsi le risque de violations de données et de perturbations des services. De plus, une collaboration étroite avec les équipes de sécurité et l'adoption de technologies de sécurité avancées telles que les services de protection contre les attaques distribuées par déni de service (DDoS) et les pare-feu d'applications Web (WAF) renforcent la posture de sécurité globale de l'infrastructure cloud.

En fin de compte, la sécurité des applications dans AWS n'est pas seulement une responsabilité technique, mais aussi une priorité commerciale critique. Les organisations doivent adopter une approche holistique de la sécurité, intégrant des mesures préventives, des mécanismes de détection et des plans d'intervention en cas d'incident pour protéger leurs actifs numériques et préserver la confiance de leurs clients. En s'engageant dans un effort continu pour rester à jour

avec les meilleures pratiques de sécurité et en favorisant une culture de la sécurité au sein de l'organisation, les entreprises peuvent prospérer dans le paysage numérique actuel tout en minimisant les risques de sécurité.

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SECȚIA INGINERIE BIOMEDICALĂ
SECTION OF BIOMEDICAL ENGINEERING

MATHEMATICAL MODEL FOR CALCULATING CARDIAC OUTPUT USING MULTI-PARAMETRIC DATA

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Abstract. *This article proposes a mathematical model to calculate cardiac output by integrating multi-parametric data derived from electrocardiography and photoplethysmography signals. Recognizing the limitations of existing measurement methods, the model aims to leverage the complementary nature of electrocardiography and photoplethysmography signals to provide a more accurate, non-invasive, and continuous assessment of cardiac function. Through a detailed methodology that includes signal acquisition, preprocessing, and mathematical integration, this work outlines the theoretical foundation and potential application of combining these two modalities for enhanced cardiovascular monitoring.*

Keywords: *electrocardiography, photoplethysmography, cardiac output, non-invasive, multi-parametric data.*

Introduction

Cardiovascular diseases are the most common cause of human death. An effective way to detect early signs of cardiovascular diseases is the continuous monitoring of the patient's critical physiological parameters during his full activity using a portable device. Most wearable devices available on the market can register only one or two types of biosignals, which are processed independently. On the one hand, the data obtained in this way is sufficient to see certain changes in the cardiovascular system, and on the other hand, it is not enough to evaluate isolated signals for a deeper analysis of the physiological state. One of the most promising methods of cardiovascular system research today is the combined use and analysis of multiparametric data, namely the combination of data obtained from electrocardiogram (ECG) signals, photoplethysmogram (PPG), signal position and acceleration from an accelerometer, etc. The use of this approach makes it possible to calculate, for example, such a parameter as cardiac output volume, which can be the greatest indicator of the level of cardiac muscle fatigue and an early predictor of the appearance of hidden pathologies of the cardiovascular system.

Cardiac output (CO), the volume of blood pumped by the heart per minute, is a critical metric of cardiovascular health. Traditional methods for measuring CO, such as thermodilution and echocardiography, are either invasive, costly, or require specialized skill, limiting their utility in continuous monitoring [1]. The advent of wearable technology offers a promising avenue for non-invasive, real-time cardiac monitoring through electrocardiography and photoplethysmography signals. However, the potential of integrating these signals into a cohesive model for CO estimation remains largely untapped. This article introduces a mathematical model designed to calculate CO using multi-parametric data, aiming to overcome the limitations of current methods and improve the accuracy and accessibility of cardiac monitoring.

Available methods

Traditional methods for CO measurement have ranged from invasive techniques, such as the thermodilution method and the Fick principle, to non-invasive approaches, including Doppler echocardiography and impedance cardiography [2]. While these methods have been foundational

in cardiovascular medicine, they come with limitations, including invasiveness, the need for specialized equipment, and variability in accuracy under different clinical conditions.

In recent years, the focus has shifted towards developing more accessible, non-invasive, and continuous monitoring technologies. This shift has been largely driven by advancements in sensor technology and signal processing algorithms, enabling the detailed analysis of ECG and PPG signals [3]. ECG, the standard for assessing electrical cardiac activity, and PPG, a technique measuring blood volume changes in the microvascular bed of tissue, are both cornerstone technologies for non-invasive cardiovascular monitoring.

Research into the use of ECG and PPG signals for CO estimation has shown promising results. Studies have explored various aspects of these signals, from heart rate variability and R-wave amplitude in ECG to the systolic peak time and amplitude variations in PPG, as potential indicators of stroke volume and, consequently, cardiac output. For example, correlations between PPG signal features and blood pressure changes have been used to infer cardiac output changes, offering a less invasive and more patient-friendly approach [4].

However, despite these advancements, the integration of ECG and PPG signals into a unified model for CO estimation remains underexplored. The majority of existing research tends to focus on either signal in isolation, overlooking the potential synergies that could arise from their combination. The complex nature of cardiovascular dynamics, coupled with the inherent variability in physiological signals, poses significant challenges in developing a model that accurately reflects cardiac function across diverse patient populations.

Furthermore, the literature reveals a gap in methodologies that can effectively harness the complementary information provided by ECG and PPG signals. While machine learning and data fusion techniques have been proposed, their application in real-time, non-invasive CO monitoring requires further investigation [5]. The development of such models necessitates a deep understanding of the physiological underpinnings of ECG and PPG signals, as well as advanced signal processing and analytical techniques to extract and integrate relevant features.

In response to these challenges, this proposal aims to contribute to the field by presenting a novel mathematical model that not only leverages the strengths of both ECG and PPG signals but also addresses the limitations of current methods. By providing a comprehensive review of existing techniques and identifying areas for improvement, this research underscores the importance of innovation in non-invasive cardiac monitoring technologies.

Methodology

Multi-Parametric Data Acquisition. The foundation of the proposed model is the acquisition of high-quality ECG and PPG signals. ECG signals are obtained using standard electrode placements on the subject's body to record the electrical activity of the heart. PPG signals are captured through optical sensors that emit light into the skin and measure the amount of light either transmitted or reflected, providing data on blood volume changes. Both signals are subject to various sources of noise and artifacts, necessitating robust preprocessing techniques to ensure data integrity.

Data Preprocessing. Preprocessing steps include filtering, normalization, and artifact removal. For ECG, a band-pass filter is applied to remove noise outside the heart rate frequency band, while PPG signals are processed to eliminate motion artifacts and baseline drift. The preprocessing ensures that the signals accurately reflect the physiological parameters of interest without extraneous noise.

Mathematical Integration of ECG and PPG Data. The integration of ECG and PPG data into a cohesive model for estimating cardiac output is predicated on the relationship between the heart's electrical activity and the volumetric changes in blood flow Eq. (1). The mathematical model combines features extracted from both signals to estimate stroke volume (SV), which, when multiplied by heart rate (HR), yields cardiac output (CO):

$$CO = SV \cdot HR. \quad (1)$$

Feature Extraction. Feature extraction involves identifying and quantifying signal characteristics that correlate with SV and HR. From the ECG, the R-R interval is used to calculate HR, while the amplitude and shape of the QRS complex can provide insights into ventricular contraction strength. PPG signal analysis focuses on the systolic peak amplitude and the time interval between successive peaks, which are indicative of blood volume changes during the cardiac cycle.

Model Formulation. The mathematical model integrates ECG and PPG features using regression analysis or machine learning techniques to estimate SV Eq. (2). The model can be represented as:

$$SV = f(ECG_{feature}, PPG_{feature}), \quad (2)$$

where: f - is a function derived from the relationship between the selected features and SV, established through calibration with known CO measurements.

Implementation and Validation

The implementation involves developing a software application that processes, analyzes, and displays the ECG and PPG signals in real-time. This application will incorporate the mathematical model to continuously estimate and display CO. The process requires robust algorithm development, including signal processing, feature extraction, and the application of the model to estimate CO.

Validation of the model will be conducted in two phases: initial calibration using data from a cohort of subjects with known CO measurements, followed by validation in a clinical setting with patients undergoing cardiac monitoring. The model's accuracy and reliability will be assessed by comparing its CO estimates with those obtained from standard methods, such as thermodilution or echocardiography.

Conclusions

This article introduces a mathematical model for estimating cardiac output using multi-parametric data from ECG and PPG signals. The proposed model offers a promising approach to enhance the accuracy and accessibility of CO monitoring, with significant implications for clinical practice and health monitoring technologies. As the field progresses, further research will be crucial in refining the model and realizing its full potential in improving cardiovascular care.

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PHYSIOTHERAPEUTIC SYSTEM FOR CRANIAL ELECTROTHERAPY STIMULATION

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Abstract. *Electrosleep, also known as CES, involves exposing the head to low-intensity electrical currents. It is known that gentle electrical currents can improve the balance of neurotransmitters, which leads to improved sleep patterns. Non-invasive cranial electrical stimulation has the ability to improve sleep by non-invasively increasing the release of endogenous opioids from areas of the brain responsible for pain control. Developing an electrosleep physiotherapy device is an exciting project that combines medical science and technology. The author offers some new ideas that could improve the performance of such a device. For example, by experimenting with overlapping different output frequencies to target treatments, new properties may be obtained. Biometric feedback for adjusting stimulation based on real-time data is also interesting. The work can have an interesting continuation and practical use.*

Keywords: *therapy device, low-intensity electrical currents, enhance neurotransmitter balance, device's effectiveness, clinical trials.*

Introduction

Developing an electrosleep physiotherapy device involves creating a tool that can induce a state of relaxation or sleep through the application of electrical impulses to the brain. This technology, also known as cranial electrostimulation therapy or transcranial electrotherapy, has been studied for its potential benefits in improving sleep patterns and aiding in relaxation [1]. The introduction of such a device typically starts with understanding the underlying principles of electrosleep therapy, which includes the generation of weak impulse currents designed to stimulate the brain and induce sleep.

Clinical studies suggest that the most effective impulses are those with a duration of approximately 0.3–0.5 ms and a frequency ranging from 0.5–2 to 80–100 Hz, with current levels typically between 50–5 mA [2].

1. Improvement of the CES system.

Improvement an electrosleep therapy system involves a blend of science, innovation, and creativity. Electrosleep, also known as Cranial Electrotherapy Stimulation System (CES), involves applying low-intensity electrical currents to the head. It originated in Russia in the 1950s and gained interest due to its potential impact on sleep quality.

Researchers found that these mild electrical currents could enhance neurotransmitter balance, leading to improved sleep patterns. Modern CES devices are pocket-sized, battery-operated, and pulse at varying frequencies (from 100 to 15,000 times per second) with current intensity around 1 mA or slightly higher.

Let's explore some ideas to create an effective system:

a) Design Considerations:

Electrode Placement: Determine optimal electrode placement on the head. Traditionally, electrodes were placed on closed eyelids and behind the skull base.

Comfort and Portability: Design a compact, comfortable device that users can easily carry and wear during sleep.

Adjustable Parameters: Allow users to customize pulse rate, intensity, and duration based on their individual needs.

b) Safety and Regulation:

FDA Compliance: Ensure your device adheres to safety standards set by the FDA or relevant regulatory bodies.

Risk Assessment: Evaluate potential risks associated with electrical stimulation (e.g., skin irritation, interference with other medical devices).

User Instructions: Provide clear instructions for safe usage.

c) Enhancements and Innovations:

Biometric Feedback: Integrate sensors (e.g., heart rate, brainwave activity) to adjust stimulation based on real-time data.

Smartphone Connectivity: Develop an app that syncs with the device, allowing users to track their sleep patterns and adjust settings remotely.

Multimodal Approach: Combine CES with other relaxation techniques (e.g., aromatherapy, white noise) for a holistic sleep solution.

d) Clinical Trials and Research:

Efficacy Studies: Conduct rigorous clinical trials to validate the device's effectiveness in improving sleep quality.

Long-Term Effects: Investigate the long-term impact of electrosleep therapy on overall health and well-being.

Safety, user comfort, and scientific validity are paramount. Collaborate with experts in neuroscience, sleep medicine, and engineering to refine your device.

2. Features of the development of the CES system.

Developing an electrosleep physiotherapy system is a fascinating project that combines medical science with technology. Here are some ideas that could help in the development of such a system:

Master-Slave System: Design a system with a master-slave architecture where the master block controls the user interface and the slave block generates the appropriate voltages and currents for treatment [3].

Microcontroller Utilization: Incorporate a microcontroller to manage the wave generation, ensuring precise control over the electrical signals used in the therapy.

Frequency Overlap: Experiment with overlapping two frequencies in the output signal to target specific treatments, such as anticellulite or antiflaccidity, as tested in aesthetic mesotherapy [4].

Non-Invasive Cranial Electrotherapy Stimulation (CES): Explore CES for its potential to improve sleep by noninvasively increasing the release of endogenous opioids from pain management regions of the brain [5].

Comprehensive Review and Research: Conduct a thorough review of the history and evolution of electrosleep and transcranial electrical stimulation (TES) to inform the design and functionality of your device [6].

Clinical Trials: Plan for clinical trials to test the effectiveness of the device in a real-world setting, focusing on safety, efficacy, and patient comfort [7].

User-Friendly Interface: Develop an intuitive user interface that allows for easy adjustments of treatment parameters and monitoring of patient responses.

Portable Design: Aim for a compact and portable design that can be used in various settings, including clinics and home environments [8].

Regulatory Compliance: Ensure that the device meets all regulatory requirements for medical devices in your target markets.

Modern methods of electrosleep therapy

Let's consider the most common methods of electrosleep therapy.

1. A widely known method for treating diseases of the central nervous system is the method of neurogenic central electroanalgesia. This method is based on the use of rectangular current pulses from 50 to 2000 Hz, which creates optimal conditions for enhancing self-regulation processes in the cerebral cortex and causes an analgesic effect. The method is based on the effect of electrotranquilization, which allows, by slowing down the conduction of pathological impulses in the frontal areas of the cortex, to ensure a persistent weakening of the cortical component of emotional reactions and their vegetative manifestations [9].

2. Currently, along with the use of rectangular pulsed current in electrosleep therapy, currents with other characteristics have begun to be used, in particular, sinusoidal modulated currents with a carrier frequency of 5000 Hz. This method is called transcerebral amplipulse therapy [10]. The direct effect of sinusoidally modulated currents on nerve formations and cerebral vessels is more pronounced than with rectangular currents, and the reflex component is less pronounced, which determines their differences in physiological effects. The most pronounced hemodynamic effects during amplipulse therapy are manifested in the correction of both central and regional (cerebral and renal) hemodynamic parameters, regardless of the initial disorders.

3. Interference currents are also used to influence the central nervous system. This electrotherapy method is called transcerebral interference therapy [10]. The mechanism of the physiological action of interference currents, although close to the action of rectangular pulsed currents, differs in that the use of higher frequencies facilitates the almost unimpeded passage of currents through the skin barrier. Consequently, the reflex component of their influence on the central nervous system is negligible, while the direct effect on excitable brain structures is quite pronounced. The following physiological effects are most pronounced during transcerebral interference therapy: antiarrhythmic, lipotropic, hormonal and immunocorrective, and hemodynamic.

Prospects for the use of electrosleep therapy

Electrosleep has the ability to increase the threshold of reaction to stress, reduce fatigue and increase mental and physical performance. During the course of electrosleep treatment, patients note calmness, an increased feeling of vigor, freshness, energy, activity, increased performance, improved or normalized night sleep. Self-observations of patients indicate that even an hour or an hour and a half procedure of electrosleep in terms of the degree of rest can be equated to a full eight-hour physiological night sleep.

The positive results of the use of electrosleep in people in dispatcher and driver professions have given rise to the use of electrosleep as a method of preventing neuroses and increasing performance in similar professions in other departments, for example, pilots, vehicle drivers, etc.

The problem of rapid restoration of microcirculation is one of the pressing problems of resuscitation. The pharmacological agents used do not fully satisfy doctors due to the presence of side effects, complications, intolerance and allergic reactions. Positive results of using electrosleep in the treatment of such vascular pathologies as obliterating diseases of the arteries of the extremities, hypertension, atherosclerosis and in obstetric and gynecological practice have shown the possibility of using electrosleep in intensive care.

In psychiatry, the development of more adequate complexes of electrosleep and psychopharmacological agents has proven promising both for more effective treatment of functional disorders and for the treatment of psychotic disorders - schizophrenia, manic-depressive, presenile and other psychoses.

Further development of adequate modifications of electrosleep for more effective antipsychotic effects is also promising in psychiatry. The discovery of ever new properties of the therapeutic effect of electrosleep makes it promising to further expand the scope of its use in various fields of medicine. At the same time, the therapeutic effect of electrosleep can be enhanced by the development of pathogenetic substantiated treatment complexes with an individual approach to each patient.

Without a doubt, further research in the practical application of electrosleep will make it possible to develop new methods of electrosleep therapy, as well as formulate requirements for modern equipment for carrying out procedures.

Conclusions

The development process would also involve designing the system's electrode parameters, such as the number, location, and shape of electrodes, as well as the signal's intensity, shape, amplitude, duration, polarity, repetition rate, and pulse series interval. These parameters are crucial as they can affect the efficacy and safety of the therapy. The development of an electrosleep physiotherapy system is a multidisciplinary endeavor that requires a deep understanding of neurophysiology, electrical engineering, and clinical therapy to create a safe and effective product for users.

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TELEMETRIC SYSTEM FOR MONITORING THE PARAMETERS OF AN EXPERIMENTAL STAND FOR TRACKING THE DAMAGING EFFECTS OF PENETRATING WOUNDS

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Abstract. *At this time, there are many threats that lead to penetrating gunshot wounds that need to be promptly and effectively diagnosed, and that require a great deal of effort in the treatment process to preserve the patient's life and health. The problem is complicated by the fact that the formation of the wound channel depends on a large number of influencing factors: the type of bullet, speed, torque and other factors, which cannot be determined during the initial examination and diagnosis of patients. There are many methods of analyzing the behavior of a bullet when passing through a patient's body for the formation of general contaminations and the study of this phenomenon: including the use of ballistic stands-simulators of a biological object. The authors considered the possibility of providing such ballistic stands with a high-speed telemetric system for controlling the parameters of the experimental stand for studying the striking effect of penetrating wounds.*

Keywords: *disaster surgery, penetrating wound, ballistic stand, telemetric parameter control system.*

Introduction

During explosions or shots, some objects acquire a large kinetic energy and unfortunately can injure people, causing penetrating wounds [1]. These wounds have a thermal, mechanical and chemical effect on the human body. In this case, the penetrating object creates a large cavity that often exceeds the size of the object itself.

In addition, local damage may occur around the wound channel, which during the healing process causes disturbances in the human body. This situation leads to diagnostic difficulties in determining effective surgical and therapeutic measures [2]. Therefore, for the successful treatment of wounds, it is important to have a deep understanding of the physical processes associated with the intervention of fast elements in the human body [3].

This problem is aggravated by the lack of critical medico-biological information, which would allow to quickly and effectively classify the patient's condition, determine the features and severity of the clinical case, as well as to manage and monitor his health on the basis of objective medico-biological indicators (Fig. 1).

Therefore, the search for new effective methods of diagnosis and monitoring of the condition of patients with penetrating wounds caused by highly kinetic foreign bodies is currently an extremely relevant area of scientific medical research and is of great practical importance in civil and military emergency medicine.

One of the methods of studying the impact of penetrating objects on the human body is the use of ballistic stands, which provide information on the formation of wound channels, using non-biological materials as samples.

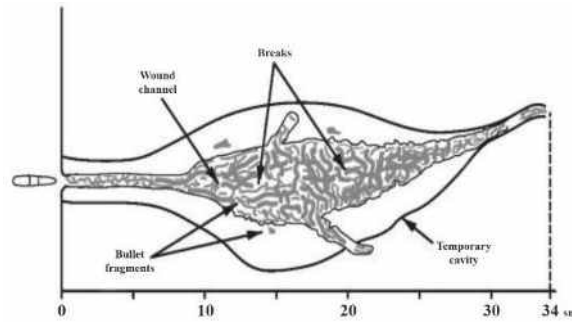


Figure 1. Impact effect of projectile

The telemetry system considered in this paper is an information and measurement system (IMS) that collects and performs primary processing of signals received from sensors during experiments on the penetration of foreign bodies on a human body simulator, and transmits this information to a personal computer through a wireless communication channel.

The structure and principle of construction of the control system of the parameters of the experimental stand for the study of the striking effect of penetrating wounds.

It is important to study the dynamics of the formation of the wound cavity and determine the physical factors influencing its formation. For this purpose, a ballistic stand simulator of a biological object is primarily used.

The authors considered the possibility of providing such ballistic stands with a high-speed telemetric system for controlling the parameters of the experimental stand for studying the striking effect of penetrating wounds.

To consider this issue, we will consider the structure of the experimental ballistic stand and options for implementing the parameter control system for it.

The experimental ballistic stand will consist of the following parts:

- The object is a dense block of ballistic clay capable of accommodating a set of sensors of various types, selected according to the parameters of the movement of penetrating elements, taking into account the properties of the material;
- The information and measurement system (IMS) is a distributed system of collection and primary processing of signals coming from sensors.

IMS is built on interchangeable sensor nodes with controllers, information input/output modules and sensors distributed in space. The characteristic features of this type of the information and measurement system are the presence of decentralized data processing and distributed input/output systems, resistance to failures and a standardized, unified structure of the database [4].

In order to organize the transmission of data from the sensors to the information gathering node (IGN) (Fig. 2) and to the personal computer, it is necessary to organize a communication channel and ensure reliable power.

The information gathering nodes (IGN) of the telemetry system will have a wired connection only directly with the sensors, and data transfer from the microcontroller (MC) to a personal computer will be carried out wirelessly. Such a solution will ensure the reliability and stability of the system even if some system elements are damaged during operation.

As a control element for the IMS node (IGN), we will use a MC that will be capable of wireless data transmission. Then the node (IGN) will consist of three parts: a microcontroller with an attached Wi-Fi module, a sensor connected to it, and a power supply circuit. That is, in the system, each sensor will have its own microcontroller.

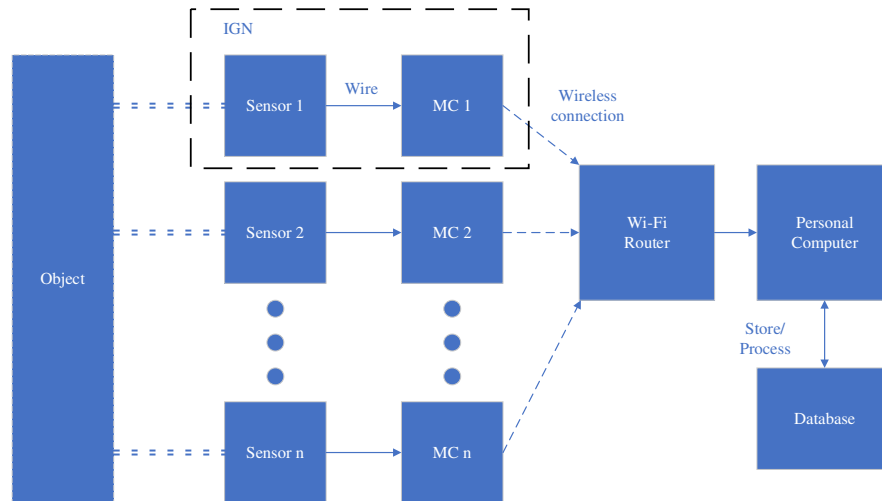


Figure 2. Structure of the information and measurement system

To obtain data from the object during the experiment, we will take an accelerometer as a pulse wave propagation sensor, and as a temperature sensor, we will take an analog thermistor, which we will connect to a high-speed ADC. We will connect both sensors to the MC through the high-speed SPI bus. This will ensure the highest speed of reading data from sensors (Fig. 3, Fig. 4).

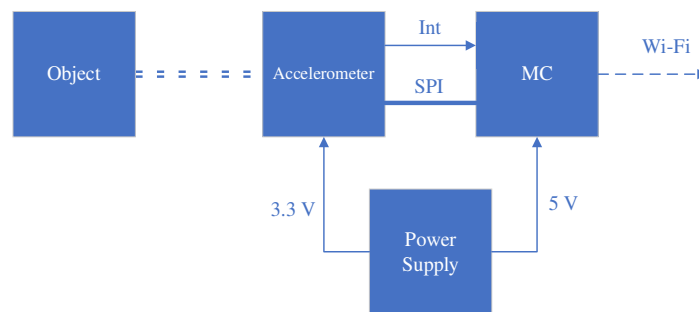


Figure 3. Structural diagram of the system node with an accelerometer

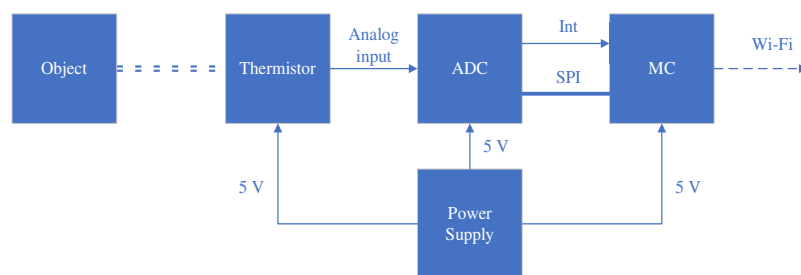


Figure 4. Structural diagram of a system node with a thermistor

The sensors must be physically connected to the object (a simulator of the human body made of ballistic clay) and set to work continuously with the accumulation of calculated values in the internal memory.

The software for IGN should work in asynchronous mode: when a part of the internal buffer is filled, a signal is triggered and the microcontroller reads data from the sensor's memory into the MC's RAM in batches via the SPI bus for each channel. The obtained values are in the form of a

single packet, which after a certain time, or after the experiment is completed, is sent to a personal computer using Wi-Fi.

IMS is intended for the study of short-term processes, therefore, it should be a node of system synchronization. With further research, it will allow to compare data from sensors of different nodes over time, to obtain the state and changes in the process in general.

For this purpose, it is proposed to add the so-called "Time Source" to the system, which will be used to synchronize the nodes of our IMS. It can be, for example, a local SNTP (Simple Network Time Protocol) server, which before the start of the experiment will send a packet with a countdown to the system t_0 .

Next, during the experiment, a time stamp t will be added to each data packet, which is determined by the formula: $t = t_0 + t_1$, where t_1 – local time elapsed since the start of the experiment. It will be counted by the internal RTC (Real Time Counter) clock of the microcontroller.

One of the tasks of the IMS is to measure the speed of the penetrating element using a chronograph with the possibility of recording the measured speed value. It is located directly in front of the ballistic clay (Object).

Among other features of the system, we would like to highlight the automatic start of testing. It is proposed to add a power switching scheme of the electric mass accelerator (EMA). It will act as a cannon in the experiment. The accelerator consists of a solenoid and a dielectric barrel into which the projectile is inserted.

When an electric current is applied to the coils of the solenoid, a magnetic field is created, which accelerates the projectile. That is, the energy of the field is transformed into the kinetic energy of the projectile, and it "takes off" from the barrel at high speed in the direction of the ballistic clay object, simulating a shot from a firearm into a human body.

Such a solution will facilitate and fully automate the process of conducting the experiment, and the human operator will only have to press the appropriate start button, as well as fix the time of the start of the experiment in the same frame of reference as the data from other sensors of the system. The scheme of the experimental stand and the information and measurement system, taking into account the specified changes, is shown in Fig. 5.

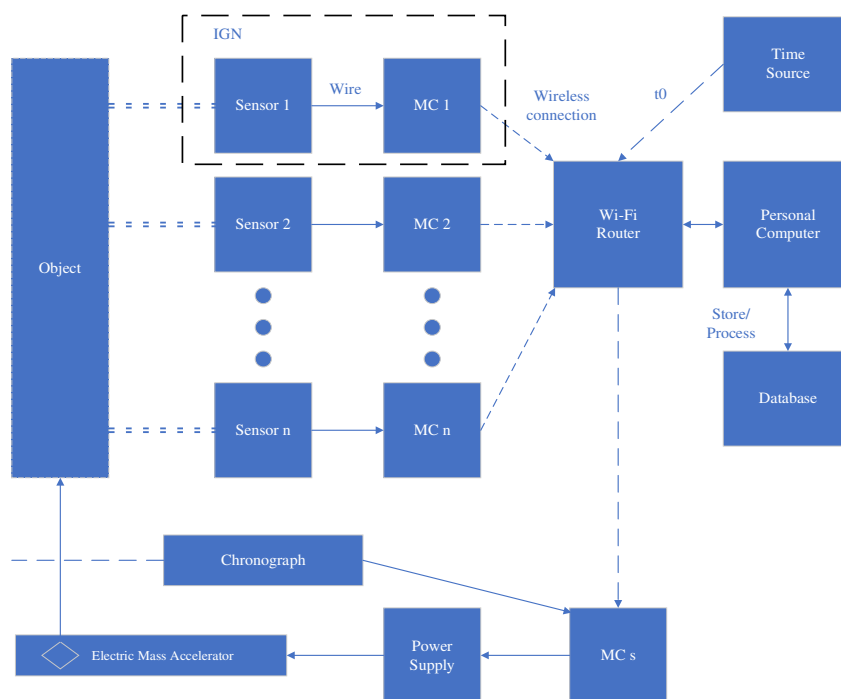


Figure 5. Structural diagram of the stand and IMS with a synchronization system

The described experimental stand with a telemetric parameter control system integrated into it, including an object (simulator) and an IMS, should ensure the fixation of physical parameters, such as acceleration and pressure during the penetration of the element into the human body simulator. The synchronized system will allow comparison and integration of data from different sensors, increasing the reliability and accuracy of measurements.

Conclusions

The authors considered the possibility of increasing the effectiveness of the study of the dynamic influence of physical factors of penetrating gunshot wounds on the formation of a wound channel in the patient's body by equipping a ballistic simulator with a telemetric control system for these parameters. At the same time, the general principles and features of such a system were determined, and practical proposals were made regarding its structure and organization. The work carried out is an important step in the practice of increasing the efficiency of diagnosis and treatment of patients with gunshot wounds, and will be used for further scientific research.

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ROLUL BIOINGINERULUI MEDICAL ÎN MONITORIZAREA EXPUNERII LA RADIAȚIILE X A PERSONALULUI MEDICAL ȘI A PACIENȚILOR

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Rezumat. Oferirea unei perspective clare asupra structurii și funcționării organismului uman utilizează tehnologii avansate în imagistica medicală. Precizia sporită a personalului medical precum și software-ul echipamentului reduce riscul de expunere la radiații și îmbunătățește siguranța și eficacitatea procedurilor. Minimizarea expunerii la radiații în radiografii (RX), tomografi computerizate (CT), osteondesitometrie se face cu ajutorul echipamentelor de protecție adecvate pe care personalul medical din sectorul de radiologie este instruit să îl utilizeze corespunzător și la rândul lor să îi protejeze atât pe pacienți, cât și pe aparținători. Utilizatorul poate adapta și ajusta strategiile în identificarea și localizarea zonei de interes pentru fiecare pacient, monitorizând și evaluând continuu riscurile din timpul procedurilor. Monitorizarea dozelor pentru operator se realizează cu ajutorul dozimetrelor, în timp ce pentru pacient se înregistrează DAP-ul și câmpul de focalizare. Aceste date sunt importate a fi stocate și analizate în vederea identificării depășirii dozei acceptate de către competențele din sfera protecției la radiații – responsabil: autoritatea națională CNCAN. În acest sens, s-a implementat o interfața grafică (GUI) cu ajutorul software-ului MATBLAB 2021B ce vine în sprijinul managementului de calitate intern al unei unități medicale.

Cuvinte cheie: dozimetru, expunere, radiații, echipament de protecție, GUI, management calitate

Introducere

Echipamentele medicale sunt în continuă evoluție și sunt folosite pentru a asigura îngrijirea, diagnosticarea, tratamentul și monitorizarea pacienților. Scopul este de a spori performanța unităților sanitare prin asigurarea unui acces rapid și disponibil, garantând în același timp viabilitate și siguranța, furnizând servicii de calitate, toate acestea fiind centrate pe satisfacția beneficiarului final.

Progresul rapid al tehnologiei în domeniul medical a generat o cerere crescută de personal specializat în selecția și întreținerea echipamentelor, gestionarea problemelor legate de software și securitatea informației medicale, precum și administrarea eficientă a diferitelor sectoare din cadrul unităților sanitare.

Bioinginerii medicali pot lucra într-o varietate de domenii și instituții: în spitale și centre medicale, industria de echipamente medicale, pot fi implicați în cercetarea și dezvoltarea, instituții academice sau consultanță și asistență tehnică.

Specializați pe un anumit sector, conform Ordinului MS/CNAS nr. 412/159 din 14 aprilie 2006, bioinginerul este menționat și ca operator în cadrul laboratoarelor de imagistică medicală oferind servicii medicale paraclinice.

Domeniul ocupațional al bioinginerului medical este unul vast, prin urmare unul dintre acestea este cel de pe departamentul de radiologie. De la computere tomografice la echipamente

de radiologie digitală, osteodensitometrie și mamografie, aceste tehnologii necesită o atenție deosebită pentru a funcționa corect și pentru a oferi imagini precise. Cercetarea noilor tehnologii și metode de imagistică medicală contribuie la avansarea practicii radiologice și îmbunătățirea diagnosticului și tratamentului pacienților.

Material și metodă

Personalul este format dintr-o echipă diversă de profesioniști medicali specializați în imagistică medicală [1, 2]. Acest personal poate include:

- Medici radiologi: specializați în interpretarea imaginilor medicale - radiografii, tomografii computerizate (CT), imagistica prin rezonanță magnetică (IRM), ecografii, mamografii
- Tehnicienii de radiologie/ operatori: pregătesc pacienții pentru examinare, efectuează procedurile de imagistică și asigură că imaginile sunt de calitate optimă pentru interpretare.
- Asistenți medicali: asistă radiologii și tehnicienii de radiologie în timpul procedurilor, pot ajuta la pregătirea pacienților, la poziționarea corectă și la administrarea substanței de contrast, dacă este necesar.
- Personal administrativ: personalul care se ocupă de programările pacienților, gestionarea documentației medicale și alte sarcini administrative legate de departamentul de radiologie.

Conform Ordin nr. 397/2018 din 27 martie 2018 privind aprobarea pachetelor de servicii și a condițiilor acordării asistenței medicale, a dispozitivelor medicale, a medicamentelor și a evaluării resurselor umane [3], bioinginerului medical, în România, i se acordă un punctaj de 13 puncte la acreditarea sectorului de imagistică, puncte care se adună împreună cu celelalte categorii de personal.

Minimizarea expunerii la radiații a personalului medical și tehnic se realizează cu echipamente de protecție, echipament individual pentru care întreg personalul este instruit să îl utilizeze în mod corespunzător pentru a putea la rândul lor să îi protejeze și pe ceilalți (fie adulți aau aparținători în cazul copiilor).

Echipamentele de protecție utilizate sunt conforme cu specificațiile din normele de securitate radiologică pentru a asigura un proces controlat de radiații ionizante, proces aprobat prin Ordinul președintelui CNCAN nr. 154/2023 și publicate în Monitorul Oficial al României, nr.759 din 22.08.2023 (NSR-06) [4] sunt:

- Șorțurile de plumb (Fig. 1)
- Mănușile de plumb (în cazul chirurgiei intervenționale) (Fig. 2)
- Gulerul de plumb pentru protejarea tiroidei (Fig. 3)
- Ferestrele de vizualizare, pentru examinările unde dozele de radiații sunt foarte mari și este nevoie de protecție suplimentară (operatorul aflându-se în camera de comandă iar pacientul în sala de examinare) (Fig. 4)



Figura 1.
Șorțurile de plumb



Figura 2.
Mănușile de plumb



Figura 3.
Gulerul de plumb



Figura 4.
Ferestrele de vizualizare

Norma de dozimetrie individuală stabilește două metode de monitorizare:

- Monitorizare internă
- Monitorizare externă

Monitorizarea externă prevede acele dozimetre individuale care trebuie să fie purtat numai de persoana căreia i s-a predat acest dozimetru. Personalul expus profesional trebuie să poarte dozimetrul pe tot parcursul programului de lucru, Dozimetrul trebuie să fie purtat la nivelul toracelui, la piept sau pe abdomen.

Există anumite limitele de doză pentru expunerea profesională:

- Limita minima de detecție: 0,02 mSv
- Nivelul de investigare: 0,50 mSv
- Limita de doză efectivă: 20 mSv/an

Este necesară minimizarea expunerilor la radiații atât a personalului medical și tehnic, cât și a pacienților și a aparținătorilor.

Pentru personalul medical și tehnic - reducerea numărului de interveniri în sala de examinare în timpul procedurii.

Pentru pacient - adaptarea și ajustarea strategiilor în identificarea și localizarea zonei de interes, înregistrarea DAP-ului (doza absorbită în aer integrată în aria de interes) și câmpul de focalizare.



Figura 4. Radiografie de torace – persoană adultă



Figura 5. Radiografie de claviculă – copil

Expunerile medicale trebuie să fie justificate prin analiza comparativă a beneficiilor de diagnostic pe care acestea le pot produce, în raport cu detrimentul pe care îl pot cauza [5].

Dozele personalului expus profesional trebuie evaluate. În acest sens, s-a implementat o interfață grafică cu ajutorul software-ului MATLAB 2021B ce vine în sprijinul managementului de calitate intern al unei unități medicale. Dozele returnate de către instituția desemnată de autoritatea națională CNCAN sunt importate a fi stocate și analizate în vederea identificării depășirii dozei acceptate.

Rezultate și discuții

Pentru un design ușor de utilizat, a fost folosit Toolbox-ul App Designer, un mediu de dezvoltare interactiv pentru proiectarea aplicațiilor de programare care au o serie de funcții bine stabilite. Programarea a fost realizată cu ajutorul editorului MATLAB 2021B. Prin intermediul butoanelor predefinite se pot realiza o serie de prelucrări ale datelor introduse și se poate observa grafic evoluția gradului de radiație acumulat de către subiecți.

Interfața grafică permite analiza datelor de pe dozimetre și calculul de radiație absorbit de fiecare cadru medical împarte. S-a dorit și implementarea unui algoritm de predicție automată pentru a face referire la perioada următoare de lucru a personalului medical, astfel încât să se poată realiza o planificare bine stabilită în momentul în care unul din personalul medical a depășit limita permisă.



Figura 6. Interfața grafică ce permite analiza buletinelor dozimetrice și evaluarea acestora pe o perioadă de 1 lună de zile respectiv 1 an

Concluzii

Decizia de a efectua o procedură medicală trebuie să fie luată în mod individualizat, luând în considerare situația specifică a fiecărui pacient și discutând în mod deschis și transparent beneficiile și riscurile asociate cu opțiunile disponibile. Prin implicarea activă în aceste activități, bioinginerii medicali în departamentul de imagistică medicală contribuie semnificativ la furnizarea unei asistențe medicale de calitate și la asigurarea funcționării eficiente a departamentului de imagistică.

Mulțumiri

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ÎMBUNĂTĂȚIREA EDUCAȚIEI STUDENȚILOR ÎN DOMENIUL BIOINGINERIEI MEDICALE PRIN CONTINUITATE ÎN MEDII DE ÎNVĂȚARE ADAPTIVE – REALITATE VIRTUALĂ

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Rezumat. *Învățarea și pregătirea profesională a bioinginerilor medicali prin utilizarea realității virtuale (VR) poate ajuta la dezvoltarea abilităților necesare în domeniu. Realitatea virtuală (VR) oferă utilizatorilor o experiență captivantă și convingătoare, care le permite să interacționeze cu simulări elaborate, scenarii medicale și echipamente medicale virtuale fără a se confrunța cu riscurile asociate din practica reală. Generarea de experiențe reale legate de viitoarea meserie, precum și o înțelegere profundă a problemelor din lumea reală prin mediul virtual sunt cele două probleme principale pe care un astfel de sistem de învățare le poate rezolva. Pe parcursul carierei lor, bioinginerii medicali pot folosi VR pentru a-și menține cunoștințele și abilitățile actualizate și să rămână la curent cu cele mai recente tehnologii din domeniu. Bioinginerii medicali lucrează cu o mulțime de date medicale, cum ar fi imagini medicale și informații despre pacienți. Deoarece datele sunt mai ușor de înțeles și analizat, aceștia pot vizualiza și manipula în mod interactiv și tridimensional în virtutea realității virtuale (VR). Scopul acestei lucrări este crearea unei platforme VR folosind un software conceput pentru a ajuta studenții Facultății de Bioinginerie Medicală să învețe și să simuleze o secție de spital cu echipament medical relevant.*

Cuvinte cheie: *învățare, bioingineri medicali, experiență clinică, perfecționare continuă, simulare, realitate virtuală*

Introducere

În contextul evoluției rapide a tehnologiilor moderne, proiectul nostru propune o abordare inovatoare în instruirea și dezvoltarea competențelor studenților de bioinginerie medicală. Inspirat de potențialul extraordinar al realității virtuale (VR) și al mediilor de învățare adaptive, acest proiect își propune să redefinească modul în care studenții sunt instruiți și pregătiți pentru carierele lor viitoare în domeniul medical. O meta-analiză efectuată într-un articol a determinat eficacitatea programelor VR, în general, și a demonstrat capacitatea acestora de a dezvolta patru rezultate specifice de reabilitare: control motor, echilibru, mersul și forța [1]. Elementul cheie în aceste aplicații este utilizarea de conținut media imersiv pentru a implica utilizatorii într-o experiență interactivă stimulată, în care aceștia simt un sentiment de prezență într-un mediu diferit și nou [2]. La începutul secolului XXI, utilizarea realității virtuale și a jocurilor în general ca instrumente de predare a devenit foarte răspândită, în special în cazul jocurilor de simulare [3].

Tehnologia VR devine tot mai populară odată cu progresele în materie de hardware și software. În viitor, aplicațiile VR vor deveni oarecum familiare în domeniul sănătății [4]. Realitatea virtuală a devenit mai accesibilă în ultimii ani. Simulările VR au fost folosite de mulți ani ca instrumente educaționale în medii cu risc ridicat, cum ar fi simulările de zbor sau cele medicale [5].

În conformitate cu cercetările recente, VR-ul este recunoscut pentru capacitatea sa de a recrea medii virtuale realiste și interactive, esențiale pentru simularea diverselor scenarii medicale și pentru instruirea practică [6]. Prin integrarea VR-ului în medii de învățare adaptive, proiectul nostru vizează să ofere studenților un mediu personalizat și adaptabil, care să le permită să își dezvolte abilitățile și cunoștințele într-un ritm individualizat.

De asemenea, proiectul nostru se bazează pe lucrările anterioare care evidențiază eficacitatea mediilor de învățare adaptive în optimizarea procesului de învățare și în îmbunătățirea performanței studenților [7].

Astfel, prin combinarea VR-ului cu mediile de învățare adaptive, proiectul nostru își propune să creeze un mediu educațional inovator și eficient, care să faciliteze dezvoltarea competențelor și expertizei studenților în bioinginerie medicală.

Materiale și metodă

Platforma noastră VR este creată în Unity Hub, cu accent pe detalii realiste ale unei secții de spital, inclusiv echipamente medicale, mobilier și iluminat adecvat (Fig. 1). A fost proiectat un salon de spital care respectă standardele medicale, conformitatea fiind asigurată prin alinierea la normele ISO 22886. Acesta se distinge prin elemente esențiale, precum aspectul ergonomic, accesibilitatea echipamentelor medicale și adaptabilitatea pentru o experiență imersivă învățătoare [8]. Unity oferă o platformă robustă pentru dezvoltarea de conținut VR care poate rula pe diferite căști și platforme VR. Unity este un motor de dezvoltare a jocurilor extrem de versatil, apreciat pentru flexibilitatea sa și pentru capacitățile de adaptare la nevoile diverse ale proiectelor. Cu instrumente puternice de programare și scripting, este ideal pentru implementarea logicii complexe și a interacțiunii utilizatorului într-un mod eficient. Datorită suportului său pentru medii 3D și interactivitate bogată, Unity oferă posibilitatea de a crea experiențe captivante și realiste în mediul virtual. Aceste caracteristici fac din Unity o alegere ideală pentru dezvoltarea proiectului nostru de salon de spital interactiv, oferind o platformă solidă și eficientă pentru crearea unei experiențe educative și interactive pentru studenții de bioinginerie medicală [9].

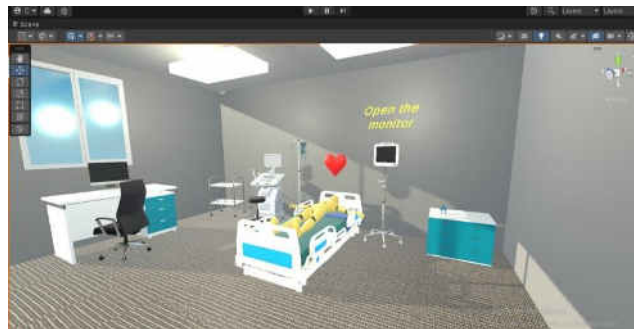


Fig. 1. Interfața salonului de spital creată în Unity

Interfața VR le permite bioinginerilor medicali să interacționeze cu mediul, oferindu-le posibilitatea de a porni și opri monitoarele pacienților și de a interpreta datele fiziologice, simulând situații reale de spital. Bioinginerul medical este responsabil de funcționarea monitoarelor pacienților, inclusiv de pornirea și oprirea acestora în funcție de starea pacientului simulat. În timpul formării, bioinginerul medical este instruit să interpreteze datele cardiace simulate și să reacționeze în mod corespunzător, oferindu-i astfel experiență practică în gestionarea echipamentelor medicale (Fig. 2). Este imperios necesar ca studenții din domeniul ingineriei biomedicale să fie pregătiți în medii reale de asistență medicală, unde apare cea mai mare parte a industriei dispozitivelor medicale. Imersiunea clinică ajută la realizarea acestui obiectiv de formare [10].



Fig. 2. Diferite unghiuri ale salonului de spital create în Unity

Experiența de realitate virtuală ajută la pregătirea bioinginerilor medicali pentru situații reale, oferindu-le posibilitatea de a învăța și de a face greșeli fără consecințe asupra pacienților reali. Această abordare oferă posibilitatea de a exersa și de a dezvolta abilități critice, pregătind bioinginerii medicali și profesioniștii din domeniul sănătății pentru cerințele complexe ale mediului medical.

Rezultate și discuții

Aplicația creată oferă componente și sisteme pentru gestionarea interacțiunilor VR, inclusiv urmărirea mâinilor, manipularea diferitelor dispozitive medicale într-o secție medicală. Dorim ca studenții să aibă posibilitatea de a examina în detaliu fiecare componentă a unui dispozitiv medical, împreună cu specificațiile acestuia. Platformele de educație virtuală pot oferi diverse metode de evaluare, inclusiv teste, teme și examene. Notarea automată îi ajută pe studenți să își urmărească progresul și să facă îmbunătățirile necesare.

Din feedback-ul colectat de la un lot de 38 de studenți, rezultă că 64% dintre aceștia au evaluat platforma de realitate virtuală ca fiind satisfăcătoare, în timp ce 25% au considerat-o nesatisfăcătoare și 11% au indicat un nivel de satisfacție scăzut. Majoritatea participanților au exprimat opinii pozitive despre proiect, deoarece oferă oportunități utile de învățare și dezvoltare într-un mediu inovator și adaptiv, precum realitatea virtuală. Oferind studenților acces la experiențe practice și simulări relevante pentru domeniul bioingineriei, acest lucru poate contribui la îmbunătățirea calității educației. În ciuda faptului că o mică parte a eșantionului a dat rezultate neutre și nesatisfăcătoare, este esențial să investigăm mai departe cauzele acestor rezultate și să identificăm eventualele zone de îmbunătățire. Aceste opinii pot oferi indicii utile pentru optimizarea și ajustarea proiectului pentru a satisface mai bine așteptările și cerințele tuturor. În cele din urmă, este esențial să continuăm să urmărim și să evaluăm efectele proiectului, să-l modificăm în funcție de feedback și să ne asigurăm că satisface în mod eficient nevoile și dorințele studenților bioingineriei medicale. Vom putea consolida și extinde beneficiile proiectului în cadrul facultății și în comunitatea academică mai largă prin aceste eforturi.

Concluzii

Sistemul de realitate virtuală pentru formarea personală a bioinginerilor medicali este o soluție inovatoare și eficientă pentru dezvoltarea cunoștințelor și abilităților în domeniul bioingineriei. Prin imersiunea completă în scenarii medicale complexe și simulări avansate, utilizatorii pot dobândi o experiență practică valoroasă și pot învăța într-un mod sigur și interactiv. Sistemele VR pot urmări progresul fiecărui student în parte și pot adapta experiența de învățare la nevoile lor, oferind sprijin sau provocări suplimentare, după cum este necesar.

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SISTEM DE MONITORIZARE IoT PENTRU PACIENȚI CU DEFICIENȚE RESPIRATORII ÎN SOMN

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Rezumat. Apneea în somn este o tulburare respiratorie caracterizată prin întreruperi recurente ale respirației în timpul somnului. Această afecțiune se manifestă prin episoade de oprire sau reducerea fluxului de aer către plămâni, ce produc o scădere a nivelului concentrației de oxigen din sânge și o intensificare a activității nervoase simpatice, rezultând în consecințe fiziologice negative, precum creșterea frecvenței cardiace și a tensiunii arteriale. Scopul acestei lucrări constă în elaborarea și implementarea unui dispozitiv destinat monitorizării tulburărilor respiratorii în timpul somnului. Dispozitivul își propune să detecteze fluxul de aer nazal și să înregistreze sunetele generate de vibrația structurilor nazo-orale în cazul apariției episoadelor de apnee, cu ajutorul unor senzori specifici (CO₂ și a unui microfon), asistați de o canulă nazală. Suplimentar, are loc o înregistrare a activității cardiace prin intermediul unui senzor de puls și colectarea datelor pe un SD card, cu scopul de a facilita interconectarea cu serviciile medicale. Datele procesate sunt afișate utilizatorului printr-un display, permițând monitorizarea și analiza propriei stări. Tot acest proces are ca obiectiv final diminuarea și chiar eliminarea manifestărilor apneei în somn: hipertensiunea arterială cu incidență cardiovasculară, somnolența diurnă excesivă, accidente vasculare cerebrale.

Cuvinte cheie: apnee, Arduino, ritm cardiac, senzor de CO₂, disfuncții respiratorii

Introducere

Este esențial să fie recunoscute, diagnosticate și tratate tulburările de somn pentru a preveni efectele negative asupra sănătății cardiovasculare, metabolice și psiho-comportamentale, influențând atât performanțele intelectuale, cât și relațiile sociale.

Apneea în somn se caracterizează prin simptome care provin de la opririle (apnee) sau diminuările (hipopnee) fluxului respirator în timpul somnului, atipice ca durată și frecvență, ce duc hipoxemie și/sau hipercapnie [1].

Apneea obstructivă în somn (SASO) se produce din cauza îngustării sau colapsului căilor respiratorii superioare, definindu-se prin intervale repetate de obstrucție parțială sau completă a acestora. Durata pe care o are un repaus respirator se află în intervalul 10 secunde - 2 minute și depinde de fiziologia patologică a pacientului. Aceste episoade, care durează cel puțin 10 secunde, conduc la scăderea nivelului de oxigen în sânge și la o creștere a activității nervoase simpatice, determinând creșterea ritmului cardiac și a tensiunii arteriale [2,3,4].

Evaluând gradul de severitate și numărul de episoade ce apar într-o oră, apneea în somn poate fi clasificată astfel : apnee ușoară (5-15 episoade pe oră), moderată (15-30 episoade pe oră) și severă (mai mult de 30 episoade pe oră) [5].

Apneea obstructivă în somn devine tot mai prevalentă la nivel mondial, afectând aproximativ 34% dintre bărbați și 17% dintre femei, cu o mărire a acestor valori în cazul celor care

suferă de afecțiuni precum obezitatea sau atopia. Riscul de apnee în somn crește odată cu înaintarea în vârstă, mai ales în rândul bărbaților și la femeile aflate în etapa postmenopauzei [6].

Dintre persoanele afectate de apneea în somn, majoritatea prezintă o stare de oboseală persistentă, lipsă de energie și un somn de calitate scăzută, definit de întreruperi. Există și cazuri de apnee obstructivă severă asimptomatică, în care simptomele pot fi observate doar de persoanele care îi însoțesc în timpul somnului, deoarece schimbările determinate de această afecțiune pot avea loc fără a fi resimțite [2,3].

Simptomele apneei în somn pot fi împărțite în două categorii: nocturne și diurne. Simptomele nocturne includ: sforăit puternic, treziri frecvente, sufocare, insomnie, somn agitat, treziri frecvente, nicturie, refluxul gastroesofagian și transpirațiile nocturne. Simptomele diurne includ: somnolență excesivă, dureri de cap, scăderea libidoului, dureri cornice, dureri de cap, gură și gât uscate la trezire. În plus, performanța intelectuală poate fi afectată de tulburări de memorie și concentrare, confuzie mentală și probleme cognitive. În unele cazuri, pot apărea anxietate, temperament coleric, depresie și simptome asociate ADHD la copii [5].

În prezent, polisomnografia nocturnă reprezintă metoda standard pentru diagnosticul tulburărilor de somn, însă aceasta este asociată cu costuri ridicate și lipsa de confort pentru pacienți, care trebuie să doarmă conectați la senzori sub supraveghere medicală [7].

Configurarea sistemului și materiale utilizate

Sistemul conceput are la bază o placă de dezvoltare Arduino UNO, ce utilizează un microcontroler Atmega 328. Dispozitivul are în componență un senzor de calitate a aerului, un senzor de puls M1192A, un microfon, un display OLED și un card SD (Fig. 1).

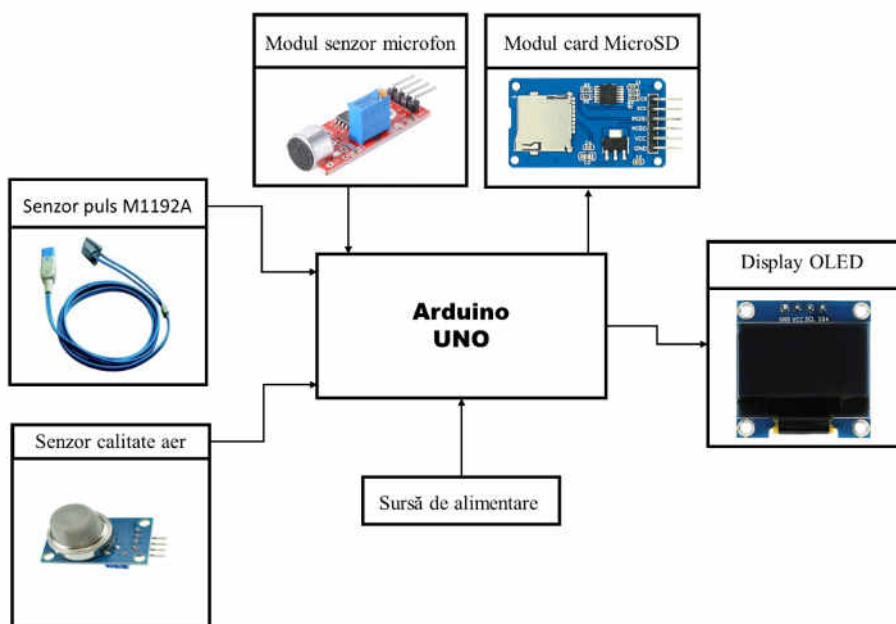


Figura 1. Schema bloc a sistemului

Modulul microfon KY-037, ce are o sensibilitate ridicată, a fost utilizat pentru a detecta sforăitul prin captarea, transformarea și prelucrarea sunetului în semnal electric [8]. Acesta este atașat de canulă pentru a permite detectarea precisă a sforăitului (Fig. 2).

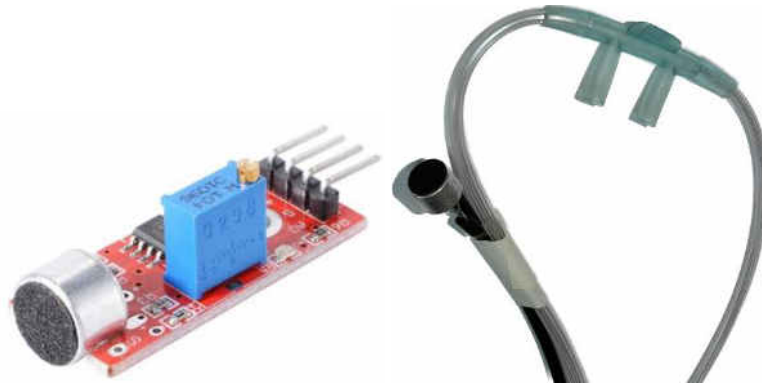


Figura 2. Modul microfon atașat la canula nazală

Dispozitivul monitorizează fluctuațiile în intensitatea sunetelor asociate sforăitului, furnizând date și generând grafice în software-ul Arduino IDE pentru analiza variațiilor și valorilor în decibeli ale sunetelor (Fig. 3).

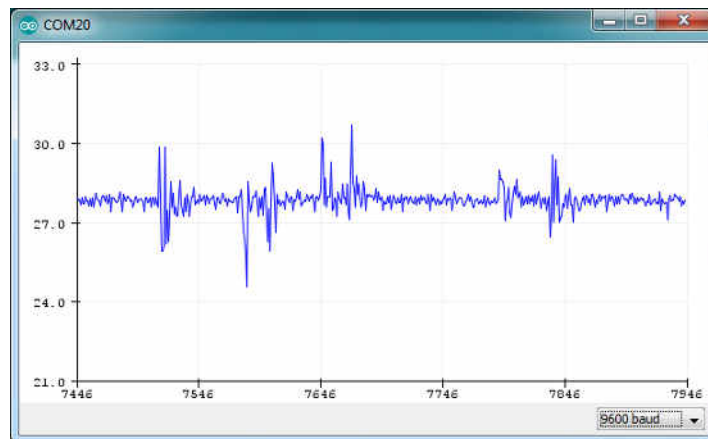


Figura 3. Înregistrare grafică a sunetelor cauzate de sforăit

Un interval considerat normal de nivel de zgomot este definit între 0 și 20 dB, iar pentru această gamă de valori, pe display-ul OLED se va afișa cuvântul "ușor" asociat imaginii microfonului. În cazul în care nivelul de zgomot este cuprins între 20 și 40 dB, se va afișa "moderat", iar pentru valori mai mari de 40 dB, se va afișa "sever" [9].

Senzorul de calitate a aerului, prezentat în Fig. 4 poate detecta gaze nocive precum amoniacul, benzenul, sulful sau dioxidul de carbon. Acesta a fost integrat în sistem pentru a înregistra variațiile nivelului de CO₂ întâlnite în apnee, analizând cantitatea ce a fost preluată cu ajutorul canulei. Intervalul considerat normal de CO₂ este între 35.000 și 50.000 ppm (părți per milion), iar pentru această gamă de valori, pe afișajul OLED se va afișa cuvântul "scăzut", iar pentru valori mai mari de 50.000 ppm, se va afișa "ridicat". Senzorul utilizează un material sensibil la gaze, în care conductivitatea crește odată cu creșterea concentrației gazului (Fig. 6) [10,11].



Figura 4. Senzor de calitate a aerului

Senzorul de puls M1192A (Fig. 5) este plasat la nivelul degetului subiectului, permițând monitorizarea continuă a ritmului cardiac pe durata întregii perioade de somn [12].



Figura 5. Senzor de puls M1192A

Este important de menționat faptul că valorile normale ale pulsului și a nivelului de CO₂ pot varia de la persoană la persoană și pot fi influențate de factori precum vârsta, sexul, greutatea și istoricul medical.

Ecranul OLED de 0.96 inch oferă o afișare clară și luminoasă, cu un consum redus de energie și caracteristici reglabile, precum luminozitatea și contrastul. Are 4 pini de conectare, este ușor de integrat, iar rezoluția sa înaltă și dimensiunile compacte îl fac potrivit pentru acest sistem. Acesta a folosit pentru a afișa valoarea pulsului, severitatea sforăitului și a nivelului de CO₂ (Fig. 6) [13].

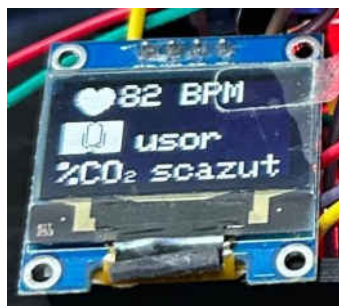


Figura 6. Afișarea datelor

Datele obținute din monitorizarea activității respiratorii, a ritmului cardiac și a calității aerului pe durata somnului sunt colectate și înregistrate pe un card micro SD. Acesta este integrat în dispozitiv și permite salvarea datelor într-un format digital pentru analiză ulterioară, facilitând astfel interconectarea datelor cu serviciile medicale.

În urma testării preliminare, dispozitivul dezvoltat (Fig. 7) îndeplinește cu succes obiectivele propuse, reușind monitorizarea unor parametri fiziologici pe baza cărora poate fi detectată apneea în somn.

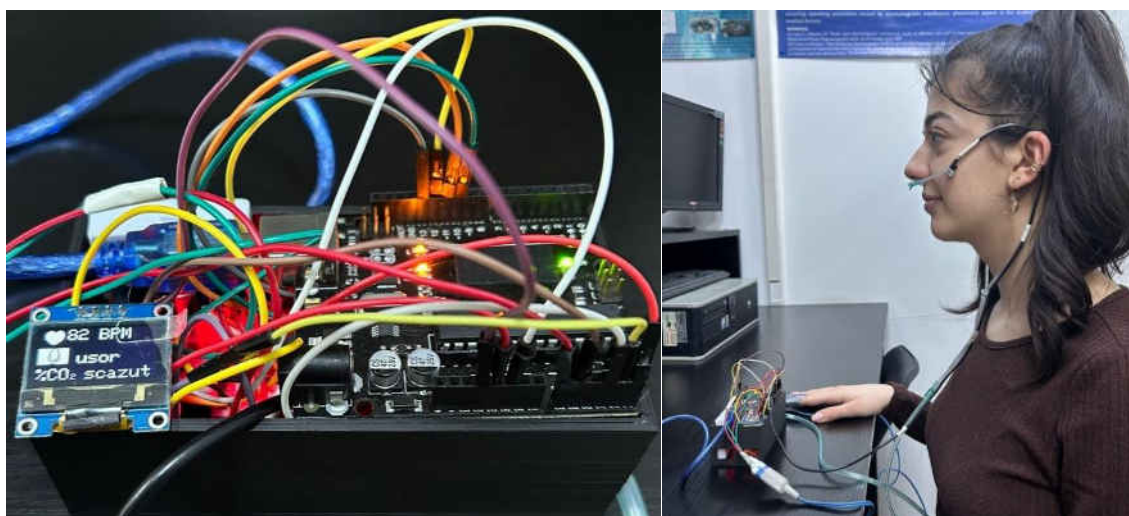


Figura 7. Testarea sistemului

Concluzii

Dispozitivul dezvoltat reprezintă o soluție eficientă pentru monitorizarea tulburărilor respiratorii în timpul somnului, având ca scop detectarea apneei în somn și furnizarea de date relevante pentru analiza stării de sănătate a pacientului.

Pe viitor se dorește optimizarea designului, garantarea preciziei măsurătorilor, includerea analizei EEG și dezvoltarea unei aplicații mobile sau a unui software pentru monitorizarea continuă a stării de sănătate a pacientului.

Aceste îmbunătățiri pot contribui semnificativ la îmbunătățirea monitorizării și tratamentului pacienților cu tulburări respiratorii în somn, facilitând obținerea unui diagnostic precis și a unui plan de tratament personalizat

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DISPOZITIV DE REABILITARE PENTRU RECUPERAREA ȘI ÎMBUNĂTĂȚIREA MOBILITĂȚII MEMBRULUI SUPERIOR

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Rezumat. Această lucrare prezintă un dispozitiv medical pentru recuperarea și îmbunătățirea mobilității membrilor superioare, cu ajutorul senzorilor pir(cu lumină infraroșie) și LED-uri pentru a crea butoane tactile cu feedback senzorial. Echipat cu un microcontroler arduino UNO și un ecran LCD, acesta oferă informații în timp real și permite configurarea unor setări personalizate în funcție de cerințele utilizatorului. Folosit în terapie interactivă în cadrul unor boli sau în etapele inițiale de învățare a utilizării unui braț robotic, fie în context nonterapeutic dispozitivul îmbunătățește coordonarea și agilitatea utilizatorului. Integrând exerciții fizice moderate, acesta reprezintă o metodologie inovatoare pentru recuperarea mobilității. Studiul evidențiază importanța continuării cercetărilor în acest domeniu. Prototiparea a fost metoda utilizată pentru dezvoltare, iar în urma feedback-ului primit de la utilizatori vom optimiza dispozitivul și îi vom îmbunătăți capacitățile pentru a ne atinge în întregime obiectivele de lungă durată și pentru a oferi cât mai multe unelte fizioterapeuților din jurul lumii.

Cuvinte cheie: Arduino Uno, Senzor pir, dispozitiv medical, prototip.

Introducere

Există o gamă diversă de afecțiuni care pot afecta mobilitatea membrilor superioare, inclusiv condiții precum Boala Parkinson, care implică tulburări ale controlului motor și coordonării. În unele cazuri mai severe, cum ar fi post-amputarea membrilor, utilizarea unui braț robotic poate fi necesară pentru a compensa pierderea funcționalității. Cu toate acestea, adaptarea la utilizarea unui astfel de dispozitiv necesită o perioadă de acomodare, în care individul trebuie să învețe mișcări simple și să-și dezvolte abilități de control, dispozitivul nostru fiind încadrat în prima etapă a exercițiilor, urmat apoi de exerciții cu o intensitate mai ridicată [1].

Printre metodele terapeutice de importanță deosebită în domeniul recuperării funcționale a membrului superior se numără terapia prin stimulare motorie. Această abordare se concentrează pe utilizarea stimulilor și exercițiilor pentru a îmbunătăți controlul motor și mobilitatea, contribuind astfel la restaurarea sau îmbunătățirea funcționalității membrilor afectate. Am ales această metodă din cauza prevalenței bolii Parkinson. Conform datelor furnizate de Organizația Mondială a Sănătății, se estimează că există aproximativ 8.5 milioane de persoane afectate de această afecțiune în întreaga lume [2-4]. Prin urmare, dezvoltarea și implementarea dispozitivului nostru se bazează pe nevoia critică de soluții terapeutice eficiente și accesibile pentru această populație în creștere.

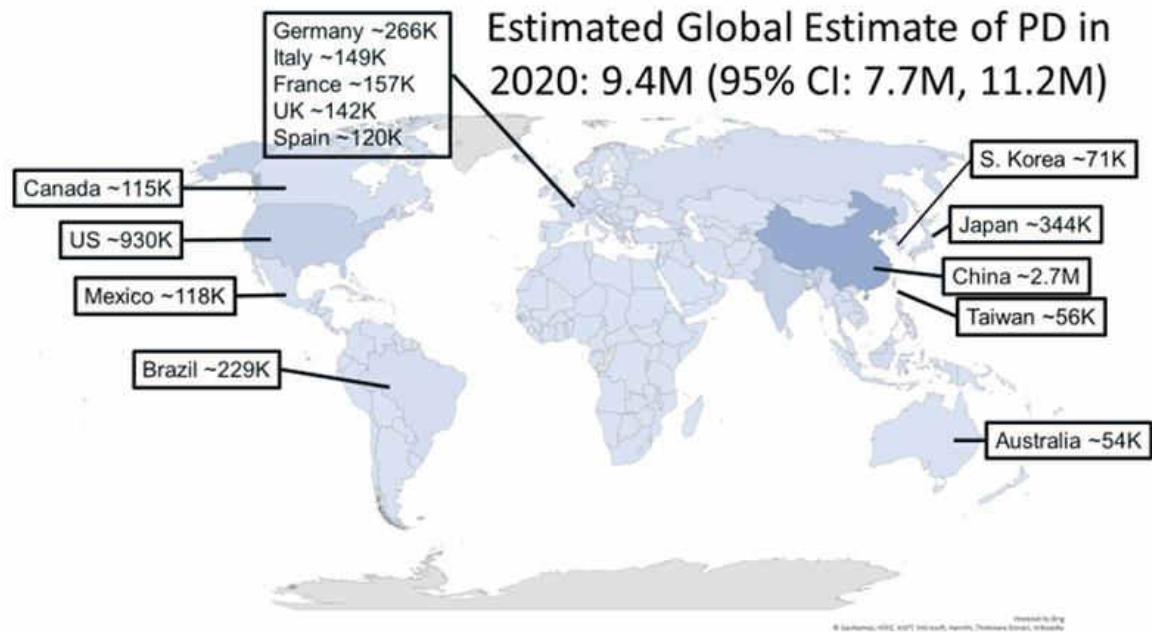


Fig. 1 Numărul estimat de cazuri de boala Parkinson (PD)

În acest context, dispozitivul nostru a fost conceput pentru a facilita acest proces de adaptare și îmbunătățire a mobilității membrilor superioare. În plus, dispozitivul nostru nu este limitat doar la utilizarea terapeutică, ci poate fi, de asemenea, benefic în contextul sportivilor de performanță. Aceștia necesită reflexe rapide și o coordonare eficientă între membrii lor și ochii lor pentru a excela în disciplinele lor. Prin urmare, dispozitivul nostru poate oferi un context non-terapeutic, contribuind la îmbunătățirea acestor abilități și la optimizarea performanței sportive.

Dispozitivul nostru constituie o soluție inovatoare pentru gestionarea și ameliorarea afecțiunilor asociate membrilor superioare prin intermediul unor exerciții fizice de intensitate moderată. Aceste exerciții sunt facilitate de dispozitivul nostru, care utilizează un sistem de ghidare vizuală, constând în deplasarea membrului superior către LED-ul care este aprins în acel moment, urmată de deplasarea către următorul LED activ. Aprecierea eficacității acestor exerciții este determinată de viteza de execuție, în care progresul și beneficiile exercițiului devin mai evidente odată cu creșterea vitezei de deplasare. Această metodă oferă o modalitate interactivă și personalizată de a îmbunătăți controlul și mobilitatea membrilor superioare, abordând astfel nevoile terapeutice ale pacienților într-un mod eficient și eficace [5].

Materiale si metode

Dezvoltarea designului a fost efectuată în software CAD: Autodesk Tinkercad și Fusion 360 ce au facilitat concepția schemei de conexiuni și modelarea suportului dispozitivului, permițându-ne să adaptăm designului pe nevoile studiului. Această abordare modulară a designului ne-a permis să iterăm rapid prototipuri, fiecare versiune aducându-ne mai aproape de realizarea viziunii noastre. De asemenea am folosit software-ul Arduino IDE pentru a coda pe placa de dezvoltare Arduino UNO în limbajul de programare C.

Inițial am constituit un prototip utilizând o versiune mai simplă a designului avansat. Crearea prototipului a fost efectuată utilizând placa Arduino UNO, senzori PIR, LED-uri și ecran LCD.

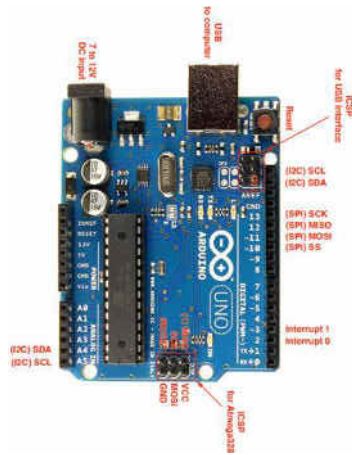


Fig. 2 Configurația pinilor pentru placa ARDUINO UNO

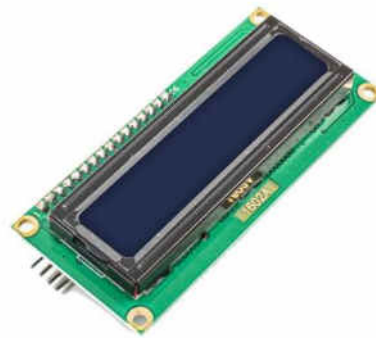


Fig. 3 Ecran LCD 16X2 I2C

Arduino UNO este o platformă de procesare open-source care constă într-un microprocesor Atmega328. Pentru programarea sistemului se utilizează software-ul Arduino IDE, ce permite compilarea și încărcarea programului în microcontroler-ul ATmega328, care este capabil să ruleze și să interpreteze secvențele de cod în limbaj C. Alimentarea plăcii de dezvoltare în cazul prototipului nostru este realizată prin intermediul calculatorului, utilizând portul USB, urmând ca ulterior să dezvoltăm o soluție care să nu mai depindă de laptop.

În nucleul dispozitivului se află un microcontroler Arduino UNO. Ecranul LCD fiind partea de afișaj, oferind feedback în timp real. Componentele periferice - senzori PIR pentru detectarea mișcării și LED-uri pentru feedback vizual - sunt dispuse strategic într-un aranjament hexagonal pe suportul dispozitivului [6,7].



Fig. 4 Senzor de proximitate infraroșu

Specificațiile tehnice ale senzorului PIR includ:

interval de sensibilitate: până la 6 metri cu un unghi de detecție de $110^\circ \times 70^\circ$.

sursă de alimentare: tensiune de intrare de 5 V-12 V pentru majoritatea modulelor (acestea au un regulator de 3,3 V), dar 5 V este ideal în cazul în care regulatorul are specificații diferite.

output: Un impuls digital de tensiune ridicată (3 V) este emis când este declanșat (detectată mișcare), iar nivelul digital este scăzut când este inactiv (nu se detectează mișcare). Lungimea impulsurilor este determinată de rezistoare și condensatoare pe placa de circuit imprimat și variază de la senzor la senzor [8].

Rezultate și discuții:

Am dezvoltat un produs cu un design avansat, care constă într-un sistem de butoane conectate, fiecare dintre ele având un senzor PIR și un inel LED. Butoanele vor clipi într-o anumită ordine, iar utilizatorul va încerca să le atingă rapid, pentru a îmbunătăți coordonarea mână-ochi (Fig. 5 și Fig. 6)

A fost dezvoltat un prototip simplu, care îndeplinește funcțiile primare ale dispozitivului final. Acesta afișează pe ecranul LCD un mesaj către utilizator concomitent cu aprinderea unui LED, la activarea senzorului PIR. (Fig. 7 și Fig. 8)

Crearea prototipului a servit drept instrument esențial pentru a obține informații despre modul de operare și de proiectare a unui astfel de dispozitiv, urmărind în cele din urmă un design mai precis și mai ușor de utilizat. Lucrând la prototip, au fost învățate lecții valoroase în ceea ce privește funcționalitatea, utilizabilitatea și ergonomia [9].

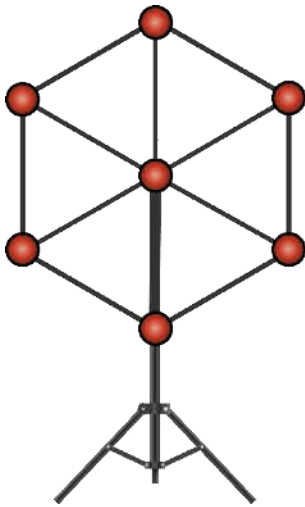


Fig. 5 Designul dispozitivului final.

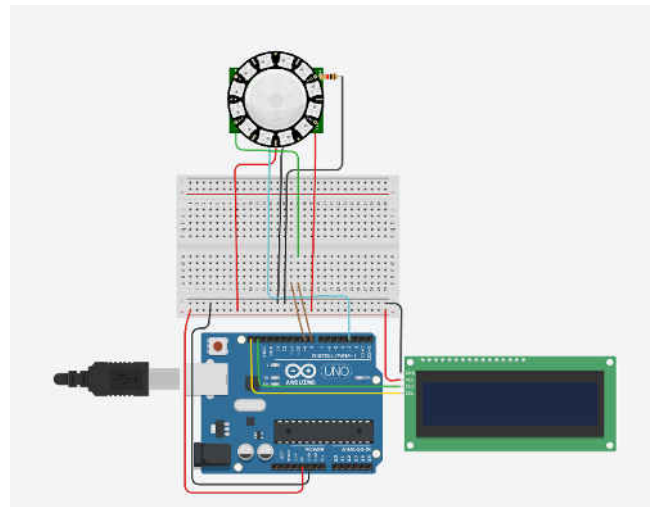


Fig. 6 Schema grafică a dispozitivului avansat, ce conține 1 buton tactil.

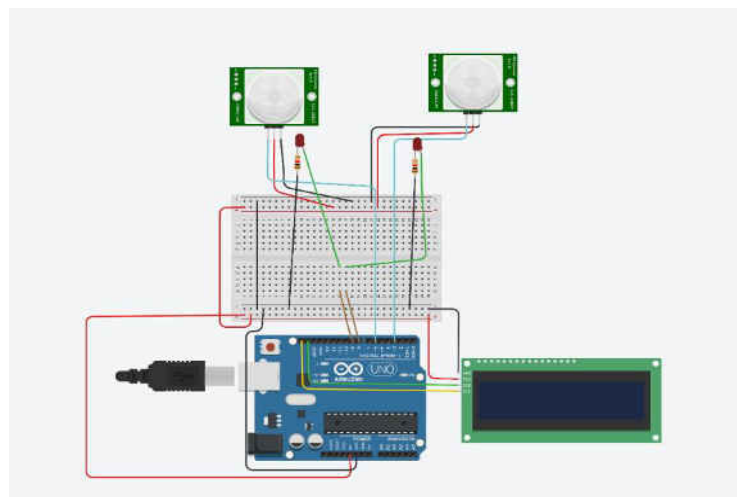


Fig. 7 Schema grafică a prototipului

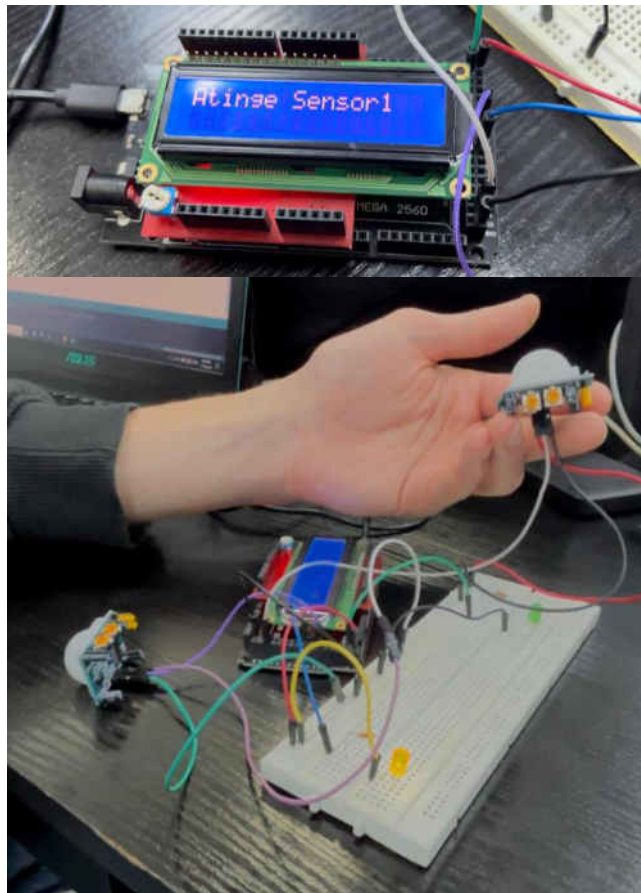


Fig. 8 Prototipul în funcțiune

Pentru a acoperi o gama largă de pacienți intenționăm să dezvoltăm un sistem personalizat în funcție de cerințele fiecăruia, așa cum forma și exercițiile dispozitivului pot fi modificate pentru a satisface nevoile utilizatorului indiferent de vârstă, sex, greutate și condiția medicală.

Designul ergonomic al dispozitivului nostru și diversele jocuri sunt promițătoare pentru îmbunătățirea coordonării ochi-mână, ajutând la reabilitarea membrilor superioare. Următorii noștri pași includ perfecționarea pe baza feedback-ului utilizatorilor, extinderea jocurilor terapeutice pentru diverse abilități și integrarea cu platformele digitale de sănătate pentru monitorizare de la distanță și programe de reabilitare personalizate [10].

Concluzii

În urma testării prototipului, putem concluda că dispozitivul dezvoltat îndeplinește cu succes obiectivele propuse. Dispozitivul nostru poate avea un rol important în reabilitarea membrului superior și antrenarea coordonării ochi-mână. El reprezintă o soluție versatilă pentru o gamă largă de utilizatori. Ne propunem să dezvoltăm un prototip avansat și să îl optimizăm pe baza feedbackului în urma testării.

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REHABILITATION OF THOSE WHO LOST LIMBS FROM SHRAPNEL AND GUNSHOT WOUNDS

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Abstract. *In today's reality, unfortunately, there are many people who have lost limbs due to tragic circumstances. To solve this problem, there have long existed a variety of artificial prostheses designed to ensure the integration of the victim in society, but the current products on the market are expensive and need to be customized for each user individually, by highly qualified personnel. In order to solve the above-mentioned problems and to increase the comfort and safety of using the prosthesis, we decided to develop an electronic device that would simplify the process of fitting the prosthesis to a particular user, improve its comfort and increase the period of safe wear of the prosthesis.*

Keywords: *Disaster medicine, prosthetics, lost limbs, effect of electric potentials, electronic device.*

Introduction

In today's reality, unfortunately, there are many people who have lost limbs due to tragic circumstances. And every day such people with disabilities face difficulties in leading an active lifestyle. This problem is especially acute when the injured person, due to his/her professional activity, is obliged to behave as if the injury had not occurred [1].

To solve this problem, there have long existed a variety of artificial prostheses designed to ensure the integration of the victim in society, but the current products on the market are expensive and need to be customized for each user individually, by highly qualified personnel.

Also, modern artificial prostheses are not designed to be worn all day long, due to the imperfection of the fixation [2].

A person using a prosthesis will inevitably encounter problems with chafing, not to mention the fact that he or she will need a long process of adaptation to the prosthesis before wearing it directly [3].

There is also an increased risk of thrombosis due to blood stasis and increased pressure on the limb from the prosthesis.

In order to solve the above-mentioned problems and to increase the comfort and safety of using the prosthesis, we decided to develop an electronic device that would simplify the process of fitting the prosthesis to a particular user, improve its comfort and increase the period of safe wear of the prosthesis [4].

Analytic review on the state of problem solving.

Different types of amputations require different prostheses. The easiest way is to replace the loss of fingers, but with amputation above the forearm, serious difficulties begin. It is worth clarifying that the reason for installing a prosthesis can also be various congenital mutations that lead to deformation of any part of the limb [5].

Now, it's worth saying what types of prostheses exist today, now there are two main types [6]:

- Traction (mechanical)
- Bioelectric, based on the work of myoelectric sensors, are the most advanced

Traction (or mechanical) prostheses are a frame with many cables (traction). The essence of their work is simple. Special cables are fixed to certain areas of the remaining limb [7]. With the help of force, the cables can be stretched, which leads to bending (or some other) movement of the prosthesis. These prostheses are suitable for any type of amputation, even complete loss of an arm (Fig. 1).



Figure 1. Traction foot prostheses for sport

The prosthesis consists not only of a frame, a sleeve and a hand, but also has a cable. It is attached to a healthy shoulder, due to which the bend and extension of the hand are performed. Control in the elbow area can be carried out using the healthy arm, or by lifting the prosthesis with the body [8].

Mechanical prostheses are very suitable for children, because constant loads during control prepare them for a possible transition to electronics. To summarize, the main advantages of traction prostheses (Fig. 2) are [9]:

- Low cost
- Resistance to damage
- Possibility of installation for shoulder amputation
- Much less weight of the prosthesis compared to bioelectric ones.



Figure 2. Traction hand prosthesis

However, progress did not stop there. The fact is that traction prostheses have only one strict type of grip; therefore, we can say that traction prostheses are designed for some narrow function, which is not always useful in everyday life [10].

The work of bioelectric prostheses is based on reading the electrical potential of residual muscles. The impulse goes from the brain to the spinal cord, where it further diverges and enters the nerves connected to the muscle fiber (Fig. 3).

The signal is amplified, after which the signal disperses along the branches of the nerve, axons, into certain groups of muscle fiber. Several muscle cells can be recruited from one nerve. In a healthy hand, the signal successfully reaches the palm and you squeeze it, but if the hand is amputated below the elbow, the signal dissipates. The reading function is performed by myoelectric sensors [11].

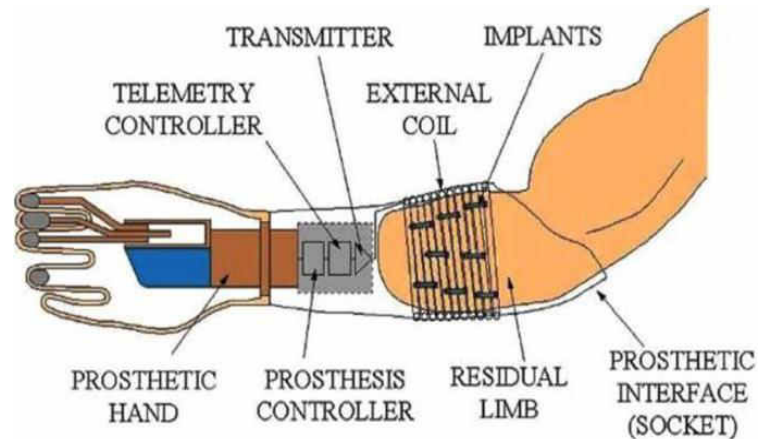


Figure 3. Schematic bioelectric of hand prosthesis

After the signal has been registered, it enters the processor, where it is processed. After this, the servos are activated, and the prosthesis makes some movement.

Because we can program the movement of the servos, we can define many different types of grips for the prosthesis. Traction methods, say, just clench and unclench your hand, when myoelectric prostheses are able to gesture, rotate the wrist, etc. On average, multi-grip prosthetics have a grip range of 18 to 22.

Conclusions

As can be seen from the information presented above, modern prosthetic technologies are far from ideal. Moreover, a person who has lost a limb, even after successful rehabilitation, will experience great difficulty wearing a prosthesis in everyday life due to imperfect fastenings.

To solve the previously mentioned problems, we decided to develop an electronic device. The basic idea is to utilize the effect of electrical potentials on the tissue at the prosthesis attachment points. We expect to gain new scientific information, reduce the risk of blood clots and reduce the effects of prosthesis pressure on the user's tissues.

Summarizing all of the above, work on this topic is in demand in the modern global prosthetics market.

Moreover, research in this area is already very relevant in the Ukrainian prosthetics market, and over time the need for a fresh look at prosthetics and the comfort of the injured person will increase.

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NETLOGO INTEGRATED DEVELOPMENT ENVIRONMENT FOR MODELING PHYSIOLOGICAL PROCESSES

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Abstract. *NetLogo integrated development environment (IDE) is a powerful tool for modeling various complex systems, including human physiological processes. This software provides a user-friendly interface and a versatile programming language that enables researchers and educators to simulate and study different aspects of human physiology in a virtual environment. One key benefit of using NetLogo IDE to model human physiological processes is its ability to visualize and simulate dynamic systems. The software allows users to create agents representing different human body components, such as cells, organs, and tissues. These agents can interact with each other, exchange information, and respond to external stimuli, mimicking the behavior of natural physiological systems. This paper presents an example of modeling the cardiovascular system using NetLogo IDE to simulate cardiac output, blood flow, heart rate, and blood pressure. By manipulating various parameters, such as vessel diameter, contractility of the myocardium, and others, one can examine the impact of different factors on the overall functioning of the cardiovascular system. This can help in understanding cardiovascular diseases and exploring potential treatment strategies.*

Keywords: *NetLogo, system dynamics modeling, agent-based models, cardiovascular system model*

Introduction

Advancements in technology and computational power have revolutionized the field of biomedical research, enabling scientists to develop sophisticated software applications that model and simulate human physiological processes. These software tools provide valuable insights into complex physiological systems, aiding in understanding disease mechanisms, drug discovery, and personalized medicine. A number of software applications are widely used for modeling human physiological processes, including PhysiCell [1], Virtual Physiological Human (VPH) toolkit [2], OpenSim [3], and others.

NetLogo integrated development environment (IDE) [4] is a different software application offering unique advantages compared to PhysiCell, VPH toolkit, and OpenSim. Some key benefits of NetLogo IDE are (a) accessibility and simplicity, which makes it an excellent choice for beginners or those who want to quickly develop and explore simulations without delving into complex coding; (b) educational value; (c) community and model sharing by providing a repository of well-documented and validated models that can be easily adapted for specific research questions; (d) flexibility and interdisciplinary applications by supporting a wide range of modeling paradigms, including agent-based modeling, cellular automata, and network modeling; (e) visualization and experimentation using powerful visualization capabilities that allow users to observe and analyze simulation results in real-time. This feature facilitates the exploration of model behavior, identifying emergent properties, and analyzing complex systems' dynamics.

NetLogo IDE also allows users to conduct experiments by systematically varying model parameters and observing the effects on the system.

It is important to note that while NetLogo IDE offers unique advantages, PhysiCell, VPH toolkit, and OpenSim are specialized software applications focused on modeling human physiological processes with more specific capabilities in their respective domains. The choice of software will finally depend on the user's specific research goals and requirements.

Some capabilities and features of NetLogo IDE

NetLogo IDE provides a unique platform for creating agent-based models. In these models, individual agents represent different components of the human body, such as cells, tissues, or organs. These agents can be programmed with specific behaviors and rules, simulating complex physiological interactions.

NetLogo IDE also supports the integration of external data and models. Researchers can import and incorporate data from experiments or clinical studies into their models. This enables the validation and calibration of the model against real-world data, enhancing its accuracy and relevance. Additionally, mathematical models developed using tools like MATLAB or R can be integrated into NetLogo IDE, allowing for the combination of computational and agent-based modeling approaches.

Furthermore, NetLogo IDE offers a variety of analysis tools to examine the results of the simulations. Researchers can collect and analyze data on agent behavior, system dynamics, or emergent properties. This analysis can involve statistical measures, such as mean values, standard deviations, or correlation coefficients, to quantify and interpret the simulation outcomes.

Another advantage of NetLogo IDE is its extensibility. The software supports the creation of custom extensions, enabling users to incorporate specific functionalities or models tailored to their research needs. This flexibility allows researchers to explore different aspects of human physiology and adapt the software to suit their particular research questions.

Moreover, NetLogo IDE has a thriving community of users and developers who share models, resources, and expertise. This collaborative environment fosters knowledge exchange and encourages the development of new models and techniques. Users can access various pre-existing physiological models, saving time and effort in model development and facilitating interdisciplinary collaborations.

Lastly, NetLogo IDE is not limited to modeling human physiology alone. It can be used to simulate and study various other biological systems, such as ecological systems, population dynamics, or biochemical reactions. This versatility expands the range of research possibilities and allows for interdisciplinary investigations.

Using NetLogo to model the human cardiovascular system. Results and discussion

In this project, the cardiovascular system was primarily modeled using the Netlogo System Dynamics Modeler (SDM) and, to a lesser extent, the IDE's Agent-Based Modeling capabilities.

In the model, the cardiac output (CO) refers to the volume of blood that the heart pumps out in one minute. It is a critical measure that is influenced by various factors, which are routinely monitored in an intensive care unit (ICU). As explained by Ohm's law, the concept of the heart as a pump, which forms the basis for determining cardiac output, is supported by straightforward hydraulic models and the analogous relationship between electrical and fluid dynamics:

$$I = \frac{U}{R} \quad (1)$$

The equation (1) states that the current (I) is equal to the voltage (U) divided by the resistance (R). In this context, the current represents the flow rate of a fluid, the voltage represents the fluid pressure, and the resistance represents the resistance of different segments of the circulation. Additionally, the charge (Q) represents the volume, and the capacitance (C) represents compliance. Elastance is the inverse of compliance (1/C). This is illustrated in Fig. 1.

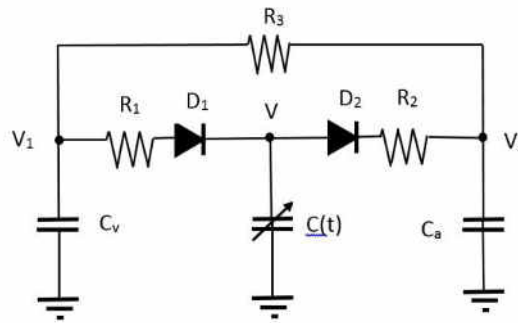


Figure 1. The hydraulic model supported by the analogy between the electrical domain and fluid dynamics, based on Ohm's law.

From a system dynamics point of view, the model comprises three compartments: two passive compartments for the arterial and venous components of the circulation, and an active compartment for the left ventricle. Figure 2 illustrates the utilization of the NetLogo SDM system dynamics approach [4]. It showcases multiple stocks and the flows between them, which are situated in proximity to the hydraulic domain. Ordinary differential equations (ODE) determine the model's behavior, which explains the dynamics and connection between three stocks (volumes of the left ventricle, arterial, and venous segment) and their corresponding flows.

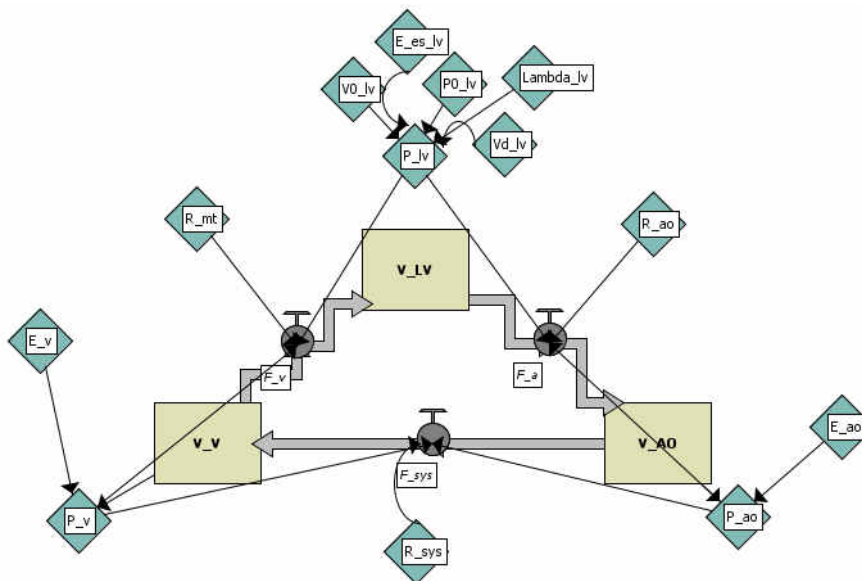


Figure 2. Representation of the stocks and flows in the model. Stocks (V) symbolize the left ventricle (V_LV), arterial segment (V_AO), and venous segment (V_V).

The pulsatile flow is determined by a driver function that imitates the heart muscle contractions and a Heaviside step function that replicates the valve mechanism, following the principle of opening in response to pressure and closing in response to flow. The model utilizes the following types of equations:

$$Q_t = \frac{P_1 - P_2}{R}, \quad (2)$$

$$\frac{dV}{dx} = Q_{in} - Q_{out}, \quad (3)$$

where P denotes pressure, V – volume, and Q flow.

The model's outputs include stroke volume (SV), CO, and ejection fraction (EF) (Fig. 3).

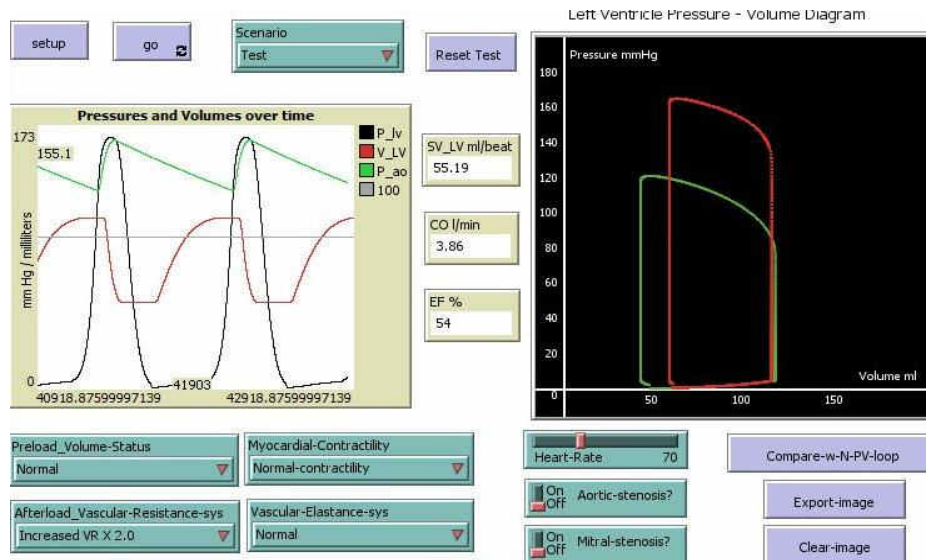


Figure 3. The model's graphical interface. In the middle are monitors for SV, CO, and EF.

In addition, the model produces a pressure-volume loop (PVL) that is specific to a particular scenario or pathological condition. This PVL can be seen in the black window in Figure 3, which shows two examples of a "normal" PVL (in green) and hypertension (in red). The PVL can offer valuable insights for the diagnosis, monitoring, and treatment of a specific patient. The region enclosed by PVL is regarded as a reliable indicator of the amount of oxygen the myocardium requires [5]. This parameter cannot be directly evaluated but can significantly impact the progression of the disease, the final result, and the approach to treatment. The model can effectively demonstrate the impact of various factors, such as preload, afterload, myocardial contractility, and heart rate, on cardiac output. The impact of altering various model parameters can be observed in the resulting pressures and volumes in the plot area [6]. Additionally, these changes can be seen in the PVL and CO of the left ventricle, both in normal and pathology. It is possible to simulate several pathological states by setting model parameters to different values.

Conclusions

NetLogo IDE offers a comprehensive set of tools and features for modeling human physiological processes. Its agent-based modeling approach, integration of mathematical models, visualization capabilities, and extensibility make it a valuable tool for researchers and educators in the field of physiology. By utilizing this software, scientists can gain insights into the human body's complexities, explore hypotheses, and contribute to advancements in understanding and treating physiological conditions.

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STUDIUL PRIVIND DEZVOLTAREA CONCEPTUALĂ A UNUI SISTEM PENTRU ANALIZA MERSULUI

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Rezumat. În contextul actual al tehnologiei medicale avansate, analiza mersului a devenit un instrument esențial în diagnosticarea și reabilitarea afecțiunilor locomotorii. Acest articol își propune dezvoltarea conceptuală a unui sistem pentru analiza mersului, care integrează tehnologii și algoritmi pentru procesarea datelor. Prin identificarea parametrilor critici ai mersului (lungimea pasului, ritmul de mers, unghiul de deviație, durata unui ciclu de mers) și aplicarea unor metode de analiză biomecanică (analiza cinematică și cinetică, distribuția presiunii plantare, evaluarea parametrilor temporali, înregistrări video ale ciclului de mers), sistemul propus oferă o evaluare detaliată și personalizată a mersului pacientului. Cercetarea se concentrează pe crearea unui model care să permită colectarea precisă a datelor, utilizând un modul care se poate monta pe glezna subiectului și un modul pe genunchiul acestuia (acestea pot fi utilizate împreună sau separat în funcție de necesitățile analizelor asupra subiecților), precum și interpretarea într-un mod semnificativ și util d.p.d.v. clinic. Sistemul pentru analiza mersului poate fi utilizat în practica clinică pentru diagnosticare, monitorizare, personalizarea tratamentului, prevenție și cercetare. Metodologia adoptată implică utilizarea senzorilor goniometrici, a platformelor de forță și a unui modul de analiză a datelor pentru definirea dinamicii mersului. Concluziile studiului subliniază importanța integrării tehnologiei în practica clinică, deschizând calea către noi cercetări în domeniul biomecanicii mersului.

Cuvinte cheie: analiza mersului, analiză biomecanică, senzori, model conceptual

Introducere

Afecțiunile sistemului locomotor sunt comune în întreaga lume afectând milioane de oameni și reprezentând o povară semnificativă a sistemului de sănătate. Aceste afecțiuni includ peste 150 de condiții diferite care pot afecta încheieturile, mușchii, oasele, ligamentele, tendoane sau coloana vertebrală. De asemenea, conform articolului de la referința [1], mai sunt incluse și alte condiții precum osteoartrita, artrita reumatoidă, dureri de spate etc. Studiul din referința [1] a fost efectuat în 240 de țări din anul 1990 până în 2020 folosind date din 68 de surse. Datele au fost analizate folosind modele meta-regresie pentru a estima prevalența în funcție de an, vârstă, sex și locație. În acest sens s-a determinat faptul că aproximativ 494 milioane de oameni au avut o afecțiune locomotorie în 2020, cu o creștere de 123,4% față de anul 1990 unde totalul cazurilor era de 221 milioane de oameni. De asemenea s-a arătat faptul că afecțiunile locomotorii sunt mai prezente la femei decât la bărbați cu 47,4% și probabilitatea crește cu vârsta, ajungând la un vârf comun ambelor sexe la 65-69 de ani.

Conform Organizației Mondiale a Sănătății (OMS), în anul 2022 aproximativ 1,71 miliarde de oameni au o afecțiune musculoscheletală. Acestea sunt contributorii principali ai dizabilităților, în special durerea lombară fiind o cauză frecventă în 160 de țări. Tulburările musculoscheletale limitează mobilitatea și dexteritatea persoanelor, ducând la incapacitatea de a efectua lucrul zilnic și la pensionare anticipate și reducere a abilității de a fi parte din societate. OMS a lansat inițiativa *Reabilitare 2030* în 2017 pentru a atrage atenția asupra nevoii profunde nesatisfăcute de reabilitare

la nivel mondial și pentru a sublinia importanța consolidării reabilitării în sistemele de sănătate. Reabilitarea disfuncțiilor ar trebui să fie disponibilă pentru toate persoanele în toate etapele vieții, cu orice fel de afecțiune și de-a lungul procedurilor [2].

Din cercetarea realizată pe mai multe articole, s-a identificat că analiza mersului este o parte importantă în diagnosticarea problemelor sistemului locomotor, precum și în reabilitarea acestora. Un exemplu este displazia de șold la copii așa cum e prezentat în articolul de la referința [3], în care s-a determinat postura piciorului și analiza mersului pe 203 copii, iar rezultatul a arătat diferențe între postura piciorului la aplicarea tratamentului conservator și respectiv cel chirurgical. Analiza mersului a arătat care membru inferior este mai afectat și abaterea de la mersul normal, în funcție de stadiul patologiei. Articolele de la referințele [4] și [5] se referă la aplicarea feedback-ului în timp real al mișcărilor în medicina de reabilitare respectiv descrierea principiilor de funcționare a unui sistem semi-portabil bazat pe un microcomputer dezvoltat pentru a măsura forțele de reacție verticale pe ambele picioare în timpul mersului. Se arată astfel că analiza mersului este importantă în detectarea anomaliilor de mers, determinarea modelelor de mers, planificarea și urmărirea tratamentelor personalizate.

Având în vedere cele prezentate dezvoltarea conceptuală a sistemului propus în acest articol are ca obiectiv principal realizarea unui sistem modular wireless pentru analiza mersului în vederea diagnosticării și a reabilitării problemelor sistemului locomotor. Sistemul va fi format din două module principale, cu înregistrări proprii putând fi folosit fie individual, fie împreună pentru o analiză completă. În capitolul dedicat modelului conceptual vor fi prezentate pe larg aceste module.

Analiza ciclului de mers

Ciclul de mers poate fi analizat în funcție de următorii parametri spațio-temporali: „lungimea pasului (definită ca distanța dintre contactul inițial al piciorului angrenat în ciclul de mers și contactul cu solul al celuilalt picior), lățimea pasului (definită ca distanța dintre centrele ambelor labe ale picioarelor în momentul contactului amândurora cu solul), durata pasului (definită ca intervalul dintre două contacte ale aceleiași picior cu solul), cadența (definită ca rata de mers a unei persoane, exprimată în pași/secundă), viteza de mers (definită ca rata de schimbări pe distanță și reprezintă viteza cu care o persoană merge (distanță/timp=viteză))” [6].

Din punct de vedere al analizei comportamentale a ciclului de mers se regăsesc următoarele tipuri de analize:

- Analiza spațio-temporală se referă la măsurarea și analizarea parametrilor ce țin cont de timp și distanță din ciclul de mers (descrise anterior).
- Analiza cinematică se referă la măsurarea și analizarea unghiurilor în articulații și a mișcărilor din timpul mersului (de exemplu flexia genunchiului sau a șoldului).
- Analiza cinetică se referă la analiza și măsurarea forțelor și a torsiunilor existente în momentul mersului [6].

Pe lângă aceste analize, în studiul de față se vor introduce analizele distribuției forțelor plantare și înregistrările video ale ciclului de mers [7]. Prin analiza mersului se urmăresc următoarele aspecte biomecanice:

- **Distribuția presiunii** pe suprafața plantară a piciorului în diferite faze ale ciclului de mers. Aceste informații ajută la identificarea zonelor de înaltă presiune (de exemplu, sub călcâi sau capetele metatarsiene), distribuția uniformă pe picior sau dacă există zone de dezechilibru.
- **Puncte de presiune de vârf:** identificate în timpul diferitelor faze ale ciclului de mers. Prin cuantificarea acestor valori, medicii pot determina dacă există zone de presiune localizată care pot fi asociate cu patologia piciorului sau mecanica anormală a mersului.
- **Încărcarea dinamică:** Analiza de mers evaluează modelele dinamice de încărcare ale piciorului, inclusiv viteza și magnitudinea forței aplicate în timpul lovirii călcâiului, a midenței, a propulsiei și a fazelor de închidere. Analizând modelele dinamice de

încărcare, clinicienii pot evalua cât de eficient absoarbe piciorul și transferă forțele în timpul mersului și pot identifica anomalii în modelele de încărcare care pot contribui la tulburări musculo-scheletice sau disfuncții de mers.

- **Centrul de presiune (COP):** Analiza de mers calculează centrul traiectoriei de presiune, care reprezintă punctul de aplicare al vectorului de forță de reacție la sol rezultat sub picior. Analiza traiectoriei COP oferă perspective asupra controlului postural, echilibrului și distribuției purtătoare de greutate în timpul mersului, ajutând clinicienii să evalueze stabilitatea și să detecteze abaterile de la modelele normale ale COP.
- **Simetria mersului:** Analiza mersului evaluează simetria distribuției forței plantare între înregistrările de pe picioarele stâng și drept. Un dezechilibru în distribuția forței plantare între membre poate indica modele asimetrice de încărcare sau mecanisme compensatorii datorate patologiei musculo-scheletice sau anomaliilor de mers.

Înregistrarea ciclului de mers trebuie realizată cu atenție de aceea în referința [7] se prezintă o serie de măsuri relativ simple care pot fi luate pentru a asigura înregistrări video de bună calitate pentru uz clinic: calitatea luminii, dimensiunile (în mersul normal lungimea pasului este 80% din înălțimea omului, iar raportul dintre înălțime și lățime unei imagini video convenționale este de 3:4), aranjarea camerei (trebuie poziționată perpendicular pe planul de interes) și să stea drept și în aceeași poziție pentru toate înregistrările.

Modelul conceptual propus pentru sistemul de fata si metodologia aplicata

Sistemul propus în acest articol are următoarele obiective principale:

- Obținerea mai multor date dintr-o singură măsurătoare;
- Realizarea oricăror tipuri de măsurători (sistemul poate fi utilizat în varianta completă sau pe module);
- Să se poată realiza aceleași măsurători pe diferiți subiecți fără modificarea sistemului;
- Să nu fie limitat de conexiuni;
- Realizarea înregistrărilor video pentru identificarea parametrilor cinematici;
- Realizarea modulelor de măsurare a parametrilor.

1) Realizarea înregistrărilor video pentru identificarea parametrilor cinematici:

Înregistrarea video (Fig. 1) pentru identificarea parametrilor cinematici se realizează utilizând sistemul Contemplas (un sistem care transformă înregistrările 2D ale mișcării în imagini 3D în vederea analizei mișcărilor). Acestea se vor efectua prin intermediul celor 3 camere video cu radiație vizibilă pentru un mers normal, cu markeri reflectorizanți care vor fi aplicați pe punctele de interes pentru respectiva măsurătoare. Analiza datelor se va face cu ajutorul aplicației software dedicate (TEMPLO Analysis) sau a unei variante gratuite (Kinovea) pentru obținerea parametrilor spațio-temporali și cei cinematici.

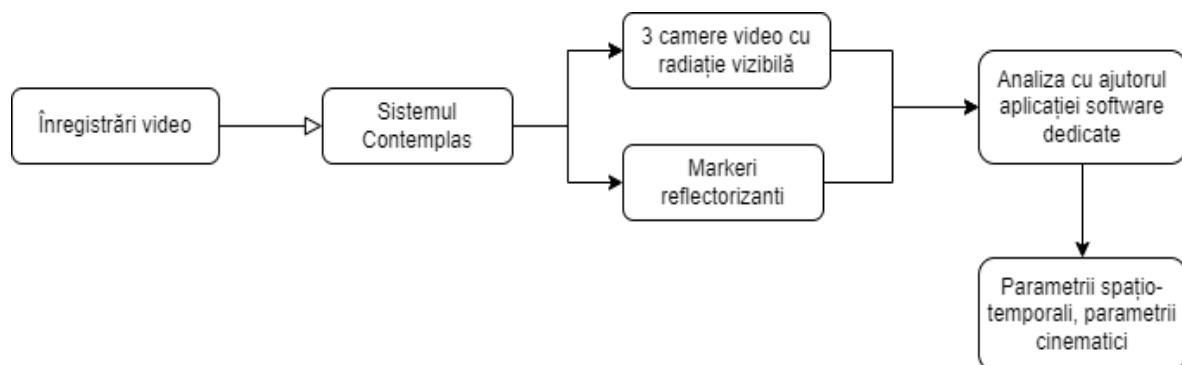


Figura 1. Diagrama identificării parametrilor cinematici

2) Realizarea modulelor de măsurare a parametrilor:

În cadrul acestui sistem se vor realiza două module de măsurare și anume, un modul de tip branțuri (descriș în Fig. 2) și un modul atașat la genunchi (descriș în Fig. 3).

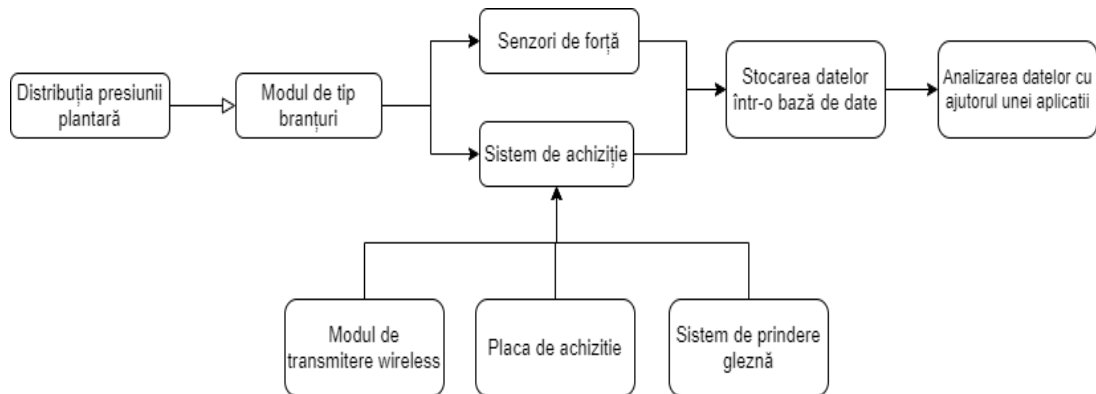


Figura 2. Diagrama modului de tip branț

Analiza distribuției plantare ne oferă informații esențiale pentru determinarea stării de echilibru, puncte de presiune în timpul ciclului de mers și determinarea centrului de presiune precum și traiectoria acestuia. Pentru aceasta se realizează un modul de tip branț care să conțină senzori de forță dispuși pe întreaga talpă și un sistem de achiziție montat pe gleznă pentru a facilita libertatea de mișcare. Sistemul va transmite datele în mod wireless pe computer unde se vor stoca într-o baza de date din care se vor analiza ulterior datele obținute.

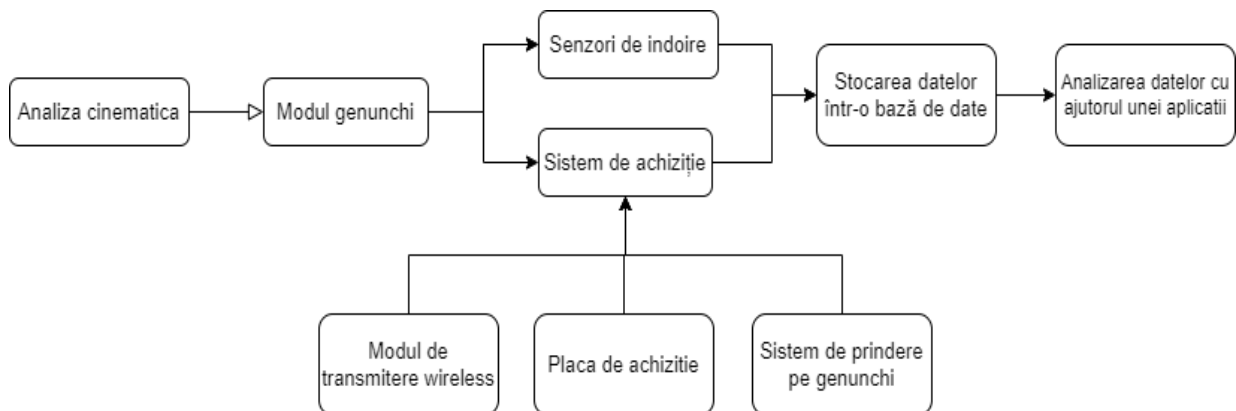


Figura 3. Diagrama modului pentru genunchi

Analiza cinematică se referă la măsurarea și analizarea unghiurilor din articulații și mișcarea membrilor în timpul mersului. Pentru a realiza acest lucru în cadrul sistemului propus, se realizează un modul care se montează pe genunchi și care va fi compus din senzori (de îndoire) și un sistem de achiziție. Sistemul transmite datele care se stochează într-o bază de date din care se vor analiza ulterior cu ajutorul unui software.

Concluzii

Datele care se pot obține din înregistrările obținute cu ajutorul acestui sistem vor fi comparate pentru validare cu valorile obținute cu sistemul RSScan (un sistem fix care înregistrează presiunea plantară pe o lungime de 2 m) și cu cele obținute din studiile din literatura de specialitate. De asemenea, datele vor fi stocate într-o bază de date de înregistrări în care se vor trece ulterior și rezultatele obținute în urma analizei. Totodată s-a inițiat realizarea unei aplicații software de analiză a datelor obținute cu ajutorul sistemului realizat.

Se poate concluziona faptul că sistemul este unul flexibil (se pot face orice fel de măsurători), versatil (dintr-o măsurare se obțin mai multe date), rezultatele sunt comparabile cu cele din literatura de specialitate, reproductibil (se poate folosi la mai mulți subiecți), wireless (nu este limitat de conexiuni).

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SPORIREA CALITĂȚII SERVICIILOR MEDICALE PRIN SISTEM FUNCȚIONAL DE EVALUARE A CONFORMITĂȚII

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Rezumat: Pentru ca în sistemul de sănătate din Republica Moldova să fie realizat obiectivul de bază, și anume îmbunătățirea sănătății cetățenilor, sunt necesare resurse financiare și resurse umane calificate. Pe lângă cele menționate, este fundamental să fie implementat un management eficient al dispozitivelor medicale, pentru asigurarea cu dispozitive medicale calitative, sigure și eficiente, care să ducă la utilizarea corectă a dispozitivelor medicale și la randamentul maxim, reducerea/evitarea incidentelor cu implicarea dispozitivelor medicale și eficientizarea mijloacelor financiare. Prin ce va putea fi asigurat un nivel înalt al securității și performanțelor dispozitivelor medicale, care să garanteze siguranța pacientului și a utilizatorului, dar și creșterea calității actului medical.

Cuvinte cheie: dispozitive medicale, sistem de evaluare periodică, proceduri specifice de verificare, organisme de evaluare a conformității, management a dispozitivelor medicale.

Introducere

Experiența internațională ne demonstrează că implicarea resurselor necesare și implementarea unui management eficient al dispozitivelor medicale, sporesc performanța dispozitivelor medicale.

Eficientizarea sistemului de management al dispozitivelor medicale trebuie să fie în raport cu bunele practici internaționale, precum și în conformitate cu cerințele actuale ale instituțiilor medicale din sistemul de sănătate. În așa fel încât să fie garantată durabilitatea dispozitivelor medicale. Respectiv, pentru ca dispozitivele medicale să fie durabile, este necesar de a asigura un nivel înalt al conformității parametrilor de electrosecuritate și a parametrilor de performanță. Respectiv, este primordial să existe un sistem funcțional de evaluare periodică a conformității dispozitivelor medicale.

Drept rezultat, sistemul de evaluare periodică a conformității dispozitivelor medicale împreună cu managementul eficient al dispozitivelor medicale, duc nemijlocit la creșterea calității serviciilor medicale, precum și la sporirea siguranței pacientului și a utilizatorului.

Evaluarea periodică a conformității dispozitivelor medicale, la nivel internațional și național

Analizând evoluția sistemului de verificări periodice a dispozitivelor medicale din Republica Moldova, începând din 1977 până în 2018, dispozitivele medicale erau privite drept mijloace de măsurare și respectiv, erau supuse obligatoriu controlului metrologic legal, conform legii, începând de la Legea/1864 pentru adoptarea sistemului metric de măsuri și greutate, după care, Legea metrologiei nr. 647-XIII din 17.11.1995, și până astăzi, Legea metrologiei nr. 19 din 04.03.2016.

Experiența internațională ne demonstrează că pentru dispozitivele medicale se efectuează verificări periodice prin încercări de către laborator. Iar încercările de laborator în diferite țări, precum Italia, Franța, Olanda, România, Japonia, Elveția, Germania se efectuează de către laborator acreditat la standardul ISO/CEI 17025, conform Fig. 1.

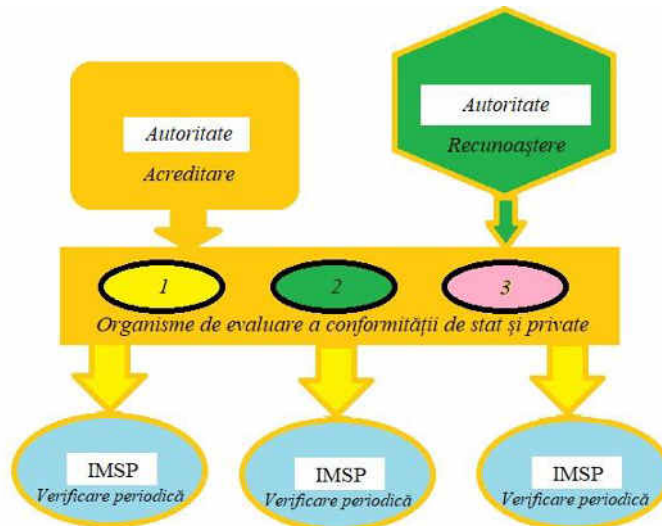


Figura 1. Modelul 1 practicat la nivel internațional

Totodată, la nivel internațional, verificări periodice prin încercări, sunt efectuate cu bioinginerii locali și echipamentele/instrumentele proprii de testare, conform Fig. 2.

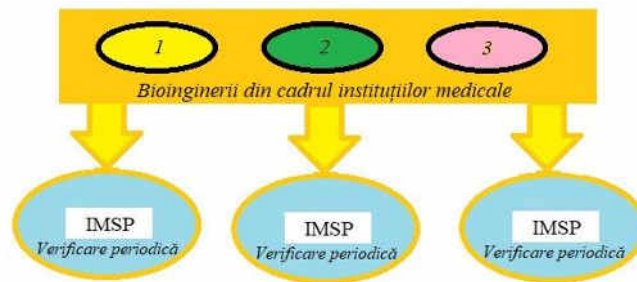


Figura 2. Modelul 2 practicat la nivel internațional

Întru atingerea scopului propus și anume implementarea sistemului de evaluare periodică a conformității dispozitivelor medicale în Republica Moldova, am cercetat și studiat, pe de o parte, verificarea metrologică care era aplicată în Republica Moldova, precum și în țările din fosta URSS, iar pe de altă parte experiența internațională în tot ceea ce înseamnă verificare periodică prin încercări de laborator.

Respectiv, s-a constatat că verificarea metrologică presupune doar măsurare și nu prevede de fapt încercare și testare a parametrilor de performanță și securitate, de funcționalitate și de control a alarmelor, ceea ce se aplică în cazul verificării periodice prin încercări de laborator, la baza căreia stau metodele din standardele dispozitivelor medicale, care se aplică integral la producerea acestora.

Verificarea periodică prin încercări de laborator, fiind de fapt modalitatea prin care se poate asigura un nivel corespunzător al parametrilor de securitate și performanță a dispozitivelor medicale.

De exemplu, verificarea metrologică la un electrocardiograf, în cazul verificării metrologice, presupunea doar verificarea nivelului de zgomot, care era măsurat, colectând datele de pe hârtia termoelectrică, conform Fig. 3 și Fig. 4. Cunoscând, totodată, că diferite electrocardiografe și software-uri, pot utiliza combinații diferite de filtre pentru a reduce zgomotul, cum ar fi: filtrul de frecvență, filtrul de zgomot de linie de bază, (zgomotele constante, cum ar fi cele generate de sursa de alimentare electrică, 50 Hz), filtrul de zgomot muscular, filtrul de zgomot de mișcare, filtrul de tip notch și filtrul de derivare.

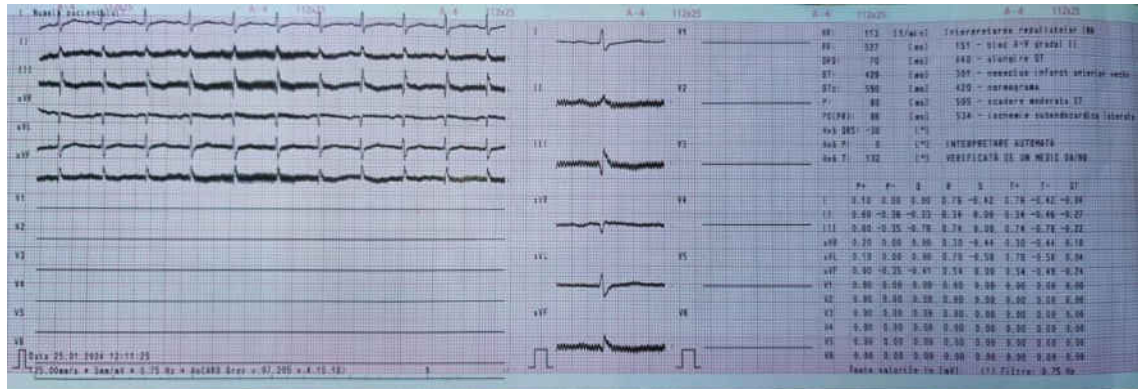


Figura 3. ECG cu zgomot

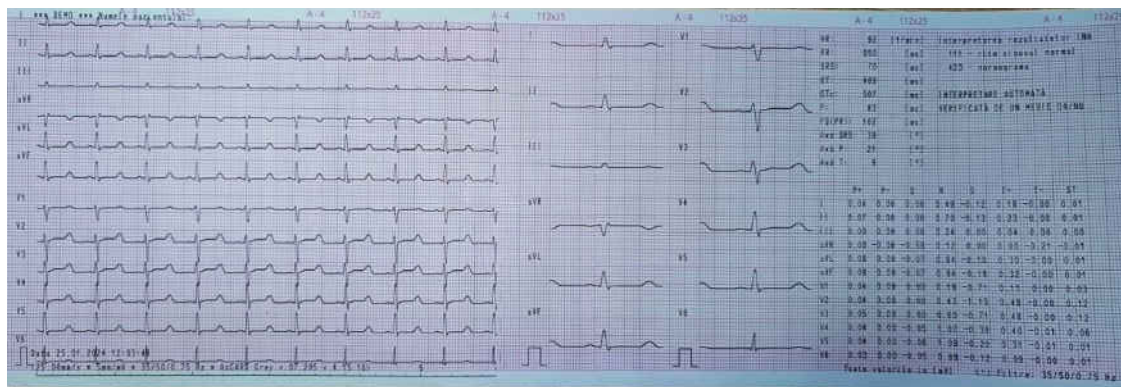


Figura 4. ECG fără zgomot

Conceptul de verificare periodică a conformității dispozitivelor medicale, devenit sistem funcțional în Republica Moldova

În context, urmare studiilor și cercetărilor realizate, am elaborat conceptul de verificare periodică a dispozitivelor medicale utilizate în sistemul de sănătate al Republicii Moldova, și anume ca verificările periodice să fie realizate de către organisme de inspecție, care sunt organisme de evaluare a conformității de stat și private, conform Fig. 5.

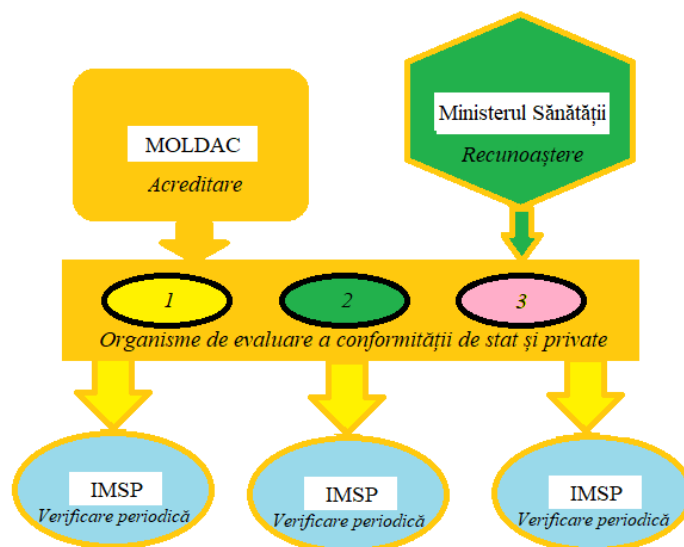


Figura 5. Conceptul de verificare periodică a dispozitivelor medicale

Astfel, pentru ca organismele de evaluare a conformității să fie admise la efectuarea verificărilor periodice a dispozitivelor medicale, acestea trebuie să fie acreditate conform prevederilor Legii nr. 235/2011 privind activitățile de acreditare și evaluare a conformității. Totodată, acestea trebuie să fie ulterior recunoscute de către autoritatea din domeniu, care este Ministerul Sănătății.

Conceptul propus a fost considerat ca fiind cea mai viabilă opțiune și respectiv, a fost acceptat pentru aprobare. În baza acestuia, a fost elaborat mecanismul privind verificarea periodică a dispozitivelor medicale, care a fost aprobat prin Hotărârea Guvernului nr. 966 din 14 noiembrie 2017, pentru aprobarea Regulamentului privind verificarea periodică a dispozitivelor medicale puse în funcțiune și aflate în utilizare.

Ulterior, pentru instituirea sistemului de evaluare periodică a conformității dispozitivelor medicale, a fost necesară determinarea noilor metode de verificare periodică a dispozitivelor medicale care să ia în calcul raportul cost-eficiență și să asigure îndeplinirea setului minim de încercări nedistructive conform prevederilor standardului, dar în același timp să garanteze un nivel înalt al performanțelor și securității dispozitivelor medicale.

Au fost studiate standardele pentru 29 de tipuri de dispozitive medicale din Anexa la HG 966/2017. Drept urmare au fost stabilite metodele de verificare periodică a parametrilor de securitate generală, de securitate electrică și a parametrilor de performanță, iar în baza acestora au fost elaborate procedurile specifice de verificare periodică a dispozitivelor medicale.

Spre exemplu, la același electrocardiograf, comparativ cu verificarea metrologică (unde era verificată doar prezența zgomotului), în cadrul verificării periodice prin încercări de laborator, doar la parametrii de performanță au fost stabilite mai multe metode, precum: determinarea erorii relative la măsurarea tensiunii; determinarea caracteristicii amplitudine – frecvență; determinarea erorii relative la măsurarea vitezei de înregistrare; determinarea erorii relative la setarea sensibilității și determinarea constantei de timp.

În baza metodelor stabilite, pentru toate 29 tipuri de dispozitive medicale din Anexa la HG 966/2017, au fost elaborate și aprobate procedurile specifice de verificare periodică, prin Ordinul Ministerului Sănătății, Muncii și Protecției Sociale nr. 30 din 12 ianuarie 2018.

Mai cu seamă, s-a reușit crearea, aprobarea și implementarea unui sistem nou și funcțional de evaluare periodică a dispozitivelor medicale, astăzi fiind aplicabil cadrul normativ integral pentru a putea efectua astfel de verificări periodice a dispozitivelor medicale, la nivel național.

Concluzii

Sistemul de verificare/evaluare periodică a dispozitivelor medicale, este imperial necesar pentru sistemul de sănătate al Republicii Moldova, întru asigurarea utilizării unor dispozitive medicale sigure. Începând din 2018, mecanismul de verificare periodică a dispozitivelor medicale este aplicabil și funcțional pentru toate instituțiile medicale. Totodată, acesta poate fi extins și dezvoltat, în vederea acoperirii și altor tipuri de dispozitive medicale utilizate.

Mulțumiri

În calitate de doctorand, exprim recunoștință și mulțumiri pentru suportul și îndrumarea oferită de către dl Șonțea Victor, dr., prof. univ., conducător al tezei de doctor.

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EVALUAREA PERFORMANȚEI ORTEZELOR FUNCȚIONALE DE GENUNCHI CU SISTEMUL BIOPAC

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Rezumat. Studiul actual își propune să evalueze eficacitatea ortezelor funcționale de genunchi, omologată și prototip; utilizând un sistem avansat de măsurare a accelerațiilor, numit sistem BIOPAC. Accelerometrele sunt poziționate la jumătatea segmentelor anatomice, gambă și coapsă, spre evaluarea și compararea accelerațiilor pe cele trei axe.

Studiul a fost efectuat pe un subiect care s-a deplasat pe o distanță de 2 m, iar ortezele au avut 2 grade active, în timpul deplasării, anume 30° , respectiv 60° .

Rezultatele preliminare indică diferențele de accelerații dintre orteza funcțională de genunchi omologată și cea prototip, în ceea ce privește nivelul de stabilitate, mobilitate și confortul oferit subiectului. În plus, analiza datelor oferite de sistemul BIOPAC, arată diferențele în modelul de mișcare și redistribuire a forțelor exercitate la nivelul articulației genunchiului în timpul locomoției.

Concluziile acestui studiu sunt esențiale spre dezvoltarea ulterioară a unei orteze de genunchi prototip și oferă o evaluare obiectivă a performanței sale în comparație cu modelele omologate. În acest context, utilizarea sistemului BIOPAC demonstrează eficacitate și utilizarea sa spre îmbunătățirea dispozitivelor ortopedice.

Cuvinte cheie: accelerații, BIOPAC, orteză, genunchi, omologat, prototip

Sistemul BIOPAC

Pentru a determina variații ale accelerațiilor liniare ale membrului inferior, s-a utilizat sistemul BIOPAC, identificat în Fig. 1.



Figura 1. Sistemul BIOPAC

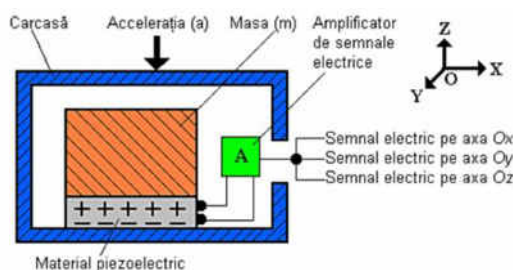


Figura 2. Accelerometru DA100C [1]

Sistemul BIOPAC prezintă componentele: unitate centrală MP150, un modulator de semnale HLT100C, un modul universal de interfață UIM100C, trei module de amplificatoare DA100C și două accelerometre TSD109C.

Unitatea centrală MP150 reprezintă cea mai importantă componentă a sistemului BIOPAC, deoarece are drept scop convertirea semnalelor analogice, provenite de la dispozitivele de măsurare aferente sistemului BIOPAC, în semnale digitale ce pot fi apoi procesate și reprezentate grafic de către calculator. Modulator de semnale HLT100C este un modul al sistemului de măsurare BIOPAC ce realizează interfața între dispozitivele de măsurare aferente sistemului

BIOPAC. Modulul UIM100C este un modul de interfață între dispozitivele de măsurare aferente sistemului BIOPAC și unitatea centrală MP150. Amplificatorul DA100C (Fig. 2) este un dispozitiv diferențial de amplificare (cu un factor de amplificare de 50, 200, 1000, 5000) a semnalelor provenite de la dispozitivele de măsurare aferente sistemului BIOPAC. Accelerometrul tip TSD109C este un traductor electric de înaltă precizie, din gama sistemelor de măsurare BIOPAC, ce este utilizat pentru determinarea simultană a accelerațiilor liniare, de până la ± 5 g, ale segmentelor anatomiche pe axele O_x , O_y și O_z [1].

Orteze funcționale de genunchi

Orteza funcțională de genunchi reprezintă dispozitivul care ajută în timpul locomoției și mișcărilor necontrolate la nivelul articulației genunchiului, prin reducerea translației anterioare anormale a tibiei în raport cu femurul [2].

Evaluarea performanței ortezelor s-a realizat prin compararea valorilor accelerațiilor liniare, în timpul purtării unei orteze funcționale de genunchi omologate (Fig. 3), respectiv, orteza funcțională de genunchi prototip, identificată în Fig. 4.



Figura 3. Orteza funcțională de genunchi omologată



Figura 4. Orteza funcțională de genunchi prototip

Experimentul propriu-zis. Reprezentarea accelerațiilor liniare

Pentru a identifica accelerațiile liniare la nivelul membrului inferior, în timpul utilizării unei orteze funcționale de genunchi și pentru a compara eficient valorile acestea, s-au utilizat două accelerometre, aceștia au fost poziționați la jumătatea segmentului coapsă, respectiv, jumătatea segmentului gambă (Fig. 5).



Figura 5. Poziționarea accelerometrelor

În primă etapă a experimentului, subiectul a purtat orteza funcțională de genunchi omologată și s-a deplasat pe o distanță de 2 metri. Orteza de genunchi a fost activă pe unghiurile 30° și 60° . În a doua etapă a experimentului, subiectul a purtat orteza funcțională de genunchi prototip, pe aceeași distanță și cu aceleași unghiuri active.

Accelerațiile liniare au fost înregistrate pe cele trei axe, Ox, Oy și Oz.

În Fig. 6 este reprezentat graficul de variație a accelerației liniare la nivelul membrului inferior, segmentul anatomic coapsă, în timpul purtării ortezei funcționale de genunchi omologate (OFGO), unghiul activ de 30°. În Fig. 7 se observă graficul accelerațiilor liniare pe cele 3 axe, pe gambă.

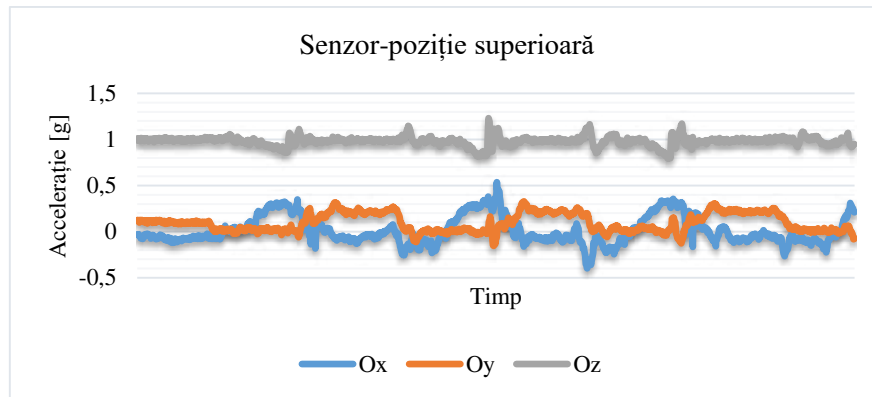


Figura 6. Accelerații liniare- OFGO- 30° - senzor pe coapsă

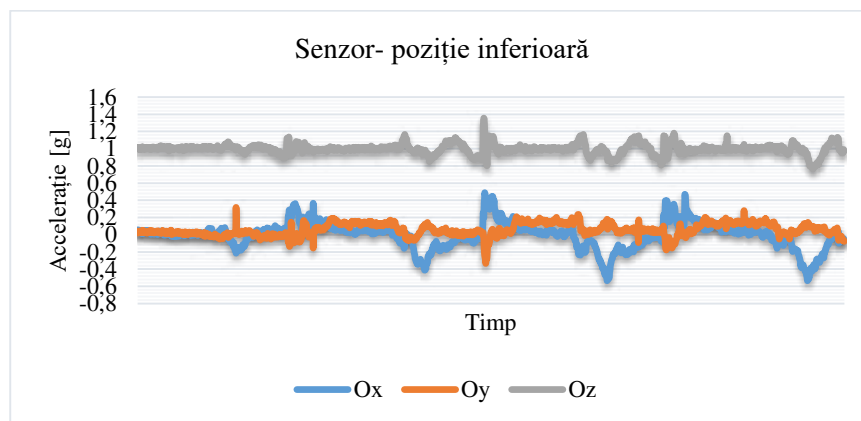


Figura 7. Accelerații liniare- OFGO- 30° - senzor pe gambă

Pentru a compara cele două orteze funcționale, s-a realizat graficul accelerațiilor liniare pentru orteza funcțională de genunchi prototip (OFGP), cu unghi activ de 30°; în Fig. 8, este reprezentat graficul cu accelerațiile înregistrate de senzorul poziționat pe coapsă, iar în Fig. 9, accelerațiile înregistrate pe gambă.

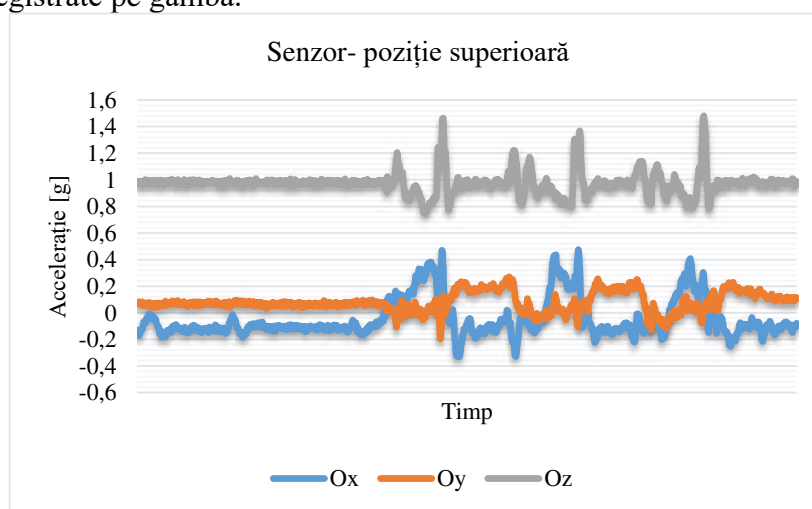


Figura 8. Accelerații liniare- OFGP- 30° - senzor pe coapsă

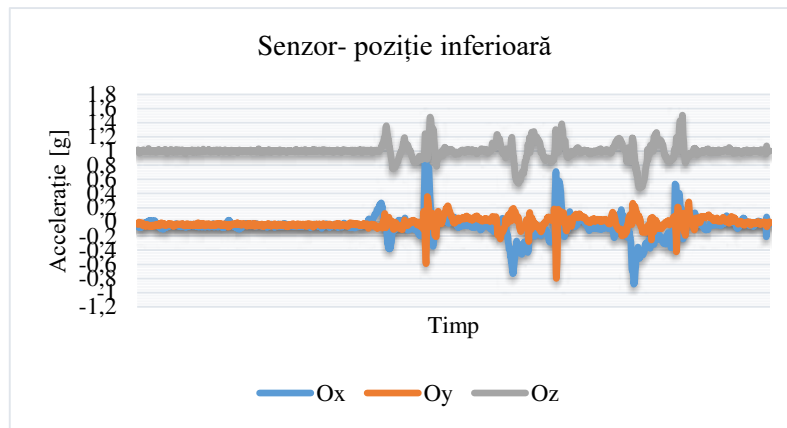


Figura 9. Accelerații liniare- OFGP- 30° - senzor pe gambă

A doua parte a experimentului s-a realizat utilizând cele două orteze funcționale de genunchi, cu unghiul activ de 60°. S-au realizat grafice pentru a reprezenta accelerațiile liniare; în Fig. 10, este reprezentat graficul cu accelerațiile liniare în timpul utilizării ortezei funcționale de genunchi omologate (OFGO), atunci când senzorul este poziționat pe coapsă, apoi în Fig. 11, se poate observa graficul pentru accelerațiile înregistrate de senzorul poziționat pe gambă.

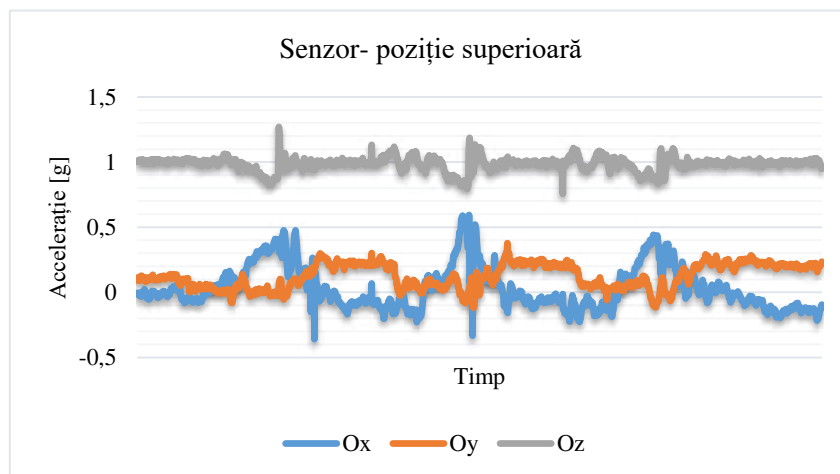


Figura 10. Accelerații liniare- OFGO- 60° - senzor pe coapsă

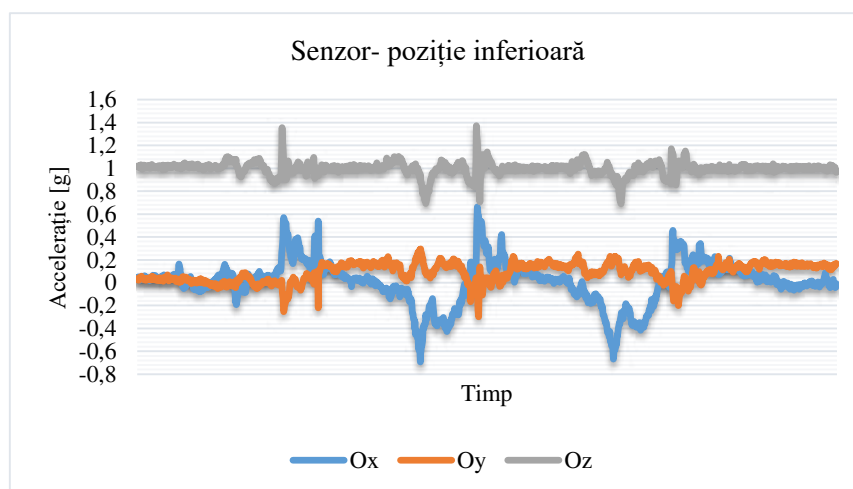


Figura 11. Accelerații liniare- OFGO- 60° - senzor pe gambă

S-au realizat grafice pentru identificarea accelerațiilor liniare, pe coapsă și gambă, atunci când a fost utilizată o orteză funcțională de genunchi prototip (OFGP) , cu un unghi activ de 60°, conform Fig. 12 și Fig. 13.

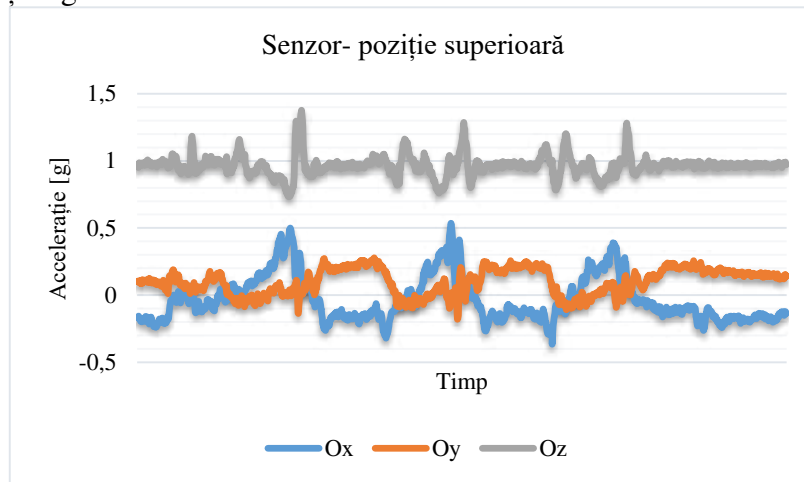


Figura 12. Accelerații liniare- OFGP- 60° - senzor pe coapsă

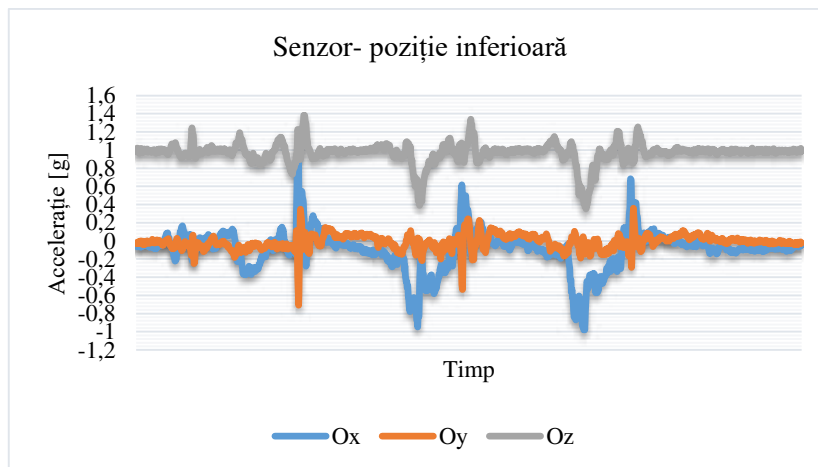


Figura 13. Accelerații liniare- OFGP- 60° - senzor pe gambă

În finalul analizei s-au comparat accelerațiile liniare pe fiecare axă, când unghiul activ al ortezelor funcționale este de 60°. În Fig. 14, este reprezentată comparația accelerațiilor liniare pe axa Ox, la cele două orteze funcționale, apoi în Fig.15, este reprezentat graficul de comparație a accelerațiilor liniare pe axa Oy și în Fig. 16, este graficul pentru accelerațiile liniare identificate pe axa Oz.

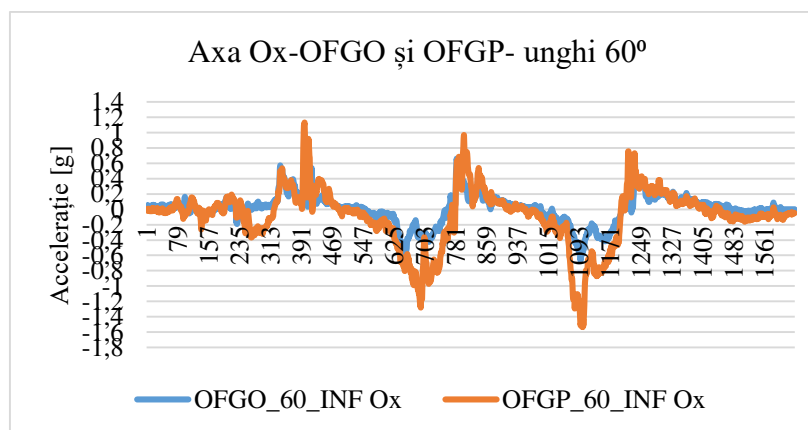


Figura 14. Accelerații liniare- comparație- axa Ox- unghi 60°

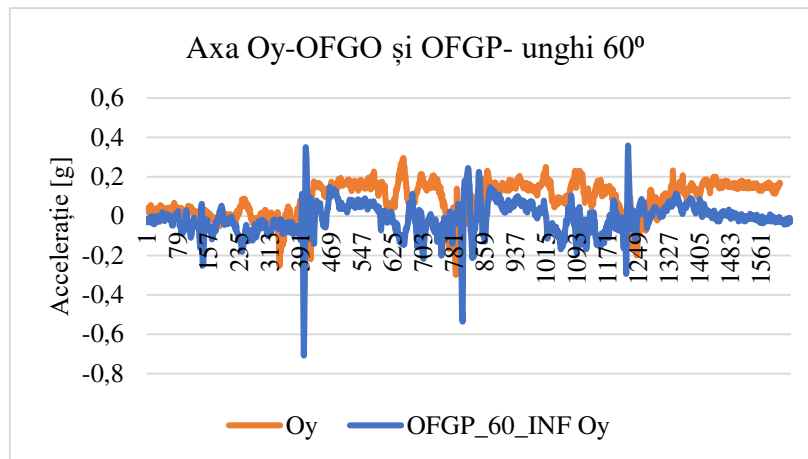


Figura 15. Accelații liniare- comparație- axa Oy- unghi 60°

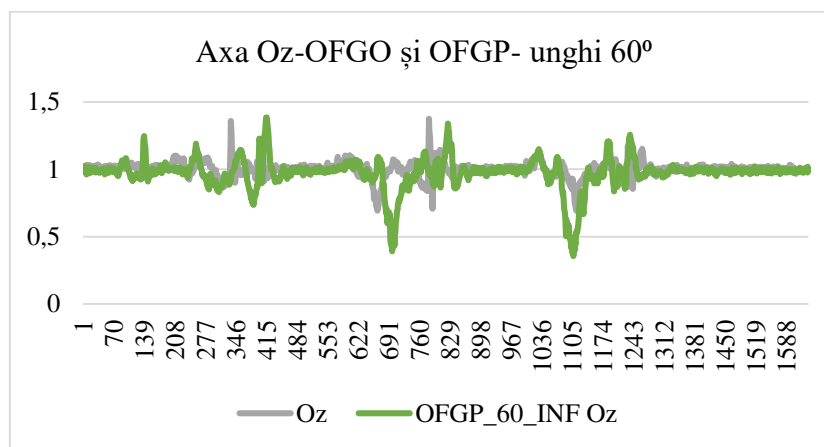


Figura 16. Accelații liniare- comparație- axa Oz- unghi 60°

În urma celor 3 grafice de mai sus, se poate observa, că nu există variații mari ale accelerațiilor liniare, în timpul utilizării ortezei funcționale de genunchi omologate, față de cea prototip.

Concluzii

Utilizarea sistemului BIOPAC demonstrează eficacitatea sa în evaluarea obiectivă a performanței ortezei de genunchi prototip în comparație cu modelul omologat, prin achiziția accelerațiilor liniare.

Studiul arată că nu există diferențe semnificative la nivelul accelerațiilor liniare înregistrate. În concluzie, orteza funcțională prototip prezintă un potențial de a îmbunătăți performanța și confortul pacientului în timpul utilizării ei.

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ROLUL PERSONALIZĂRII TRATAMENTULUI HIPERTENSIUNII ARTERIALE

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Rezumat. *O preocupare în tratamentul hipertensiunii arteriale este complianța și atingerea valorilor țintă, fapt ce impune abordarea personalizată. Scopul lucrării este de a arăta rolul personalizării tratamentului hipertensiunii arteriale. Materiale și metode: au fost analizate rezultatele studiilor publicate în anii 2022-2023 în bazele de date PubMed și Google Scholar ce au comparat răspunsul antihipertensiv la tratamentul standart și cel personalizat. Au fost identificate 2 studii. Primul s-a bazat pe personalizarea genotip-ghidată a tratamentului ce a demonstrat o scădere a TAs cu $3,52 \pm 11,72$ mmHg vs. $0,92 \pm 9,14$ mmHg tratament standart, TAd cu $2,44 \pm 11,78$ mmHg vs. $1,56 \pm 8,50$ respectiv, rezultând o rată de control a TA cu 4,9% mai mare la cei cu tratament personalizat. Al doilea studiu a comparat tratamentul standart cu cel personalizat conform unui algoritm bazat pe caracteristicilor individuale a pacienților, demonstrând o scădere cu $14,22 \pm 0,5$ mmHg mai mare a TAs în grupul personalizat, fiind cu 77,57% mai bun decât cel standart. În concluzie putem spune că tratamentul hipertensiunii arteriale cere o abordare personalizată complexă datorită eficienței și acceptabilității superioare a metodei.*

Cuvinte cheie: *tratament personalizat, hipertensiunea arterială esențială.*

Introducere

Fiind definită prin valori tensionale sistolice mai mari de 140 mmHg și/sau diastolice mai mari de 90 mmHg, prevalența hipertensiunii arteriale la nivel global în 2015 se estimase la 1,15 miliarde, dintre care 150 milioane în Europa centrală și de Est [1]. Se prezice că până în 2025 să ajungă la 1,56 miliarde cazuri [2]. Tot în 2015 tensiunea arterială sistolică mai mare de 140 mmHg a fost stabilită ca principalul contributor al deceselor ce puteau fi prevenite, fiind responsabilă de 7,8 milioane (14% din toate decesele) cazuri în lume, 41% din acestea fiind asociate cu patologia cardiovasculară care este reprezentată în 40,1% de boala coronariană ischemică, iar în 40,4% cazuri de boli cerebrovasculare (38,1% AVC ischemic și 42,5% AVC hemoragic) [3].

Importanța tratamentului antihipertensiv este evaluată într-o metaanaliză a studiilor clinice ce a arătat că scăderea cu doar 10 mmHg a tensiunii arteriale sistolice sau cu 5 mmHg a tensiunii arteriale diastolice duce la o scădere cu ~20% a tuturor evenimentelor cardio-vasculare majore, cu ~10-15% a mortalității de orice cauza, cu ~35% a accidentelor vasculare cerebrale, cu ~20% a evenimentelor coronariene și cu ~40% a insuficienței cardiace [1].

Conform datelor din 2010, în țările economic dezvoltate, hipertensiunea arterială afectase 28,5% din populație, din care 67% aveau diagnosticul stabilit, din ei doar 55,6% urmau tratament, iar atingerea valorilor țintă era doar în 51,1% din cei tratați [4]. În țările sărace și cele în curs de dezvoltare situația a fost mai gravă, 31,5% din populație fiind afectată, din aceștia 37,9% cunoșteau de prezența hipertensiunii, 29% din ei urmau tratament, iar valorile țintă erau atinse în doar 26,6% [4]. Eficiența tratamentului hipertensiunii este influențată de prescrierea unei combinații de medicamente în doze adecvate și aderența pacientului la tratamentul prescris [5]. Recomendațiile ghidurilor sunt generale și lasă la discreția clinicienilor decizia de a alege un anumit preparat pentru tratamentul hipertensiunii [6]. Abordarea personalizată sau de precizie poate fi utilizată în alegerea aceluia preparat și dozarea ce va avea cel mai bun efect antihipertensiv, evitarea preparatelor cu risc de efecte adverse sau fără efect [7]. Medicina personalizată se bazează

pe studiile genomice, epigenomice, transcriptomice, proteomice, metabolomice și farmacogenomice [8]. Farmacogenomica studiază impactul informației genetice al individului asupra răspunsului la medicație în baza informațiilor studiilor farmacogenetice a genelor ce influențează farmacocinetica medicamentelor, divizând persoanele în dependență de tipul de metabolizator sau care modulează farmacodinamia medicamentelor, influențând efectul final al substanței active în direcție pozitivă sau negativă [11, 12]. Evoluția tehnologiilor de secvențiere și accesibilitatea în țările economic dezvoltate precum China, au permis utilizarea acestora în diagnosticul și tratamentul precoce al diferitor afecțiuni precum tumori maligne, defecte congenitale, boli psihiatrice și dereglări metabolice genetice la copii [11]. Tehologia *Next-generation sequencing* are avantajul interogării numeroaselor ținte de ordinul sutelor sau miilor, chiar și milioanele în procesul de secvențiere a ADN-ului cromosomal, mitocondrial și ARN-ului, fiind posibilă secvențierea întregului genom într-o singură analiză și într-un timp relativ scurt, ceea ce îi oferă un mare potențial de aplicare în condiții clinice fiind detectate variante/mutații utilizate în diagnostic, prognoză, decizie terapeutică și evaluarea în dinamică a pacienților oferind noi oportunități medicinei personalizate [12].

Scopul studiului este de a arăta rolul personalizării tratamentului hipertensiunii arteriale.

Materiale și metode

Au fost accesate bazele de date PubMed și Google Scholar, fiind căutate studiile publicate în 2022-2023, ce au comparat răspunsul la tratamentul personalizat și cel practic-ghidat al hipertensiunii arteriale.

Rezultate

În bazele de date accesate majoritatea publicațiile din ultimii ani studiază farmacogenomica variantelor alelice a genelor ce influențează variabilitatea răspunsului terapeutic cât și implicarea în apariția reacțiilor adverse. Aceste studii permit identificarea preparatelor sau grupele de preparate ce au cel mai bun raport efect antihipertensiv/reacții adverse conform portajului unui anumit biomarker, fiind indispensabile pentru aplicarea principiilor medicinei personalizate.

Probabil primul studiu clinic ce a comparat eficacitatea tratamentului personalizat genotipic-ghidat și cel ghidat de experiența clinică (standart) s-a desfășurat în China, în perioada 2017-2018, având 660 participanți repartizați în grupul experimental și grupul de control în raport 3:1 [13]. Genele studiate în cadrul studiului dat au fost 7 locusuri polimorfice (CYP2D6*10, ADRB1, CYP2C9*3, AGTR1, ACE, CYP3A5*3 și NPPA) ce au influență asupra metabolismului, transportul și ținta medicamentelor din 5 grupe principale de antihipertensive (inhibitori ai enzimei de conversie, blocații receptorilor de angiotenzină, beta-blocante, blocații canalelor de calciu și diuretice) [13]. Tratamentul administrat în grupul experimental a fost ajustat conform portajului biomarkerilor genetici, în monoterapie sau tratament combinat, pe parcursul a 4 săptămâni [13]. În grupul de control tratamentul administrat timp de 4 săptămâni a fost indicat de un medic desemnat ce s-a condus de recomandările *Ghidului pentru prevenția și tratamentul hipertensiunii în China 2010* [13]. Cercetătorii au utilizat monitorizarea ambulatorie 24h a tensiunii arteriale înainte și după intervenție. Rezultatele studiului au arătat o scădere a tensiunii arteriale sistolice cu $3,52 \pm 11,72$ mmHg și diastolice cu $2,44 \pm 11,78$ mmHg în grupul experimental, iar în grupul de control tensiunea arterială sistolică a scăzut cu doar $0,92 \pm 9,14$ mmHg, iar tensiunea diastolică cu $1,56 \pm 8,50$ mmHg [13]. Rata de control a tensiunii arteriale în grupul experimental a fost cu 4,9% mai mare comparativ cu grupul de control [13].

Un alt studiu, unul retrospectiv ce a avut ca obiectiv structurarea unui model capabil să genereze un tratament personalizat bazat pe profilul individual al fiecărui pacient, utilizând datele demografice, semnele vitale, istoricul medical și înregistrările testelor clinice anterioare [14]. Cercetătorii au prezis viitorul răspuns al tensiunii arteriale sistolice utilizând datele anamnestic și răspunsul la tratament a pacienților ce au caracteristici similare [14]. Au fost comparate 4 modele

(DRLR informed KNN- *Distributionally Robust Linear Regression K-Nearest Neighbor*, OLS informed KNN- *Ordinary least square regression K-Nearest Neighbor*, LASSO- *Least Absolute Shrinkage and Regression Operator regression* și CART- *Classification and Regression Trees*) ce au utilizat Înregistrările Electronice a Sănătății a Centrului Medical din Boston, de unde au fost extrase informațiile a 432 096 vizite valide efectuate de 42 752 pacienți pe parcursul anilor 2012-2020 și care au administrat tratament antihipertensiv în monoterapie cu 7 tipuri de medicamente (inhibitori ai enzimei de conversie, blocanții receptorilor de angiotenzină, beta-blocante, blocanții canalelor de calciu, diuretice de ansă, diuretice tiazidice și antagoniștii receptorilor mineralocorticoizilor) [14]. Astfel modelul DRLR KNN a fost cel mai efectiv prin scăderii tensiunea arteriale sistolice cu $14,22 \pm 0,5$ mmHg, ceea ce este cu 70,30% mai efectiv comparativ cu răspunsul la tratamentul standart. Acest model este cu 7,08% mai efectiv comparativ cu al doilea cel mai bun model (OLS-informed KNN) [14]. Cercetătorii au stabilit top 10 cei mai importanți factori ce au corelat pozitiv cu tensiunea arterială sistolică prezisă, și anume: tensiunea arterială sistolică curentă, saturația cu oxigen, tensiunea arterială pe parcursul a două perioade anterioare, vârsta, tensiunea arterială diastolică curentă, neutrofile (%), lățimea distribuției eritrocitare, limfocitele (%), pulsul [14].

Concluzii

Sunt puține studii ce compară direct eficacitatea tratamentului personalizat și cel standart al hipertensiunii arteriale, fiind limitate la loturi mici din populația unei anumite regiuni geografice. Variabilitatea răspunsului antihipertensiv fiind influențat de numeroși factori genetici, comportamentali, caracteristici antropometrice, antecedentele heredocolaterale și alți determinanți, necesită o abordare personalizată complexă ce promite:

- obținerea unor valori tensionale mai mici chiar din primele zile de tratament;
- atingerea valorilor țintă într-un număr mai mare de cazuri;
- micșorarea numărului de medicamente administrate;
- scăderea riscului de apariție a reacțiilor adverse;
- creșterea aderenței la tratament și ratei de control.

Implementarea noilor tehnologii de secvențiere a ADN-ului va permite identificarea noilor locușuri ce influențează răspunsul la tratamentul hipertensiunii arteriale.

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МЕТОДЫ ИНСТРУМЕНТАЛЬНОЙ РЕАБИЛИТАЦИИ ЛИЦ С РАССТРОЙСТВАМИ АУТИСТИЧЕСКОГО СПЕКТРА В РЕСПУБЛИКЕ МОЛДОВА

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Аннотация. Аутизм сегодня является глобальной проблемой, затрагивающей и Республику Молдова. Несмотря на отсутствие официальной статистики в Молдове, специалисты специализированных государственных медико-социальных учреждений и неправительственных общественных организаций констатируют рост новых случаев заболевания. По данным ООН, в мире насчитывается 70 миллионов человек с диагнозом "аутизм". По степени функциональности люди, страдающие расстройствами аутистического спектра, делятся на два типа: те, кто способен общаться с обществом и жить продуктивно, и те, кто имеет тяжелые нарушения и нуждается в пожизненной поддержке и уходе. Диагностикой, реабилитацией и лечением аутизма в Молдове занимаются государственные и негосударственные учреждения, опираясь на международный опыт. Специалисты отмечают дефицит и низкое разнообразие в стране средств и приспособлений, активно используемых в поведенческой терапии. Не хватает всего спектра приборов, коммуникаторов, специализированных планшетов, программного обеспечения на румынском и русском языках. Данное направление, адаптация зарубежных разработок и их совершенствование представляют собой перспективное направление для исследований и работы в области биомедицинской инженерии.

Ключевые слова: аутизм, биомедицинская инженерия, медицина, реабилитация, РАС.

Введение

Аутизмом также называют аутистическое расстройство, детский аутизм, инфантильный аутизм. Расстройство аутистического спектра является комплексным состоянием, которое характеризуется спектром трудностей во взаимодействии в социуме. Состояние характеризуется следующими группами признаков: социально поведенческие, ограниченные или повторяющиеся действия, эхолалия, стимулы, физические и физиологические [1].

Не существует единой формулировки термина «аутизм». В 1911 году он был впервые использован швейцарским психиатром Эйгеном Блейлером для обозначения симптома у взрослых больных, «Autismus», страдающих шизофренией, который проявляется в виде ухода человека от внешней реальности в мир собственных фантазий. В. П. Осипов определял аутизм как «разобщенность больных с внешним миром» [2]. В. А. Гиляровский рассматривал его как своеобразное нарушение сознания самого «я» и всей личности, нарушение адекватных установок к окружающему миру. Автор подчеркивал, что больные аутизмом замкнуты и отчуждены от всего остального мира [3]. Состояние, на сегодняшний день известное как аутистическое расстройство, детский аутизм или инфантильный аутизм (все три термина означают одно и то же), было впервые описано в

1943 году доктором Лео Каннером. Первые исследования распространения, или эпидемиологии, аутизма были проведены в 1960-х годах [4].

Долговременное широкое использование термина «аутизм», включающее шизофрению, отсутствие единого подхода к диагностированию сопровождается разногласиями в оценке и при использовании методов реабилитации. Это характерно не только для Республики Молдова, но в целом для международного опыта. Причины расхождений в единой оценке – широкий спектр расстройств, сопровождаемый разнообразием форм проявления. Параллельно идут развитие диагностики и реабилитации. Этого требует масштабность распространения аутизма.

Согласно данным ООН, в мире насчитывается 70 миллионов человек с диагнозом аутизм. В Республике Молдова постановкой диагноза занимается Общественная организация “SOS-autism”. Обобщенной системной статистики по республике на данный момент не существует. Расстройство аутистического спектра регистрируется у одного ребенка из 36 в (возрасте 8 лет). У мальчиков аутизм встречается в среднем в 3,8 раза чаще, чем у девочек. Вероятность развития умственной неполноценности у страдающих аутизмом девочек выше, чем у мальчиков [5].

Методы исследования

В работе изучаются и анализируются зарубежные и национальные подходы к диагностированию и реабилитации в области аутизма. Исследователями применяются методы сравнительного анализа и интервью с практикующими специалистами государственных медицинских и социальных учреждений, неправительственных общественных организаций.

Вероятные причины возникновения аутизма

Факторы риска появления аутизма являются спорным моментом среди исследователей. Ни одна из версий не получила на данный момент научного подтверждения. Предполагается, что ими могут быть: генетический фактор (наследственность, синдром Мартина — Белл, либо мутации в течение жизни), внешние - факторы изменения окружающей среды, комплексные вакцины, качество питания, другие - зрелый возраст родителей, патологически низкий вес плода, потребление женщинами во время беременности фолиевой кислоты и так далее [6]. Результаты учёных из Johns Hopkins University представили результаты исследования, согласно которым уровень фолиевой кислоты повышает риск развития аутизма более чем в 17 раз [15].

Согласно степени функциональности, люди, страдающие особенностями аутистического спектра, делятся на два типа: обладающие полной самостоятельностью, способные коммуницировать с обществом и продуктивно существовать и люди с тяжелой формой инвалидности, которые нуждаются в пожизненной поддержке и уходе (синдром Каннера, синдром Аспергера, синдром Ретта, атипичный аутизм) [4].

Диагностирование

Точное диагностирование позволяет определить наиболее эффективные методы реабилитации и при необходимости лечения. Оба этапа тесно взаимосвязаны, реабилитация и лечение являются хронологическим продолжением диагностирования.

В случае диагностирования ребенка оно включает в себя первоначальное заполнение опросника педиатром (семейным врачом) вместе с родителями. Рекомендуются посещения врача-педиатра для наблюдения в возрасте 9, 18 и 30 месяцев. Дети, которые появились на свет из-за преждевременных родов или недоношенными могут попадать в группу риска и для этого могут потребоваться дополнительных исследований на 18 и 24 месяце жизни [7].

Для обследования взрослого пациента в зависимости от его состояния в качестве респондента выступает он сам либо его близкие. Легкие формы могут не диагностироваться

в детстве и протекать незаметно во взрослом. В случае очевидных проблем с социализацией, приводящих ко вторичной социофобии, тревожным расстройствам, депрессии, ПТСР (Посттравматическое стрессовое расстройство) необходимо обращение к специалистам для разработки схемы реабилитации. взаимоотношения с окружающими (социализация, приобретение разнообразных навыков, построение близких или дружеских отношений) [8].

Тесты, применяемые при диагностировании аутизма, являются унифицированными на международном уровне: M-CHAT-R (Modified Checklist for Autism in Toddlers, Revised), ASSQ, ADI-R, ADOS. Следующее - клиническая оценка со стороны врача-психиатра [9].

Реабилитация

Аутизм предполагает изменение образа жизни, постоянное применение разных форм реабилитации. Задачи реабилитации: минимизация негативных и атипичных поведенческих проявлений у пациента путем самоконтроля, эмоциональное и интеллектуальное развитие, выявление способностей, социализация, настройка коммуникации с окружающими, при необходимости медикаментозное вмешательство.

Лечения, в стандартном его понимании, от аутизма не существует. Медикаментозная терапия включает в себя введение препаратов в обиход пациента с РАС для улучшения концентрации (аналептики), для снижения чрезмерной тревоги или активности (антидепрессанты), препараты, помогающие при судорогах, нейрометаболические стимуляторы и другие не менее важные медикаменты [10]. Основное внимание при реабилитации отводится поведенческой терапии. Она направлена на решение ключевых проблем аутизма, таких как отсутствие социализации и коммуникации, отсутствие эмоций, невозможность концентрации внимания, неоднократное повторение не характерных для рядового человека действий. Методики поведенческой терапии постоянно совершенствуются, появляются новые направления. Наиболее известными и распространенными из них являются: эрготерапия, АВА-терапия (англ. Applied Behavior Analysis), ТЕАССН [11].

Средства, приборы и устройства при проведении поведенческой терапии

Это сенсорные игрушки, световые проекторы с изображениями, музыкальные инструменты с эффектом шума [12], машины для обнимания, устройства для эрготерапии.

Для налаживания коммуникации низкофункциональных пациентов с окружающими при реабилитации используются следующие средства и приборы: PECS (коммуникационная система обмена картинками), планшеты с приложениями для ААС (дополняющей и альтернативной коммуникации), специальные клавиатуры [13]. Eye-tracker (ай-трекер) [14]. Путем фильтрации и расчетов устройство определяет положение взгляда.

Комплексный подход в работе к стереотипии осуществляется при помощи сенсорных комнат. Их действие включает в себя разные формы стимуляции: визуальную, слуховую, обонятельную, вкусовую, тактильную, проприоцептивную, кинезиотерапевтические методы. При выборе методов реабилитации и используемых приборов необходимо придерживаться результатов диагностики и добиваться поставленных целей, при этом оставляя возможность оперативной коррекции программ и применения новых методов и разработок.

Выводы

В Республике Молдова специализированная реабилитация аутистов проводится неправительственными организациями, отдельные элементы введены в работу государственных и региональных медицинских и социальных центров. В них используются небольшое число средств, приборов и устройств. Специалисты этих учреждений указывают

на дефицит таких аппаратов в республике. Как недостаток планшетов-коммуникаторов, так и недостаток программ для приложений-коммуникаторов – отсутствие переведенных на румынский и русский языки. Данное направление, адаптация зарубежных разработок, их усовершенствование и разработка новых устройств представляют собой перспективное направление для исследований и работ в области биомедицинской инженерии. Данная работа является теоретической базой для дипломных разработок авторов исследования.

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INSIGHTS INTO THE LUMINESCENCE PROPERTIES OF A DINUCLEAR Eu^{3+} COORDINATION COMPLEX

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Abstract: We report the photoluminescent (PL) properties of a dinuclear Eu(III) complex when subjected to UV excitation. The PL spectra of coordination compound $[\text{Eu}(\mu_2\text{-OC}_2\text{H}_5)(\text{btfa})(\text{NO}_3)(\text{phen})]_2\text{phen}$ were investigated on powder samples at room temperature (btfa stands for benzoyl trifluoro acetone and phen denotes 1,10-phenanthroline). The emission spectra revealed distinctive metal-centred luminescence bands, attributed to internal radiative transitions of the Eu^{3+} ion, specifically ${}^5D_1 \rightarrow {}^7F_j$ and ${}^5D_0 \rightarrow {}^7F_j$ ($j = 0 - 4$). The radiative transition between the non-degenerate states ${}^5D_0 \rightarrow {}^7F_0$ splits into two components. The character of the photoluminescence spectra suggests the europium ions are located in a low-symmetry environment. The actual assignment of the point group symmetry can be made on the basis of XRD measurements. Understanding of the luminescent behaviour will help in development of new Eu(III) coordination compounds, for potential biomedical applications or pure scientific inquiries.

Keywords: Eu(III) ; coordination compound; UV light; PL.

Introduction

The luminescent properties of europium(III) coordination compounds have garnered significant attention, primarily for their utility in practical biomedical applications and fundamental scientific inquiries [1]. These complexes, exhibit vibrant red luminescence characterized by remarkable colour purity and high quantum yield within the visible spectrum. They can be used as spectroscopic probes for structural properties and local symmetry around the Eu(III) ion within the ligand framework [3]. Despite the extensive exploration in this domain, there persists a concerted effort to engineer novel Eu(III) complexes tailored for biomedical and biochemical applications. This study unveils experimental findings on photoluminescence properties of a novel europium(III) coordination complex $[\text{Eu}(\mu_2\text{-OC}_2\text{H}_5)(\text{btfa})(\text{NO}_3)(\text{phen})]_2\text{phen}$. Possible applications of this complex could pertain to the realm of biological systems, facilitating early disease diagnosis and unravelling cellular processes, holding promise for biomedical endeavours.

Experimental details

The synthesis of the $[\text{Eu}(\mu_2\text{-OC}_2\text{H}_5)(\text{btfa})(\text{NO}_3)(\text{phen})]_2\text{phen}$ coordination complex followed previously outlined procedures [2]. Photoluminescence (PL) emission spectra were collected with a resolution 0.125 nm, employing diverse excitation sources. Commonly a Hamamatsu photomultiplier module H9319-12, operating in photon counting mode, and a MDR-23 single grating monochromator were utilized for low-resolution spectra acquisition. Alternatively, for high resolution (2 cm^{-1}) PL emission spectra measurements we employed a double grating spectrophotometer DFS-52. PL excitation was conducted using a Thorlabs laser diode at 375 nm (70 mW power) L375P70MLD.

Photoluminescence spectrum of Eu complex

The photoluminescence spectra of the powdered samples were recorded at room temperature employing the excitation source emitting at 375 nm, aligning closely with the compound's peak absorption wavelength. The PL emission spectra display (Figure 1) characteristic luminescence bands originating from the Eu^{3+} ions internal radiative transitions, specifically ${}^5\text{D}_1 \rightarrow {}^7\text{F}_j$ ($j = 0-3$) and ${}^5\text{D}_0 \rightarrow {}^7\text{F}_j$ (where j ranges from 0 to 4). The primary emission bands stem from the radiative transitions between the first excited ${}^5\text{D}_0$ level and the ${}^7\text{F}_j$ (where j ranges from 0 to 4) manifold [3].

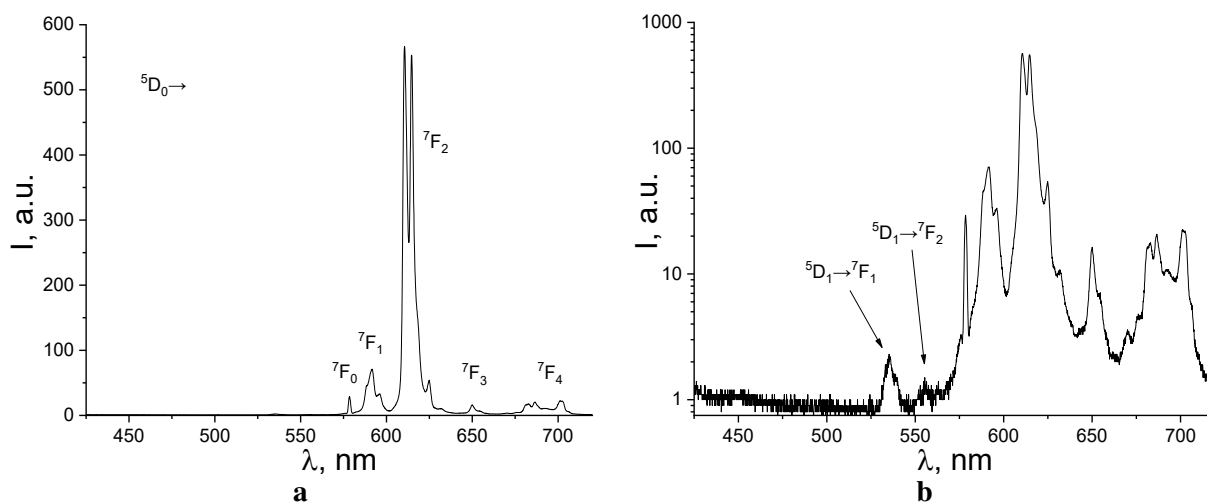


Figure 1. PL emission spectrum of the powder sample: (a) linear scale; (b) logarithmic scale.

The dominant emission band in the luminescence spectrum is determined by the electric dipole transition ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$ of the Eu^{3+} ion, that occurs at about 612 nm which is well-known to be hypersensitive to the local symmetry of the lanthanide ion. The distinct red colour of the compound emission is related to this specific transition.

The intricate structure of the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$ transition is distinctly discernible, primarily dictated by the molecular electric field generated by the influence of the ligand on the degenerate ${}^7\text{F}_2$ level of the Eu^{3+} ion, as outlined in reference [4].

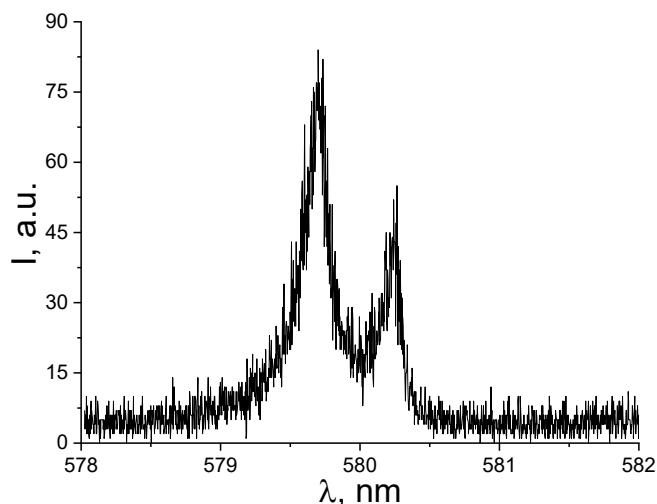


Figure 2. High-resolution PL emission spectrum of the transition ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$.

The ultra-narrow emission band at ca 580 nm is determined by transition ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$, which is forbidden according to the standard Judd–Ofelt theory [3]. Registration of more than one component in the spectrum of ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$ band suggests that more than one emitting site is present in the $\text{Eu}(\text{III})$ complex. This however, does not allow to determine the exact number of Eu^{3+} sites.

In order to verify the number of components in the ${}^5D_0 \rightarrow {}^7F_0$ transition (Figure 1), the PL emission spectrum was registered with high resolution (2 cm^{-1}). The high-resolution spectrum of the ${}^5D_0 \rightarrow {}^7F_0$ transition, confirms the presence of two components in this band, which supports the model of dinuclear complex.

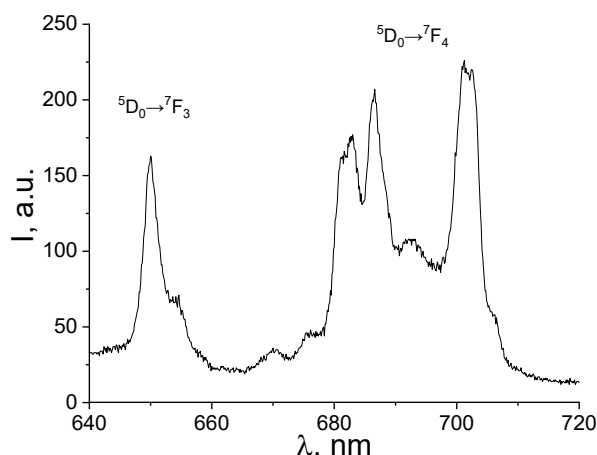


Figure 3. PL emission spectrum of the transitions ${}^5D_0 \rightarrow {}^7F_3$ and ${}^5D_0 \rightarrow {}^7F_4$, under excitation 375 nm.

Notably, the electric dipole transition ${}^5D_0 \rightarrow {}^7F_2$ exhibits significantly greater intensity compared to the magnetic dipole transition ${}^5D_0 \rightarrow {}^7F_1$. This feature presumes the non-centrosymmetric placement of the Eu^{3+} . The multiplicity of components observed in the transitions ${}^5D_0 \rightarrow {}^7F_j$ (where j spans from 0 to 4) is intricately linked to the symmetry of the crystal field surrounding the $\text{Eu}(\text{III})$ ion [3].

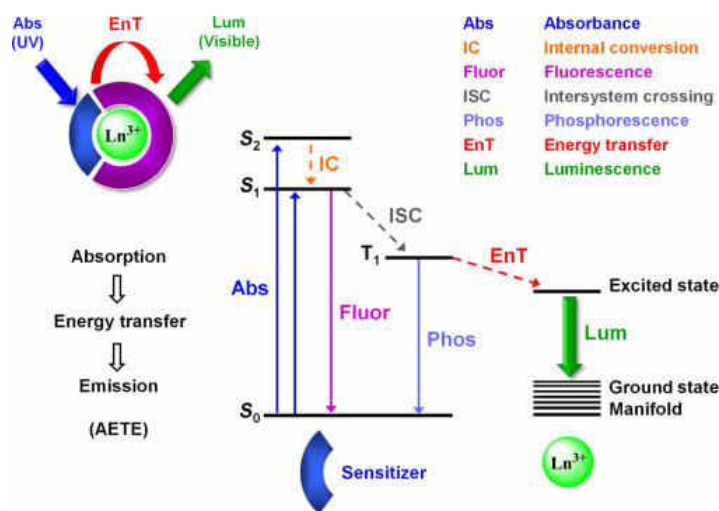


Figure 4. Jablonski diagram of energy transfer mechanism [5].

The energy transfer mechanism in lanthanide compounds during photoluminescence, involving transfer of absorbed energy from organic ligands to $\text{Eu}(\text{III})$ ions, is commonly referred to as the "antenna effect". Essentially, when exposed to UV or near-UV radiation, the organic ligands undergo excitation from their ground singlet state (S_0) to the first excited singlet state (S_1) (Figure 4). Subsequently, the excitation energy shifts from the S_1 state, through intersystem crossing to the triplet state (T_1), and ultimately to the Eu^{3+} ion, leading to the radiative emission from the states 5D_0 and 5D_1 . Notably, the detection of the transition ${}^5D_0 \rightarrow {}^7F_0$ may be an indicator of a low symmetry complex, as far as this particular transition is typically not observable in other symmetries except C_{nv} , C_n or C_s symmetries [4].

Conclusion

The studied complex exhibits strong luminescence under UV excitation (375 nm), which indicates on its good potential for practical applications. For instance, these applications could pertain to the realm of biological systems, facilitating early disease diagnosis and also some unravelling cellular processes. The straightforwardness and affordability of the excitation method rely on employing a cost-effective laser.

The character of PL emission spectra indicates on the existence of two Eu^{3+} emitting centres in the dinuclear coordination compound. The actual assignment of the structural properties of the complex can be made on the basis of XRD measurements.

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ELABORAREA ELECTROCARDIOGRAFULUI PORTABIL CU FUNCTIA DE ÎNREGISTRARE ȘI AFIȘARE A DATELOR

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Rezumat. *Electrocardiograful este un dispozitiv medical utilizat pentru înregistrarea și evaluarea activității electrice a inimii, generând o electrocardiogramă care oferă informații despre ritmul cardiac și posibilele anomalii ale acestuia. În lucrare se proiectează un electrocardiograf portabil și software-ul pentru controlul acestuia. Se expun specificațiile tehnice ale dispozitivului, conform documentației specifice a circuitelor integrate utilizate în urma cărora ca rezultat este proiectată placheta cu cablaj imprimat pentru dispozitivului. Se oferă o prezentare a posibilităților software-ului pentru prelucrarea și înregistrarea semnalului recepționat utilizând filtre de tip hard și soft. Noutatea lucrării o reprezintă portabilitatea și capacitatea dispozitivului de a monitoriza și înregistra semnalele ECG a pacientului. Această monitorizare durează o perioadă îndelungată în timp real, astfel atât medicul poate vizualiza rezultatele obținute în cabinetul său cât și pacientul în afara cabinetului în timp real. Datele colectate se înregistrează pe un dispozitiv de stocare a memoriei cu dimensiuni reduse, ce ulterior se conectează în calculator și datele respective sunt prelucrate și analizate de personalul medical.*

Cuvinte cheie: ECG, portabil, dispozitiv medical.

Introducere

Electrocardiografia (ECG) este o metodă de diagnostic care este utilizată pentru a evalua funcționarea inimii prin înregistrarea activității electrice a mușchiului cardiac [1]. Un electrocardiograf portabil este un dispozitiv medical care măsoară și înregistrează activitatea electrică a inimii unei persoane în timp real. În timpul achiziționării unui semnal ECG, electrozii care sunt atașați de piele în regiunea pieptului, brațe și picioare înregistrează semnalele electrice generate de inimă în timpul funcționării sale. Aceste semnale sunt înregistrate sub forma unui grafic care poate fi analizat de un medic pentru a identifica anomalii ale ritmului cardiac, prezența bolilor de inimă și a altor afecțiuni. Un ECG este unul dintre principalele instrumente în cardiologie pentru diagnosticarea și evaluarea sănătății cardiace.

ECG-urile portabile pot fi utile în cazurile în care este necesară monitorizarea activității cardiace pentru o lungă perioadă de timp sau în mod regulat pentru a detecta anomalii precum aritmii sau alte tulburări cardiace. Monitoarele ECG portabile oferă de obicei posibilitatea de a salva date și apoi de a le transfera unui medic pentru analiză și interpretare. Această tehnologie poate fi deosebit de utilă pentru monitorizarea stării inimii la pacienții cu probleme cardiace sau cu risc de a le dezvolta.

Partea tehnică

Conceptul acestui dispozitiv este de a crea un electrocardiograf portabil, astfel încât să fie ușor de utilizat, compact și, în cazul unei posibile defecțiuni, funcționarea acestuia poate fi ușor

restabilită. Astfel, părțile componente de bază sunt prezentate în figura 1, și anume: modulul amplificator cu potențial biologic AD8232 [2], microcontrolerul Arduino NANO [3], modulul OLED [4], modulul Micro SD Reader [5] și RTC3121 [6]. Mediul de lucru utilizat pentru a elabora circuitul cu un cablaj imprimat este EasyEDA [7], care reprezintă un mediu de lucru cu acces liber. Aceasta furnizează o gamă largă de instrumente pentru proiectarea și testarea circuitelor, permițând utilizatorilor să creeze și să simuleze scheme electronice, să proiecteze plăci de circuit imprimate (PCB) și să colaboreze cu alți utilizatori în procesul de proiectare.

Amplificatorul cu potențial biologic AD8232 este un amplificator instrumental analog dezvoltat de Analog Devices [2], special conceput pentru a măsura semnalele bioelectrice, cum ar fi cele provenite de la ECG. Așa tip de dispozitiv este frecvent utilizat în aplicații medicale și de monitorizare a sănătății pentru a detecta și amplifica semnalele electrice generate de activitatea cardiacă.

Microcontrolerul Arduino Nano este o placă de dezvoltare bazată pe microcontroler, similară cu celelalte plăci Arduino [3], dar cu dimensiuni fizice mai mici. Această placă este proiectată pentru a fi compactă și ușor de integrat în proiecte electronice.

Ecranul OLED (Organic Light-Emitting Diode) cu numărul de model SSD1306 128×64 de 0.96 inch [4] este un tip de afișaj cu diode electroluminiscente organice, care are o rezoluție de 128x64 pixeli și o dimensiune fizică de 0.96 inch.

Un modul de adaptor pentru card Micro SD este un dispozitiv care permite utilizarea unui card Micro SD (Secure Digital) într-un sistem electronic sau proiect [5]. Acest modul facilitează conexiunea și interacțiunea cu cardurile de memorie Micro SD într-un mod controlat și ușor de utilizat.

Circuitul integrat (CI) DS3231 este un circuit dezvoltat de Maxim Integrated, și reprezintă un ceas în timp real (RTC - Real-Time Clock) de precizie [6]. Acest dispozitiv este proiectat pentru a oferi un ceas și un calendar exact, fiind adesea utilizat în aplicații care necesită urmărirea timpului cu o precizie ridicată.

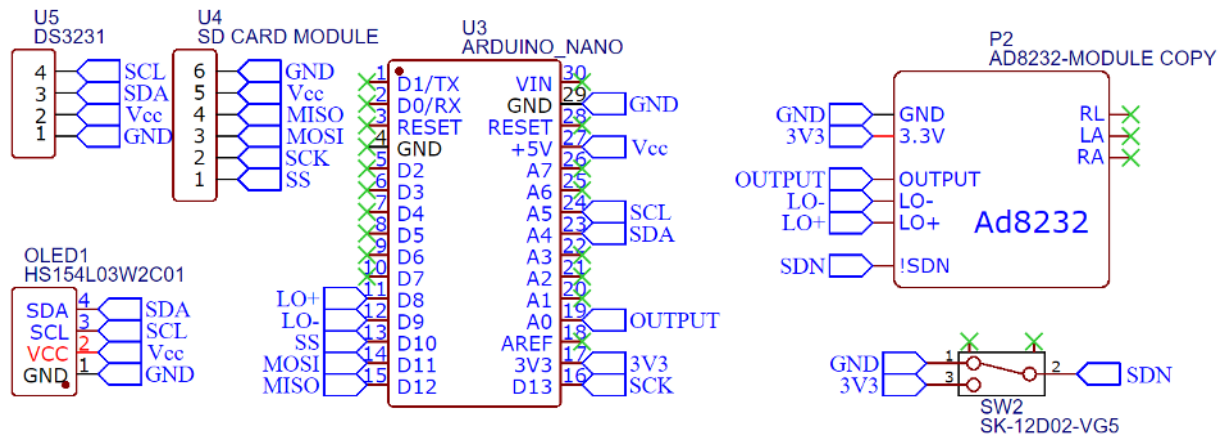
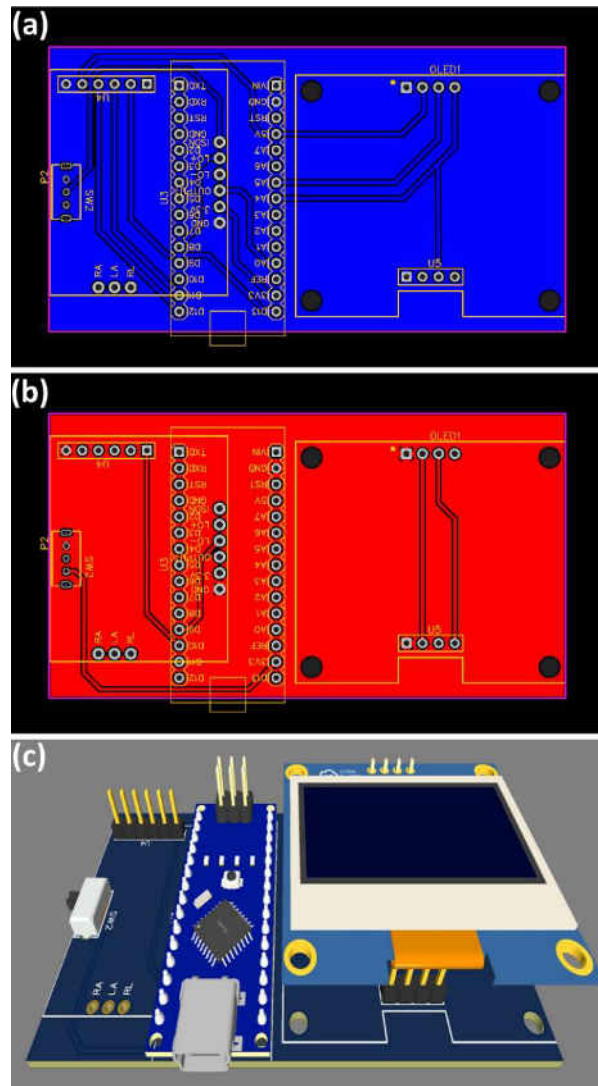


Figura 1. Schema principală a ECG-ului portabil

ECG-ul bazat pe circuitul integrat AD8232 constă din mai multe componente principale. În primul rând, conține trei electrozi: doi pentru a primi semnalul inimii și al treilea pentru a crea un potențial de referință. Acești electrozi sunt conectați la intrările corespunzătoare ale circuitului integrat. Circuitul integrat în sine îndeplinește funcțiile de amplificare și filtrare la nivelul componentelor electronice ale semnalului ECG. Acesta include mai multe amplificatoare și filtre care permite colectarea semnalului ECG curat și amplificat.

Semnalul primit este trimis la microcontrolerul Arduino NANO și trece filtrarea software. Această filtrare constă în utilizarea filtrului median [8] pentru a elimina sau atenua eventualele valori aberante sau impulsuri înregistrate în semnalul primit. După primirea semnalului filtrat, se transmite către afișorul OLED [4] pentru vizualizare și înregistrarea valorilor simultan pe cardul SD [5].



**Figura 2. Imaginea PCB a dispozitivului:
vedere de jos, (b) vedere de sus și (c) imaginea plăcii de bază**

În figura 2 este reprezentat cablajul imprimat din vederile de jos (figura 2a) și sus (figura 2b), precum și modelul 3D a dispozitivului elaborat (figura 2c). Astfel acest dispozitiv are dimensiunile de 80 mm x 45 mm.

Avantajele dispozitivului

Electrocardiografele portabile oferă o serie de avantaje datorită mobilității și ușurinței de utilizare. Portabilitatea lor face posibilă analiza activității cardiace în diferite condiții, inclusiv în locuri cu spațiu limitat sau în situații medicale de urgență. Datorită monitorizării continue, aceste dispozitive permit detectarea aritmii și a altor anomalii cardiace care sunt ratate în timpul testelor de rutină. De asemenea, pacienții se simt mai confortabil în timpul testării în mediul lor normal (condiții casnice). Accesul rapid la rezultate asigură un răspuns prompt al personalului medical la posibile probleme cardiace, ceea ce face ca electrocardiografele portabile să fie un instrument valoros pentru diagnosticarea și monitorizarea bolilor de inimă.

De asemenea, datorită faptului că dispozitivul elaborat este format din module, acesta poate fi reparat sau schimbat cu ușurință într-un timp scurt și readus la starea funcțională pentru a continua monitorizarea ritmului cardiac. De asemenea, datorită consumului redus de energie al circuitului integrat AD8232 [2] autonomia dispozitivului crește, ceea ce permite utilizarea acestuia un timp cât mai îndelungat posibil.

Concluzii

Utilizarea electrocardiografelor portabile bazate pe modulul utilizat în această lucrare este o soluție rentabilă și eficientă în scopuri medicale și științifice. Acest modul oferă măsurări precise și fiabile ale biopotențialelor, inclusiv a semnalelor ECG, precum și un mod simplu de utilizare, miniaturizarea dimensiunilor, consum redus de energie și flexibilitate în configurarea și extinderea funcționalității.

Acest lucru este important pentru crearea de dispozitive compacte și portabile de monitorizare a sănătății care îmbunătățesc disponibilitatea asistenței medicale și oferă condiții mai accesibile și confortabile pacienților și medicilor. În plus, electrocardiografele portabile sunt un instrument valoros pentru diagnosticarea și monitorizarea bolilor de inimă datorită mobilității, ușurinței de utilizare și capacității de a detecta anomalii ale activității cardiace. Capacitatea acestora de a lucra în diferite condiții, inclusiv situații de urgență, le face un element integrant în practica medicală.

În plus, design-ul modular și posibilitatea unei mentenanțe rapide asigură utilizarea pe termen lung și eficiență a dispozitivului. Consumul redus de energie crește autonomia dispozitivului, ceea ce evită necesitatea încărcării frecvente. Această soluție structurează procesul de monitorizare a activității cardiace, o face mai accesibilă și mai convenabilă pentru pacienți și specialiști, reduce costurile și crește eficiența asistenței medicale.

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PACEMAKER SIMULATOR

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Rezumat: Un circuit stimulator cardiac a fost creat utilizând diverse componente electronice disponibile comercial, iar microcontrolerul ATmega328 a servit ca nucleu al întregului sistem. Circuitele stimulatorului sunt clasificate drept oscilatoare de relaxare, generând ieșiri repetitive nesinusoidale și fiind monitorizate printr-un buclaj de feedback. Pentru monitorizarea eficientă a activității electrice a inimii, s-a utilizat un senzor AD8232, care acționează ca un amplificator operațional, furnizând semnale clare și având capacitatea de a conecta semnale suplimentare pentru brațe și picioare. Controlul stimulatorului cardiac și interfața cu AD8232 au fost realizate folosind Arduino Uno, oferind un mediu de programare convenabil în limbajul C++. Asamblarea sistemului a fost realizată pe un breadboard, iar rezultatele testelor au fost vizualizate în Serial Plotter. În plus, pentru utilizarea ulterioară a sistemului în experimente, a fost proiectată o placă de instruire dedicată.

Cuvinte-cheie: Stimulator cardiac, microcontroler ATmega328, senzor AD8232, Arduino Uno.

Introducere

Circuitul stimulator cardiac a fost dezvoltat folosind mai multe componente electronice disponibile comercial. Aceste componente au fost asamblate și integrate ca parte a acestei lucrări. Partea cea mai importantă a sistemului a fost microcontrolerul ATmega328. Microcontrolerul a fost programat în timpul acestei sarcini pentru a calcula și executa procesele necesare.

Circuitele stimulatorului cardiac sunt clasificate ca oscilatoare de relaxare. Aceste oscilatoare produc o ieșire repetitivă nesinusoidală. Ieșirea este menținută și monitorizată folosind un buclaj de feedback.

Oscilatoarele operează în principal prin generarea de frecvențe diferite folosind circuite rezistor-condensator(RC). Acest mod de operare îi diferențiază de circuitele de comunicație, care constau în principal din circuite rezistor-inductor(LC), cunoscute și sub numele de circuite tank [1].

Monitor de ritm cardiac - AD8232

Pentru a monitoriza eficient activitatea electrică a inimii, s-a utilizat un senzor AD8232 (Fig. 1). Monitorizarea ieșirii unui ECG poate fi extrem de zgomotoasă, motiv pentru care implementarea acestui senzor a rezolvat aceste probleme. AD8232 acționează ca un amplificator operațional pentru a asigura un semnal clar primit de la sistem. Placa senzorului oferă, de asemenea, posibilitatea de a conecta semnale suplimentare pentru brațe și picioare. Cu indicatorul LED integrat, timpul necesar pentru depanare a fost redus semnificativ.

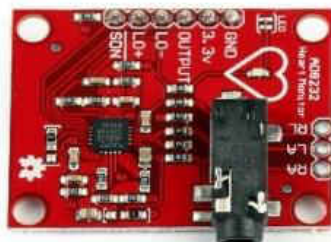


Figura 1. Senzorul AD8232

Arduino Uno

Elementul cheie al întregii lucrări a fost microcontrolerul Atmega328. Microcontrolerul a furnizat lucrării capacitatea de a interfața cu AD8232 de a controla stimulatorul cardiac. ATmega328 a fost programat folosind o placă de dezvoltare Arduino (Fig. 2). Utilizarea Arduino a furnizat un compilator pentru programare în limbaj de nivel înalt, C++. Mai târziu, compilatorul a fost utilizat pentru a monitoriza ieșirile pe serial monitor și serial plotter.



Figura 2. Placă de dezvoltare Arduino Uno

Programarea microcontroller-ului

Microcontrolerul a fost programat folosind o placă de dezvoltare Arduino și software-ul asociat [2]. Codul software utilizat pentru a programa Arduino este atașat (Fig. 3).

```
pacemaker.ino
1  long instance1=0, timer;
2  double hrv =0, hr = 72, interval = 0;
3  int value = 0, count = 0;
4  bool flag = 0;
5  #define shutdown_pin 10
6  #define threshold 100 // to identify R peakss
7  #define timer_value 10000 // 10 seconds timer to calculate hr
8  void setup() {
9      Serial.begin(9600);
10     pinMode(8, INPUT); // Setup for leads off detection LO +
11     pinMode(9, INPUT); // Setup for leads off detection LO -
12 }
13 void loop() {
14     if((digitalRead(8) == 1)|| (digitalRead(9) == 1)){
15         Serial.println("leads off!");
16         digitalWrite(shutdown_pin, LOW); //standby mode
17         instance1 = micros();SS
18         timer = millis();
19     }
20     else {
21         digitalWrite(shutdown_pin, HIGH); //normal mode
22         value = analogRead(A0);
23         value = map(value, 250, 400, 0, 100); //to flatten the ecg values a bit
24         if((value > threshold) && (!flag)) {
25             count++;
26             Serial.println("in");
27             flag = 1;
28             interval = micros() - instance1; //RR interval
29             instance1 = micros();
30         }
31         else if((value < threshold)) {
32             flag = 0;
33         }
34         if ((millis() - timer) > 10000) {
35             hr = count*6;
36             timer = millis();
37             count = 0;
38         }
39         hrv = hr/60 - interval/1000000;
40         Serial.print(hr);
41         Serial.print(",");
42         Serial.print(hrv);
43         Serial.print(",");
44         Serial.println(value);
45         delay(1);

```

Figura 3. Codul Arduino

Asamblarea simulatorului

Partea dată a proiectului a fost realizată prin intermediul unui breadboard și a firelor de conexiune (Fig. 4) cu ajutorul cărora am conectat contactele între AD8232 și microcontrolerul Arduino.

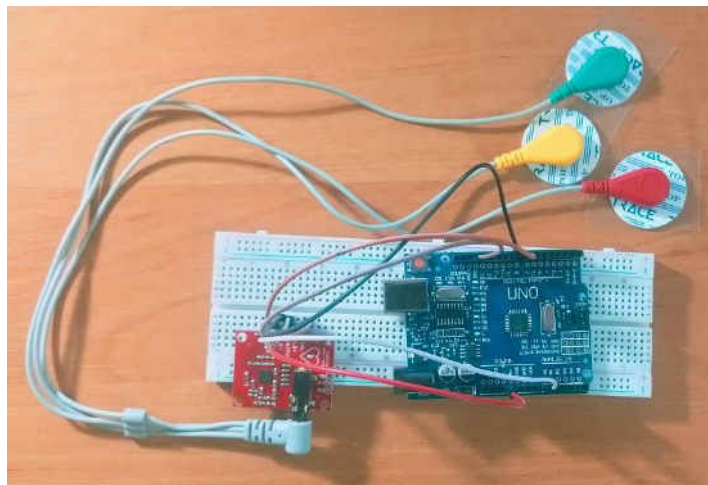


Figura 4. Dispozitivul asamblat

Rezultatele testării

După conectarea elementelor device-ului, rescrierea și testarea codului în aplicația Arduino IDE, putem trece la vizualizarea bătăilor ritmice cardiace în Serial Plotter (Fig. 5).

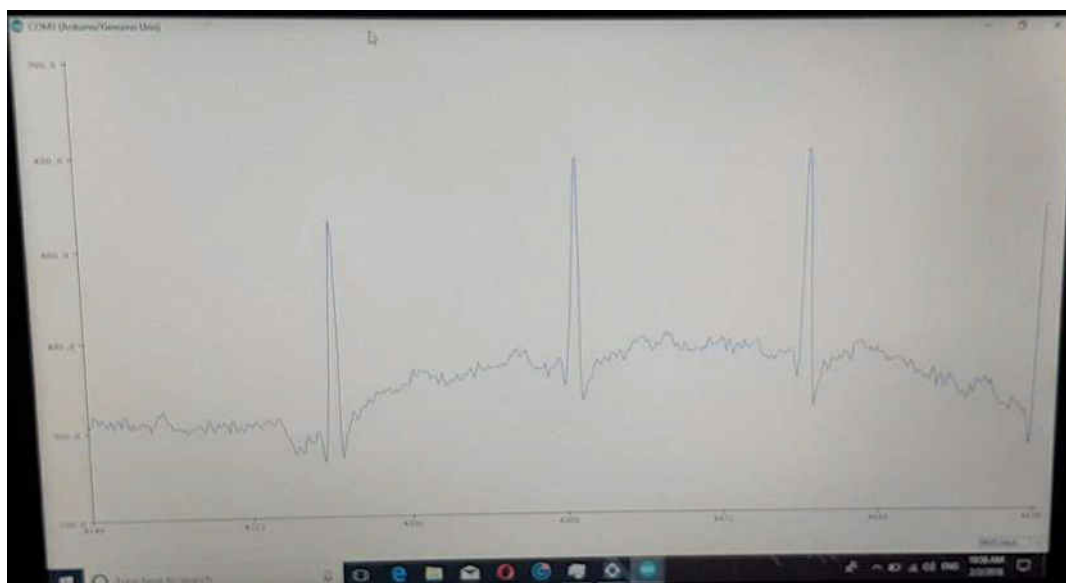


Figura 5. Vizualizarea bătăilor cardiace in Arduino IDE

Proiectarea stand-ului

Pentru a asigura că sistemul poate fi folosit pentru experimente ulterioare, a fost proiectată și dezvoltată un concept de placă de instruire (Fig. 6).

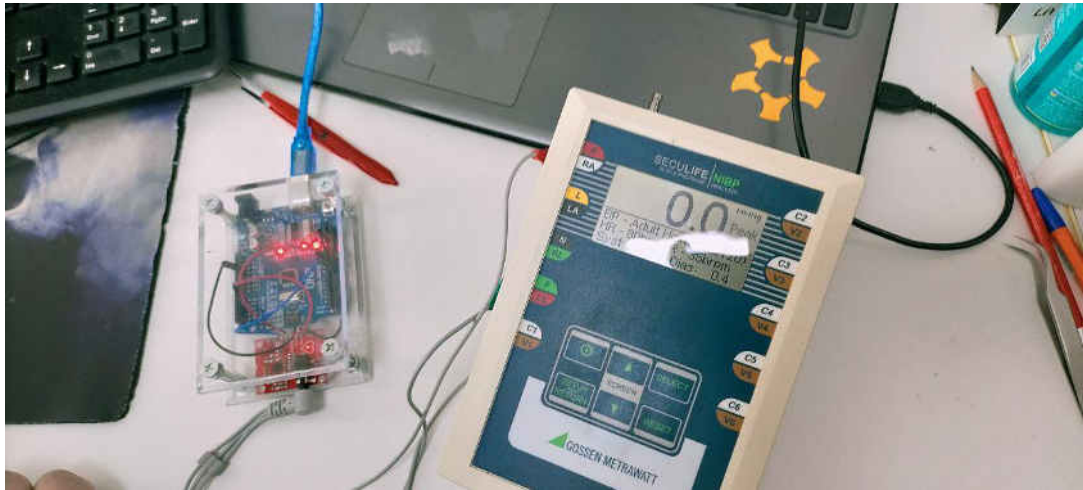


Figura 6. Concept de placă de instruire

Concluzie

Articolul dat descrie realizarea unui circuit stimulator cardiac complex, care integrează componente electronice comerciale și tehnici de programare avansate. Cu un accent deosebit pe microcontrolerul ATmega328 și senzorul AD8232, sistemul poate monitoriza și regla eficient activitatea electrică a inimii. Utilizând tehnologia Arduino Uno, dispozitivul este capabil să genereze și să evalueze în mod precis bătăile ritmice cardiace. Asamblarea și testarea au confirmat funcționalitatea și fiabilitatea dispozitivului, consolidându-l ca o soluție promițătoare pentru cercetarea și aplicarea practică în domeniul medicinei cardiovasculare.

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PORTABLE NON-INVASIVE DEVICE FOR LACTATE THRESHOLD DETERMINATION

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Abstract. *Lactate is an important metabolic product that provides an opportunity for analysing a person's physical condition. This paper will focus on the phenomenon of anaerobic metabolic threshold. Receiving an accurate value of this parameter allows designing a precise training plan that corresponds to any goals, from prevention of cardiovascular diseases to achieving high performance in sports disciplines. There are different ways to find out lactate threshold but all of them either handy but not rigour or explicit but invasive. Therefore, this piece will offer options on how to create a minimally sized non-invasive device which allows to integrate a strict low cost, recyclable and convenient for use in any context lactate threshold measurement technology in sports centres and in the lives of people interested in their health and outcomes.*

Keywords: *heart rate, temperature, sensors, lactate, cardio-vascular system, non-invasive measurement.*

Introduction

Consistent aerobic workouts decrease the probability of cardiovascular disease [10]. But the utility of this type of workout depends on prescribed instructions corresponding to individual's specifics. In particular to get the minimum essentials data it's necessary analyse:

HR under load,

lactate concentration in blood/CO₂ concentration in exhaled air.

Existing methods of measurement of this data derives into two main categories: laboratory analyses and portable devices. Former provides precise values but requires distinctive equipment with its operator and qualified specialist in sport medicine whereas latter is very easy to use but cannot give accurate data. The solution of this problem can be a portative non-invasive device for defining all above-mentioned parameters during step test which causes the aerobic and anaerobic metabolic pathways to activate.

Application field is really wide. The final solution can be useful for everyone who's interested in safety and efficient ways of training.

Cell metabolism. Lactate threshold.

In this section we'll talk about process of synthesis of ATP applicable to physical effort. The synthesis starts from glycolysis which splits glucose into two pyruvate molecules [1].

After the first ten steps of glycolysis, the chemical perturbations with pyruvate are determined by the cell's microenvironment. The enzyme *lactate dehydrogenase* can convert pyruvate to lactate in cells that lack mitochondria, have inadequate oxygenation, or whose energy demand has grown too quickly for oxidative phosphorylation to produce enough ATP. In this stage, NADH and H⁺ are oxidized to NAD⁺, which permits glycolysis to proceed via the *glyceraldehtde-3-phosphate dehydrogenase* process [1].

Under aerobic conditions pyruvate and co-products enters mitochondria where occurs citric acid cycle (TCA) thereafter oxidative phosphorylation happens.

The main difference between anaerobic and aerobic glycolysis is reaction velocity. When skeletal muscle cells contract quickly and require more energy than can be supplied though oxidative phosphorylation alone, anaerobic glycolysis speeds up the synthesis of ATP. The rate of glycolysis is around 100 times higher than that of oxidative phosphorylation [1].

Whence follows the definition of lactate threshold – *this is a moment when intensity of skeletal muscles effort as high that quantity of producing metabolic products in anaerobic glycolysis equals the abilities of mitochondria to utilize these products during TCA and oxidative phosphorylation.*

Determining lactate threshold by HR.

Using the HR method for the identification of lactate threshold showed high level of accuracy. In particular showed a 100% sensitivity, 95% specificity and 90% positive prediction value [4].

Determining lactate threshold by temperature.

There are not so many researches that estimated the concentration of lactate in blood and temperature changes. Here is an example.

20 men who train regular with a range of specializations have participated in the study (skiers, rock climbers etc.). The Nec TH9100SL infrared thermovision chamber was used to measure for forehead skin's temperature. These findings were contrasted with measurements of HR, gas exchange, peripheral blood lactate concentration, and anthropometric traits. It was demonstrated that two unequal groups may be formed from the dynamics of skin temperature at maximum work load: one (2/3 subjects, most of which trained endurance): the temperature decreases and the gradually rises until the subject refuses to work; two (1/3 subjects, pertraining to different sports specializations): the temperature drops from the moment active sweat evaporation begins until the work is terminated.

In first group lactate threshold, or blood lactate concentration of 4 mmol/l, marks the start of a temperature rise following a drop in temperature brought on by sweat perspiration was actively evaporating [5].

As you can see the results are pretty indefinite. But due to physiology increasing of quantity of energy supply processes like glycolysis should have an impact on temperature. That's why it's necessary to run a correlation test with a great number of subjects.

Determining lactate threshold by breath frequency.

It's commonly known that reaching lactate threshold leads to pH decreasing. This phenomenon is called metabolic acidosis. One of compensation reaction of this process is increasing respiratory rate. That's why this is a significant variable for evaluating individual's anaerobic threshold. But there are some researches that claim the opposite: for the majority of participants, the field-based evaluation of the lactate or ventilatory thresholds during running exercise is not feasible using the breathing frequency breakpoint [5].

This is the reason to perform a test which provides the necessary data (correlation between breath frequency and lactate concentration in blood).

Determining lactate in biological fluids.

Numerous studies have shown that the content of lactate in biological fluids (sweat, tears, saliva) and blood are strictly correlated:

- there is a strict connection between lactate levels in human tear samples and blood samples ($R=0.977$) [6];

- rat blood samples and human blood samples were examined to determine the amount of lactate present before and after vigorous physical exercise. The potential variation was obtained for both fluids, and the proposed method corroborated the human sweat response in comparison to the portable device's lactate assay in blood [6];
- there is a positive correlation ($r > 0.8$ and $r > 0.7$, respectively) between the variable rates of lactate concentration in sweat from working and latent muscle regions and blood lactate levels [7];
- correlations were discovered between the rise in blood and sweat lactate concentrations. Sweat lactate concentrations can be utilized to assess changes on blood lactate levels [8].

But there are researches with opposite results:

- there is no correlation between lactate concentration in sweat samples and in blood samples [9].

The fact that results are diametrically opposed the tests aimed at identifying correlation of blood and biological fluids lactate must be carried out. It's also very important to pay extra attention on the way the sample is collected.

Conclusions

Despite the wide range of studies conducted in the area of determining lactate threshold through mediating variables, results and opinions vary widely. Whence the conclusion that one must conduct one's own research from which one can conclude the truth or falsity of the existing literature. This stage will allow the design of the device to progress significantly as it will finalise the concept of the device, in particular:

- the parameters required to be read (temperature, respiratory rate, etc.);
- the sensors to be used to detect biological fluids, and importantly, the choice of the fluid to be analysed.

The sensors are the defining part for the design of the device, since the parameters of the signal to be read completely determine the hardware, which in turn will determine the software.

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FABRICATION OF ZnO NANOFIBERS USING ELECTROSPINNING METHOD

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Abstract. *Zinc oxide (ZnO) nanofibers have attracted significant attention due to their unique properties and diverse applications in fields such as electronics, photonics, and sensing. Fabrication parameters play a crucial role in determining the morphology, structure, and properties of ZnO nanofibers synthesized via the electrospinning method. This mini-review systematically discusses the impact of critical parameters on the electrospinning process and the resulting characteristics of ZnO nanofibers. Parameters such as polymer concentration, solvent selection, applied voltage, spinning distance, and post-processing conditions are examined in detail. Furthermore, the influence of these parameters on the morphology, diameter distribution, crystallinity, and functional properties of ZnO nanofibers is elucidated. Strategies for optimizing these parameters to achieve desired morphologies and properties are also discussed. Understanding the interplay between fabrication parameters and ZnO nanofiber characteristics is essential for tailoring these materials to specific applications and advancing their technological relevance. This review provides valuable insights into the fabrication of ZnO nanofibers via electrospinning, guiding researchers and engineers toward effective synthesis strategies and future developments in this exciting field.*

Keywords: *Nanofiber synthesis, ZnO precursor, polymer concentration, applied voltage, spinning distance*

Introduction

Zinc oxide (ZnO) nanofibers have garnered significant attention in recent years owing to their unique properties and versatile applications in fields ranging from electronics and photonics to biomedicine and environmental remediation. Among the various methods available for synthesizing ZnO nanofibers, electrospinning has emerged as a prominent technique due to its simplicity, scalability, and ability to produce continuous and uniform nanofibers. The electrospinning process involves applying a high voltage to a polymer solution, resulting in the formation of ultrafine fibers through the stretching and solidification of the polymer jet.

However, the properties and performance of ZnO nanofibers synthesized via electrospinning are heavily influenced by the choice of fabrication parameters. These parameters encompass a wide range of variables, including polymer concentration, solvent selection, applied voltage, spinning distance, and post-processing conditions. Each of these parameters plays a crucial role in determining the resulting ZnO nanofibers' morphology, structure, crystallinity, and functional properties.

In this review, we aim to provide a comprehensive overview of the fabrication parameters involved in the electrospinning method for the synthesis of ZnO nanofibers. We systematically explore the influence of each parameter on the electrospinning process and elucidate its impact on the characteristics of the synthesized nanofibers. By understanding the interplay between these fabrication parameters and the resulting properties of ZnO nanofibers, researchers and engineers can effectively tailor the synthesis process to achieve desired morphologies, structures, and

functionalities. The parameters collected and the results obtained over the years are presented in Table 1.

Through a critical analysis of existing literature and experimental findings, this review aims to shed light on the optimization strategies and challenges associated with fabricating ZnO nanofibers via electrospinning. By providing valuable insights into the synthesis process, this review seeks to facilitate further advancements in developing and utilizing ZnO nanofibers for a wide range of applications, including sensors, catalysis, energy harvesting, and tissue engineering.

Table 1.

Electrospinning parameters for ZnO nanofibers synthesis

Ref	Material	T _{annealing} , °C	Applied voltage, kV	Distance, cm	Flow solution, μl*min ⁻¹	Diameter before annealing, nm	Diameter after annealing, nm
[1]	(Zn(CH ₃ COO) ₂ ·H ₂ O)+PVP	550	18	16	5	156	50
[2]	(Zn(CH ₃ COO) ₂ ·H ₂ O)+PVA	480	25	15	5	278	124
[3]	ZnO(nanoparticle)+PAN+DMA (solvent)	-	1	8	10	500-1000	-
[4]	Zn(CH ₃ COOH) ₂ *2H ₂ O+PEO	600	1	23	20	-	55-70
[5]	(Zn(CH ₃ COO) ₂ ·H ₂ O)+PVA	550	1	15	6	-	120
[6]	Zn(CH ₃ COO) ₂ ·2H ₂ O+ZnO (NPs)+PVP	550	23	20	25	220	120
[7]	Zn(CH ₃ COO) ₂ * 2H ₂ O+ PVP+ ethanol	550	25	25	-	300	90
[9]	Zn(NO ₃) ₂ ·6H ₂ O+PVP+ ethanol	520	15	15	17	400	160

The materials and the concentration of the solution.

One of the essential parameters for electrospinning is the solution concentration and type of materials. In many cases, solutions from tree-based materials, such as ZnO precursor, polymer, and solvent, were used in different concentrations depending on the application scope to obtain ZnO nanofibers. Was properly demonstrated the importance of the concentration of zinc acetate/polymer by Di Mauro A. et al. [1], who reported morphology changed in high concentrations of zinc acetate (14 wt%), becoming a rope-like structure. However, at the same time, Imran M. et al. [2] reported that the concentration of zinc acetate from 5 to 15 wt% does not show any effect on the morphology, but the diameter of nanofibers is affected from 278nm to 423nm, characterized by a broader distribution of nanofibers, due to the high viscosity which causes non-uniform ejection of the jet.

As ZnO precursors are zinc acetate [1,2,4,5,7], zinc nitrate [9,10], ZnO NPs [3], and in some cases can be used hybrid precursor [6], which combines zinc acetate and ZnO nanoparticles, which can offer certain advantages in obtaining ZnO nanofibres. The combination of zinc acetate and ZnO nanoparticles allows more precise control of the composition and morphology of the resulting nanofibrils, which was reported by W. Matysiak and M. Zaborowska, obtaining a more uniform and better-defined ceramic structure with free structural defects [6]. In the case of zinc nitrate, structural defects were observed due to oxygen deficiency [9], which is not good when using ZnO nanofibers as a sacrificial material to grow another material such as GaN.

The type of polymer used for electrospinning has one of the most critical roles in nanofiber fabrication: it serves as a matrix or support for the ZnO precursors, which facilitates the electrospinning process and allows the obtaining of ZnO nanofibres with controlled dimensions,

as well as the control of the morphology, size, and alignment of the ZnO nanofibres. There are reports on a variety of polymers that can be used in the electrospinning process, such as polyacrylonitrile (PAN) [3], polyethylene oxide (PEO) [4], polyvinylpyrrolidone (PVP) [1,6], and polyvinyl alcohol (PVA) [2,5]. This versatility allows the electrospinning process to be adapted to the specific requirements of each application.

As solvents, more often used ethanol [7,9], distilled water (DW) [2,5], and dimethylformamide (DMF) [1,3,4,6], these types of solvents depend on the field of application and the dimensions of the desired nanofibers. Compared ethanol with DMF, the first one has low density and viscosity due to the simple molecule and can be used to obtain thinner fibers. In contrast, DMF has higher viscosity due to its complex molecular structure than ethanol. As a result, using DMF can get thick, non-uniform structures with beads.

The applied voltage.

Adequate voltage is required to ensure the jet formation and stability and to allow polymer extraction from the solution. A higher tension can lead to a smaller diameter of the nanofibers, while a tension that is too high can generate cracks or discontinuities in the resulting fiber. Nevertheless, at the same time, applied voltage depends more partly on the solution's viscosity; if high viscosity is required, adequate high voltage is necessary to form a uniform structure.

It must be controlled to avoid unwanted phenomena such as electrospray or droplet formation, leading to non-uniform or low-quality nanofibril structures.

The flow of the solution and the distance between the tip of the spinneret and the collector

The precursor solution flow rate is the amount of solution flowing from the spinneret tip in a given interval. This parameter determines the amount of material deposited on the collector and influences the thickness and density of the nanofiber layer. A higher flow rate can lead to the formation of thicker layers of nanofibers, while a lower flow rate can lead to the deposition of thinner layers. Suyitno S. et al. [7] report the importance of flow rate and its influence on nanofibers dimensions in their work. Investigated flow rate from 2 ul/min to 6 ul/min demonstrates that the high flow rate increases fiber diameter, in the same time in case of 6 ul/min, the tip of the needle formed a giant bubble size, which caused larger fibers to be drowned without any sufficient stretching for the same magnitude of the electrostatic field.

The distance between the spinneret tip and the collector influences the length the precursor solution jet traveled to the collector and the nanofibrils' degree of stretching and alignment. A smaller distance may favor the uniform spreading of the precursor solution on the collector and the formation of thinner and more uniform nanofibers. On the other hand, a too-small distance can lead to the aggregation of nanofibrils and the formation of improper layers.

Calcification

The calcination temperature used to obtain ZnO nanofibrils by the electrospinning method is a critical parameter influencing the nanofibrils' properties and characteristics. Calcification is the process of transforming the ZnO precursor into crystalline zinc oxide. The calcination temperature affects the degree of crystallinity and purity of the resulting ZnO. Higher temperatures can promote complete calcination and higher crystallinity of ZnO, which can lead to improved performance in further applications.

The calcination temperature can affect the size and morphology of ZnO nanofibrils. Sometimes, a temperature that is too high may lead to retraction or fusion of nanofibers. At the same time, a too low temperature may not ensure complete calcination or allow the formation of high-quality crystalline ZnO. A. Di Mauro et al. [1] anneal material at different temperatures, from 350 to 650 °C. In the case of 450 °C was determined, very low crystal quality with the presence of a partially amorphous state. At the same time, in the case of 650 °C, materials have high

crystallinity but are impossible to use in any application due to the high fragility of the material. As a result, an optimal temperature was reported at 550 °C, an equilibrium between crystal quality and the fragility of the material.

Another important aspect is the thermal and chemical stability of the obtained ZnO nanofibers. By calcining at suitable temperatures, ZnO's increased thermal and chemical stability can be ensured, which can be crucial in various applications.

Conclusion

The fabrication of ZnO nanofibers using the electrospinning method involves a multitude of parameters that significantly influence the morphology, structure, and properties of the resulting nanofibers. This review reveals that careful control and optimization of these parameters are essential for achieving desired characteristics and functionality in ZnO nanofibers.

Parameters such as solution properties, including polymer concentration, solvent type, and ZnO precursor concentration, play a critical role in determining the solution's spinnability and the nanofibers' final morphology. Additionally, the electrospinning process parameters such as applied voltage, flow rate, distance between the spinneret and collector, and environmental conditions (temperature and humidity) exert profound effects on fiber diameter, orientation, and uniformity.

Furthermore, post-treatment techniques such as calcination, annealing, and surface modification can further tailor the properties of ZnO nanofibers, enhancing their crystallinity, surface area, and chemical reactivity for specific applications.

However, the review reveals that optimizing these parameters is often challenging due to their complex interplay and the electrospinning process's sensitivity to small variations. Therefore, future research efforts should focus on systematic studies aimed at understanding the underlying mechanisms governing the electrospinning process and the relationship between process parameters and nanofiber properties.

Moreover, the development of advanced characterization techniques and computational modeling approaches can aid in elucidating the intricate dynamics involved in electrospinning ZnO nanofibers, thereby facilitating more precise control and optimization of the fabrication process.

In conclusion, while significant progress has been made in the fabrication of ZnO nanofibers via electrospinning, continued research is necessary to harness the potential of this method fully for various applications. By advancing our understanding of the key parameters and their influence on nanofiber properties, we can unlock new opportunities for the design and synthesis of ZnO nanofibers with tailored characteristics suited for diverse technological applications.

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A COMPREHENSIVE ASSESSMENT OF SEQUENCE READ ARCHIVE METADATA COMPLETENESS

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Abstract. *Recent advances in high-throughput sequencing technologies have enabled the collection and sharing of a vast amount of omics data, along with its associated metadata. Enhancing the availability of this metadata is crucial to ensure the reusability and reproducibility of raw data, as well as for facilitating novel biomedical discoveries through efficient data reuse. In this study, we performed a comprehensive assessment of metadata completeness by analyzing over 26,000,000 experiments shared in the Sequence Read Archive (SRA) from 2008 to 2023. Our results show that the countries of Central Europe, the USA and China show dominance in generating sequencing data, corresponding to 45%, 16% and correspondingly 8% of total data in the SRA repository, the most frequently used platform is ILLUMINA (90%). Identified that some of the metadata contains inconsistencies in completeness: the absence of temporary identifiers (5.2%), the lack of assigned TaxonomyID (5%), and the absence of library strategy (8%). Our results highlight the urgent need for improved metadata sharing practices and the standardization of reporting.*

Key words: *Metadata, data reusability, Sequence Read Archive, sequencing*

Introduction

The quantity and diversity of genomic data continues to grow exponentially, it is essential that these data are discoverable, accessible, interoperable and reusable [1]. Metadata is information about data that describes its content, structure, and other characteristics. Metadata plays a crucial role in understanding accompanied data, as it provides essential information necessary to reproduce the data accurately [2,3,4]. Since the completion of the human genome and the creation of the second commercial next generation sequencing platform, DNA sequencing databases have been actively growing [5,6] and outpacing Moore's Law [7]. Recent estimates indicate that the global market for microbiome sequencing will continue growing. Unfortunately, most public databases rely on user input and do not have methods for identifying errors in the provided metadata, leading to the potential for error propagation and exacerbating issues of incompleteness or lack of standardization [8]. Poor metadata can significantly lower the value of sequencing experiments by limiting the reproducibility of the study and its reuse in meta analyses [9].

In order to delve into the nuances of data types and their sources, our objective is to procure the existing metadata from the SRA repository. This endeavor aims to evaluate both the comprehensiveness and quality of the data, thereby fostering a deeper comprehension of the research conducted. Such an assessment not only facilitates researchers in reusing findings and data in subsequent projects but also contributes to the broader scholarly discourse. Our study based on SRA data will elucidate the technological, geographical, temporal, and methodological intricacies of sequencing with indication of the completeness of the metadata.

Materials and Methods

We used the SRA Toolkit to extract information on 25.2 million experiments. Additional data on study descriptions, protocols, and design obtained by parsing information from the NCBI web resource with python scripts. Searching NCBI web resources also identified 1,467,839 new records, highlighting differences between the online version and the database accessible through the SRA Toolkit. This demonstrated a 94% correspondence between the sources. Information on the countries in which sequencing was performed was obtained from the domains of sites that Bing returned for queries of the organization's name, specified in metadata. The data were also subjected to country categorization using ChatGPT 3.5. The country was determined for 39916 (91%) of 43543 organizations covering 25909854 sequencing runs (92%) of 28124436. Manual evaluation on 100 samples showed that the accuracy of the country determination method is 90%.

Results

The metadata obtained from SRA by November 15, 2023, include describe about 28,124,436 sequencing runs conducted within 26,767,311 experiments on 23,692,425 unique samples from 184,134 organisms during the period from 2008 to 2023 had been obtained, utilizing 80 different sequencing models across 11 platforms. The experiments were conducted by 43540 research centers.

Between 2008 and 2012, fewer than 100,000 sequencing runs were recorded annually. Since 2013, there has been a significant increase in genomic sequencing, with sequencing runs reaching 1 million per year by 2016. By 2020, 3 million sequencing runs per year had been completed, with a record of over 6 million sequencing runs in 2022 (Fig. 1), driven by the COVID-19 pandemic, 47% of all sequencing runs for 2022 was for coronavirus.



Figure 1. Increase in the number of sequencing runs over time in the SRA repository

North American and European countries conduct 51.5% and 32.8% of sequencing runs, respectively (Fig. 2b). The U.S. leads in the number of studies conducted with 12,725,632 sequencing runs, accounting for 45% of the total data in SRA. The top 3 countries with the highest number of runs include England with 4,731,180 (16%) sequencing runs and China with 2,318,559 (8%) sequencing runs (Fig. 2c). The US has generated over 1 petabyte of information annually since 2018. As of 2018, China generates 250 to 500 terabytes of data annually, while England generates between 100 and 250 terabytes per year (Fig. 2a). Other countries such as Germany, Canada, Switzerland, Japan, Australia, and France also contributed to SRA data deposition, together submitting between 20,000 and 200,000 sequencing runs per year and generating between 10 and 50 terabytes of data per year (Fig. 2a).

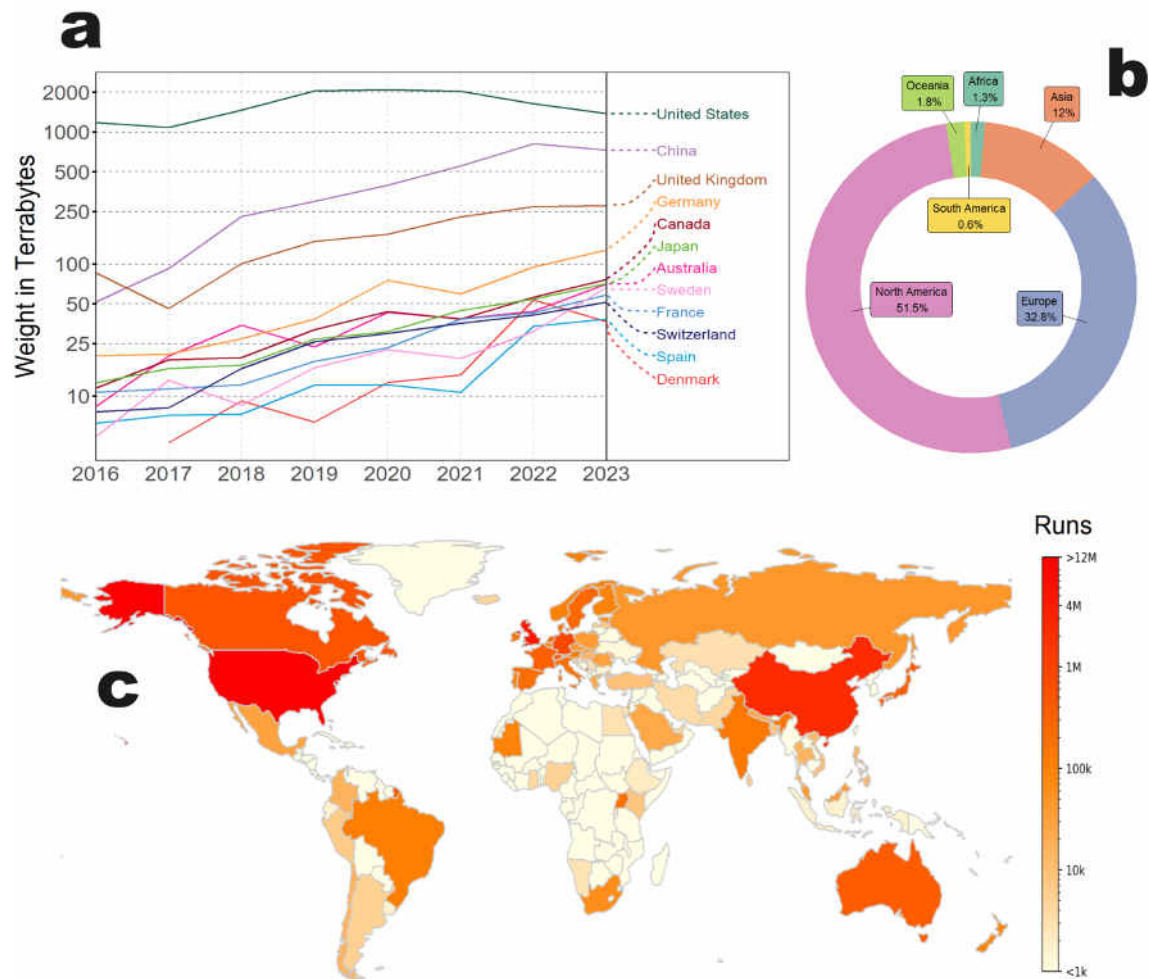


Figure 2. Overall distribution of SRA runs. (a) Change in the amount of generated data for countries over time (sqrt scale for weight); (b) Share of regions by number of sequencing; (c) Heatmap for countries by number of sequences

The Illumina platform accounts for 90% of sequencing cases and data volume, indicating the widespread use of short-read sequencing. The PacBio and Oxford Nanopore platforms are used for sequencing with shares of 2.6% and 2.3% respectively. The Ion Torrent share is 1.6%, while LS454 and Capillary each account for 1.3%. Other sequencing platforms collectively account for less than 0.5% of research. In terms of data generated, the new platforms BGIseq and DNBseq account for 2.1% and 1.5% respectively. PacBio represents 1.8%, while Oxford Nanopore accounts for 1.1%. The share of other platforms in the total data volume does not exceed 0.4%.

The NovaSeq 6000 and MiSeq models lead in the number of sequencing runs generated, producing 7 million and 6.2 million sequencing runs, respectively (Fig. 3d). Other models range from 1.3 million to 3.4 million sequencing runs. The expensive X Ten model conducted 1 million sequencing runs (Fig. 3d) but leads in the total data volume - 7000 terabytes, 1800 terabytes more than the NovaSeq 6000 (Fig. 3a). The HiSeq 2000, 2500, 4000 generated 3500, 3200, and 1800 terabytes of data, respectively. Together, all other models including Miseq produced less than 2600 terabytes of data (Fig. 3a).

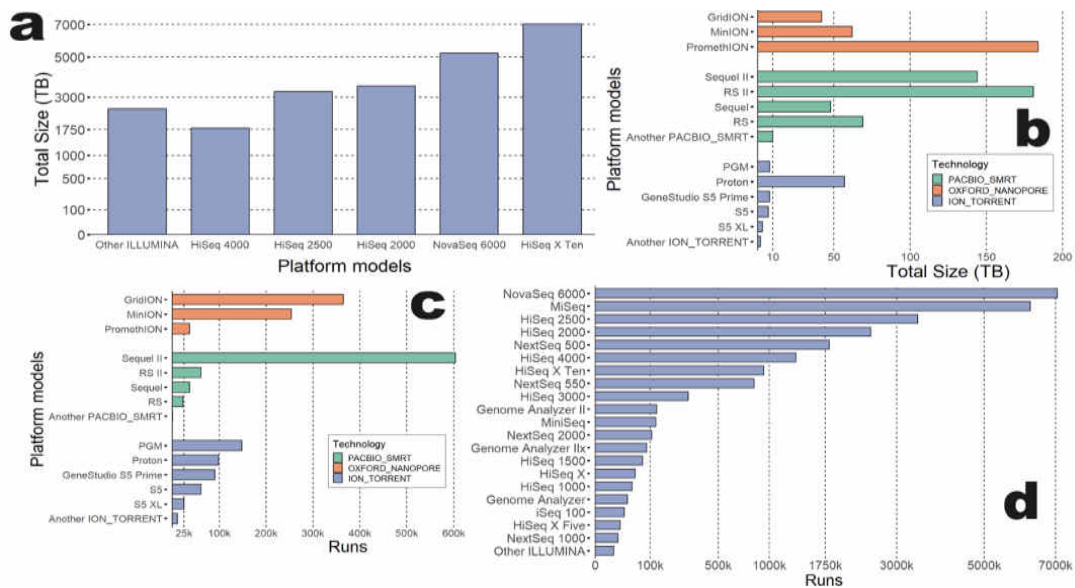


Figure 3. Distribution of the number of sequencing runs and the amount of data generated by the sequencing model. (a) Number of data generated by ILLUMINA models; (b) Number of data generated by Pacbio, Oxford Nanopore, Ion Torrent models. (c) Number of sequencing by Pacbio, Oxford Nanopore, Ion Torrent models; (d) Number of sequencing runs by ILLUMINA models.

Models such as Sequel II from Pacific Biosciences, Personal Genome Machine (PGM) from Ion Torrent, and GridION from Oxford Nanopore Platforms stand out among less common technologies, demonstrating volumes of 150,000 to 600,000 sequencing runs (Fig. 3c). In terms of the volumes of generated data, models like PromethION, Sequel II, and RS II generate between 145 and 180 terabytes of data (Fig. 3b).

Analyzing methodologies we noticed that researchers primarily focus on whole-genome sequencing studies, achieving 9 million sequencing runs, leading with the human genome. With the onset of the coronavirus pandemic, 6.1 million viral RNA sequencing runs were conducted, of which more than 95% were related to the SARS-CoV-2. Transcriptomic and metagenomic studies show similar volumes, with about 4.6-4.7 million sequencing runs each. Other research directions attract significantly less interest, with a total volume of less than 800,000 sequencing runs. Amplicon sequencing, which targets specific genomic regions, is the most common library strategy with 12 million cases. RNA-seq and Whole Genome Sequencing (WGS) were used in 4.8 million and 4.4 million sequencing runs, respectively. Less common methods find application in a range from 30,000 to 43,000 sequencing runs.

Analysis of the SRA database revealed 183,102 unique organisms classified into vertebrates, invertebrates, metagenomes, bacteria, viruses, fungi, protists, and archaea taxonomic groups. A total of 9,100,000 vertebrate sequencing runs were conducted (Fig. 7), with a combined volume of 18,000 terabytes, primarily focusing on human (*Homo sapiens*) genomes (5.1 million) and mice (*Mus musculus*) (2.6 million). A significant number of studies have also been conducted on domestic animals, in particular cattle (*Bos taurus*), pigs (*Sus scrofa*), chickens (*Gallus Gallus*) and dogs (*Canis lupus familiaris*), ranging from 37,000 to 87,000 sequencing runs. Viruses underwent 6.7 million sequencing runs (Fig. 7) with a total data volume of 555 terabytes, predominantly targeting the SARS-CoV-2 (95%). Cultivated plants such as rice (*Oryza sativa*), wheat (*Triticum Aestivum*), barley (*Hordeum vulgare*), as well as model plants like *Arabidopsis thaliana*, underwent sequencing runs ranging from 50,000 to 180,000. Invertebrates of particular interest include mosquitoes (*Anopheles gambiae*) and fruit flies (*Drosophila melanogaster*) with 65,000 and 165,000 sequencing runs respectively, as well as organisms similar to *Hydra* with 3,000 sequencing. Bacterial research focused on pathogenic microbes such as *Salmonella* (609k), *E. coli* (390k), *Streptococcus* (208k), *Mycobacterium tuberculosis* (202k), and *Staphylococcus*

(150k). Among fungi, yeast (*Saccharomyces cerevisiae*) the most interest with 200,000 sequencing runs. Among protists, *Plasmodium falciparum*, which causes malaria in humans, stood out with 247000 sequencing runs.

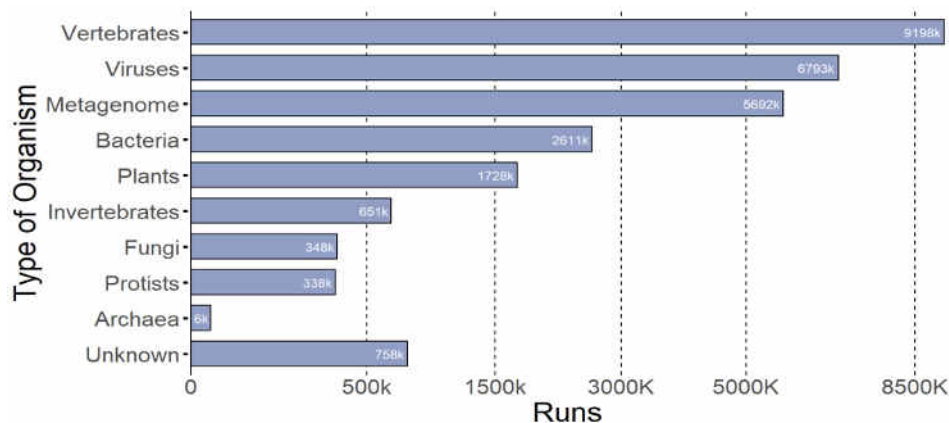


Figure 4. Distribution of sequencing runs by organism classes in SRA repository

Metagenomic analysis comprised 5,690,000 sequencing runs (Fig. 4), representing 350 unique metagenome samples in the SRA database. Researchers are particularly interested in human metagenomes, for instance, the study of gut metagenomes led to 1 million sequencing runs. Metagenomes from the oral cavity and skin also attracted attention, with 120,000 and 72,000 sequencing runs respectively. Among environmental metagenomes, soil research stands out, encompassing 778,000 sequencing runs. Various aquatic metagenomes also pique interest, ranging from 15,000 to 176,000 sequencing runs. Mouse metagenomes are frequently encountered in animal studies, with 253,000 sequencing runs conducted, along with metagenomes from pigs, cattle, and insects ranging from 63,000 to 66,000 sequencing runs. In artificial environments, researchers conduct runs on human waste and wastewater, totaling 90 terabytes in data volume.

The SRA database contains detailed descriptions of the data, methods, technologies and organisms studied. However, in some cases there are gaps or incomplete metadata. Although the completeness of the source data is high, even 0.85% of missing data represents 200 thousand mislabeled data, which is significant for certain domains and data reusability. We found that 5.2% for XXX samples lack submission date information. Additionally, XXX samples that represent 9% lack submitter information. About 9.4% of the metagenomic data are incompletely described, lacking an indication of where a particular metagenome was derived from, for 8% of the data the library strategies used are unknown. Also, 5% of the metadata do not have a specified taxid and 41% of the data do not have information on the attribute that specifies the design of the conducted experiment. For 2% of the data there is no description, it should be noted that this is not always critical. A small amount of metadata includes information about the presence of diseases, present in less than 1% of the human metadata.

Discussion

Our study based on the SRA database demonstrates that many countries are involved in DNA research. ILLUMINA-based models are the most commonly used, but long reads-based models are gradually increasing in popularity. A large amount of research is focused on the human genome, pathogens, and organisms that are pets or used as food. Among metagenomes, human body parts, soil, and wastewater account for a large proportion. The absence of standardized metadata schema compounds issues the veracity of experiments design and downstream analysis, hampering efforts to harness datasets for advanced computational analyses and integrative bioinformatics approaches. Metadata accompanying the raw data in public repositories allows us to better understand global trends in DNA research and reuse it for new-hypothesis testing analyses and more advanced studies, however, it has been found that some of the data contains critical lacks

in the metadata, making it difficult to reuse. The incompleteness of the metadata identified by the submission date makes it difficult to compare results and assess the consistency between different genetic changes and different phenotypic or environmental conditions occurring in the world. The absence of a taxonomyID that describes the object of study makes the data themselves unusable. Variations in the quality and organization of metadata yield considerable analytical uncertainties and can trigger a cascade of interpretative inaccuracies. Such inconsistencies could be major obstacles to the reproducibility of research findings and their subsequent extension into new scientific inquiries. It is necessary to ensure the data meets minimum requirements specified in the metadata standards. We also highlight the significant benefits that the improved availability and quality of metadata can offer, facilitating broader reuse within the scientific community. Improvement over data partitioning will improve the quality and completeness index of databases, this in turn will have a positive impact on storage efficiency, speed of research and information retrieval and data reuse.

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SECȚIA ȘTIINȚA ALIMENTELOR
SECTION OF FOOD SCIENCE

ANALIZA COMPOZIȚIEI VINURILOR ROȘII SECI DIN SOIURILE DE STRUGURI AUTOHTONI FETEASCA NEAGRĂ ȘI RARA NEAGRĂ DIN DIFERITE REGIUNI GEOGRAFICE ALE REPUBLICII MOLDOVA

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Rezumat. *Lucrarea dată constă în analiza compoziției vinurilor roșii, obținut în Laboratorul de Microvinificație al Departamentului de Oenologie a Universității Tehnice a Moldovei. În acest scop au fost examinate mai multe vinuri obținute din soiuri de struguri autohtone Feteasca Neagră și Rara Neagră din diferite regiuni geografice a Republicii Moldova. În vinuri au fost studiate caracteristicile fizico-chimice pe tot parcursul ciclului tehnologic și caracteristicile indicilor specifici a vinurilor roșii seci. Analizând indici fizico-chimici s-a ajuns la concluzia că vinul din același soi, dar produs în zone diferite se obțin cu indicii asemănători, întrucât zona influențează mai mult asupra indicilor organoleptici. Întrucât aceste două soiuri se aseamănă, rezultatele obținute la fel sunt apropiate. Analizând conținutul de substanțe fenolice, remarcăm că Rară Neagră are cel mai mic conținut de substanțe fenolice, zona Bugeac, 978 mg/l, iar conținutul de antociani la fel se numără printre cel mai mic 149 – 153. Acest lucru este normal, întrucât Rară Neagră este un soi de struguri cu intensitatea culorii nu foarte înaltă. Cercetând intensitatea colorantă (suma absorbanților D 420, 520, 620) și nuanța culorii, observăm că Rară neagră din ambele zone Mircești și Bugeac are o intensitate colorantă joasă indiferent de zona unde acești struguri sunt crescuți și anume 0,23; pe când vinul cu cea mai înalta intensitate colorantă este Feteasca Neagră Mircești 0,675. Rară neagră are nuanța culorii cea mai ridicată 1,05 în zona Mircești, iar în zona Bugeac mai scăzută 0,861.*

Cuvinte cheie: *indici fizico –chimici, nuanța culori, intensitatea culori, substanțe fenolice*

Introducere

Vinurile roșii din Moldova au devenit demult vestite în întreaga lume. Acestea ocupă o bună parte în volumul total al producției vinicole. Vinurile roșii sunt în mare parte foarte bine apreciate de consumatori. În prezent sunt tot mai mult cerute de consumatori pe piața internă și cea mondială. Volumul vinului roșu pe piața mondială azi constituie aproximativ 20-40% din volumul total [1].

Compoziția fizico-chimică a vinului este dependentă de soi, factorii ecologici, gradul de maturare și starea de sănătate a strugurilor, condițiile de producere și de păstrare, vârstă, etc. Aprecierea calității vinurilor se face sub aspect compozițional, igienic și organoleptic.

Calitatea vinului de asemenea se verifică prin controlul fizico- chimic care cuprinde determinarea unor indici cu aplicarea metodelor fizico-chimice de analiză. Vinurile trebuie să îndeplinească anumite cerințe de compoziție în momentul când este livrat consumatorilor, și anume: concentrația alcoolică, aciditatea totală, aciditatea volatilă, conținutul de zahăruri, de dioxid de sulf liber și legat, etc.

Determinarea acestor indici cu aplicarea metodelor fizico-chimice de analiză, determinarea indicilor specifici cât și a caracteristicilor organoleptice la vinurile roșii seci produse din soiurile de struguri autohtoni Feteasca Neagră și Rară Neagră în cadrul departamentului de Oenologie și Chimie, în secția de microvinificație stau la baza acestui articol.

Materiale și metode

Pentru cercetări au fost utilizate vinurile roși seci fabricate din soiurile de struguri autohtoni Feteasca Neagră și Rara Neagră, din diferite regiuni a Republicii Moldova, cum ar fi regiunile: Bugeac, Mircești, Leova, Purcari.

Feteasca Neagră caractere ampelografice - frunza e de dimensiune medie, uniformă, de culoare verde deschis, tri- sau pentalobată, lobul terminal este triunghiular și alungit. Sinusurile laterale superioare sunt foarte profunde, cu lumen ovoidal, iar sinusul pețioar apare sub forma unei lire larg deschise. Floarea e hermafrodită. Strugurii sunt de dimensiuni mijlocii de formă cilindro-conică, aripat sau biaripat. Greutatea medie a strugurelui de Feteasca neagră este de 190-230 grame. Bobul este sferic și mic. Pelița este groasă de culoare neagră- albăstruie acoperită cu pruină. Miezul este zemos cu un gust franc (ierbos) [2].

Rara Neagră caractere ampelografice - perioada de maturare medie-târzie sau târzie-decada III-a septembrie-prima decadă a lunii octombrie. Vigoarea de creștere a butucilor medie spre mare. Floarea hermafrodită. Strugurii de mărime mare (uneori ating 500-600 gr) de formă conică, mediu compacți sau lacși, în mare majoritate cu 1-2 aripi de diferite dimensiuni. Bobul de mărime medie sau mare, rotund la coacere deplină de culoare neagră acoperit cu un strat de pruină de culoare albăstruie [3].



Figura 1. Soiul de struguri Feteasca Neagră



Figura 2. Soiul de struguri Rară Neagră

Vinurile au fost fabricate în secția de microvinificație a departamentului Oenologie și Chimie, FTA. Pentru determinarea indicilor fizico-chimici și proprietăților organoleptice ale vinurilor obținute s-au utilizat metode de analiză conform standardelor în vigoare, precum și recomandate de OIVV [4].

Rezultate și discuții

Pentru un vin de calitate indicii fizico – chimici joacă un rol foarte important întrucât aceștia trebuie să se armonizeze între ei, deoarece în mare parte datorită combinațiilor dintre aceștia se formează niște indici organoleptici bine apreciați [5]. Pentru comparație s-a determinat câțiva indici fizico – chimici, alcoolul, aciditatea titrabilă, pH-ul, extractul și glicerolul, ai vinurilor obținute din soiurile autohtone Rară neagră și Fetească neagră, din struguri recoltați din diferite regiuni ale țării: Bugeac, Leova, Mircești și Purcari.

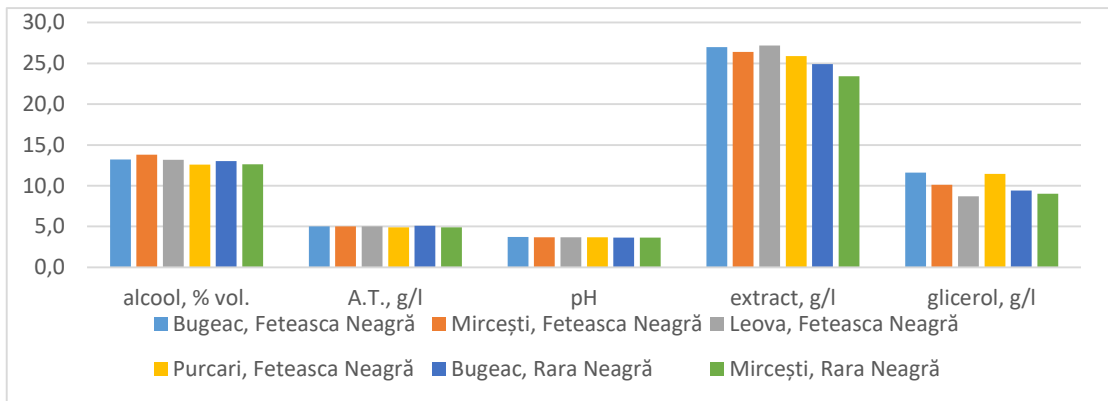


Figura 3. Indicii fizico – chimici ai vinului Rară Neagră și Fetească Neagră obținut în diferite zone geografice a Republicii Moldova

Analizând Figura 3 s-a ajuns la concluzia că vinul din același soi, dar produs în zone diferite se obțin cu indicii fizico – chimici asemănători, întrucât zona influențează mai mult asupra indicilor organoleptici. Întrucât aceste două soiuri se aseamănă, rezultatele obținute la fel sunt apropiate. Au fost analizate și cantitatea de substanțe fenolice și antociani a vinurilor: Rară neagră, Fetească neagră, Merlot, Cabernet – Sauvignon, în diferite zone, pentru a face o comparație între soiuri, și pentru a se putea aprecia influența zonei în care sunt crescuți strugurii.

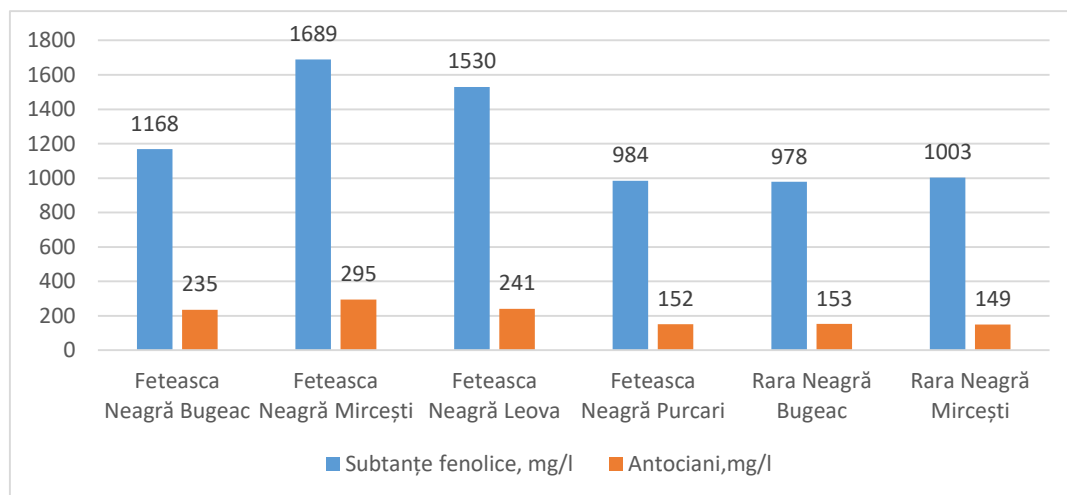


Figura 4. Cantitatea de substanțe fenolice și antociani în diferite soiuri de vin din diferite zone geografice ale Republicii Moldova

Analizând Figura 4, putem spune că Rară Neagră are cel mai mic conținut de substanțe fenolice, zona Bugeac, 978 mg/l, iar conținutul de antociani la fel se numără printre cel mai mic 149 – 153. Acest lucru este normal, întrucât Rara Neagra este un soi de struguri cu intensitatea culorii nu foarte înaltă. Au fost analizate, prin determinare la fotocolorimetru, intensitatea colorantă și nuanța culorii a diferitor vinuri roșii: Fetească neagră, Rară neagră, Merlot și Cabernet – Sauvignon, în diferite zone, și anume Purcari, Mircești, Bugeac și Leova, pentru a face o comparativă a acestor indici atât între soiurile de struguri cât și între zone.

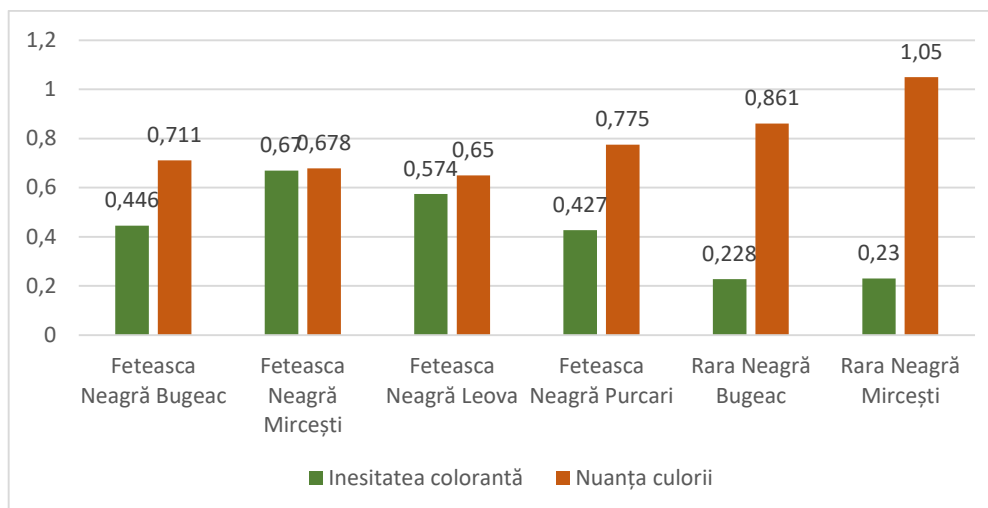


Figura 5. Intensitatea colorantă și nuanța culorii în diferite regiuni

Analizând Figura 5, observăm că vinul cu cea mai joasă intensitate colorantă (suma absorbanților D 420, 520, 620) este Rară neagră din ambele zone Mircești și Bugeac are o intensitate colorantă joasă indiferent de zona unde acești struguri sunt crescuți și anume 0,23; pe când vinul cu cea mai înalta intensitate colorantă este Cabernet Sauvignon Purcari. Rară neagră are nuanța culorii cea mai ridicată 1,05, în zona Mircești, iar în zona Bugeac mai scăzută 0,861.

Concluzii

Au fost determinate și apreciate indicii fizico-chimici vinurilor din soiul de struguri autohtoni Rară neagră și Feteasca Neagră produs în diferite zone geografice a Republicii Moldova. S-a determinat intensitatea colorantă și nuanța culorii mai multor vinuri roșii, pentru a putea face o comparație, printre care se numără și vinul cercetat din soiul autohton Rară neagră, astfel am ajuns la concluzia că vinul cu cea mai joasă intensitate colorantă 0,23 este Rară neagră din ambele zone Mircești și Bugeac, de aici rezultă că acest soi are o intensitate colorantă joasă indiferent de zona unde acești struguri sunt crescuți; pe când tot acest vin Rară neagră are nuanța culorii cea mai ridicată 1,05, în zona Mircești, iar în zona Bugeac mai scăzută 0,861. Pentru obținerea unui vin de calitate, cu o valoare biologică ridicată este nevoie de a urma cu strictețe toate operațiile și regimul tehnologic propus în schema de producere.

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ANALIZA INFLUENȚEI ADITIVILOR ALIMENTARI ASUPRA HIDRATĂRII, FIERBERII ȘI TRANSFERULUI DE SUBSTANȚE DIN LEGUMINOASE ÎN APA DE FIERBERE A ACESTORA

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Cuvinte cheie: *năut, aditivi alimentari, apă de fierbere, transfer de substanță*

Leguminoasele sunt cultivate și consumate pe scară largă ca sursă de proteine vegetale în întreaga lume. Acestea sunt considerate una dintre cele mai ieftine și mai bogate surse de proteine vegetale, fiind al doilea grup de culturi ca importanță după cereale, în alimentația umană. Acest fapt se datorează costului scăzut de cultivare, proprietăților nutritive înalte și efectelor fiziologice benefice asupra organismului uman. S-a raportat că consumul regulat de leguminoase reduce susceptibilitatea oamenilor la boli cronice, cum ar fi bolile cardiovasculare, diabetul, cancerul și excesul de masă corporală. Acest lucru se datorează conținutului ridicat de proteine, fibre alimentare, acizi grași esențiali, minerale și izoflavone.

Apa de fierbere a leguminoaselor prezintă un lichid vâscos rezultat din gătitul leguminoaselor. Acest ingredient conține o sursă importantă de proteine solubile și minerale. Proteinele din apa de fierbere pot servi ca agenți de spumare la fabricarea produselor de cofetărie. Scopul acestui studiu a fost de a investiga influența aditivilor alimentari asupra hidratării, fierberii și transferului de substanțe din leguminoase în apa de fierbere a acestora.

Pentru cercetare a fost folosit - năut din soiul Ichel. În calitate de aditivi alimentari s-a folosit sarea de bucătărie, bicarbonatul de sodiu și acidul acetic. A fost determinată capacitatea de hidratare a năutului în soluții de sare de bucătărie, bicarbonat de sodiu și acid citric în diferite concentrații. La fel sa determinat influența aditivilor alimentari asupra transferului de substanțe din boabele de năut în apa de fierbere, și proprietățile apei de fierbere a năutului obținute. Sa observat că aditivi alimentari folosiți au influențat diferit capacitatea de hidratare a leguminoaselor. Cea mai mare capacitate de hidratare în raport cu proba martor a fost înregistrată pentru proba cu soluție de bicarbonat de sodiu de 0,5%. Iar cea mai mica capacitate de hidratare sa înregistrat pentru proba cu soluție de sare de bucătărie de 2.5%. S-a determinat conținutul de SU a apei de fierbere a năutului care a fost hidratat timp de 12 ore în soluțiile cu diferite concentrații a aditivilor alimentari menționați. S-a observat că toți aditivi alimentari folosiți la hidratarea năutului au influențat pozitiv transferul de substanțe în timpul fierberii din boabe în apa de fierbere. Conținutul de SU în apa de fierbere a năutului a înregistrat cea mai mare valoare pentru proba cu concentrația de 2,5 % de bicarbonat de sodiu și pentru proba cu concentrația de 2,0 % de sare de bucătărie. Substanța uscată a probelor menționate fiind mai mare decât la proba martor cu aproximativ 10%.

Studiul dat ne arată influența aditivilor alimentari asupra procesului de hidratare a leguminoaselor. S-a demonstrat că bicarbonatul de sodiu și sarea de bucătărie în anumite concentrații favorizează transferul de substanțe din boabe în apa de fierbere a acestora.

IDENTIFICAREA METODELOR DE CONSERVARE A POMUȘOARELE DE JOSTA

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Rezumat. Tendința actuală a consumatorilor de a utiliza în consum produse alimentare naturale în viața de zi cu zi creează oportunități noi de utilizare a materiilor prime cu o valoare nutritivă și biologică înaltă, în calitate de aditivi naturali. În acest context, având în vedere că materiile prime de origine vegetală bogate în aditivi naturali sunt produse sezoniere, este important de cercetat aspectul conservării acestora cu păstrarea maximă a indicilor de calitate respectivi. Scopul prezentei lucrări a fost analiza și identificarea parametrilor optimi ai metodelor de conservare a pomușoarele de Josta, un produs autohton, recoltat în lunile iulie-august, bogat în antocieni, reieșind din păstrarea compoziției chimice și a conținutului de compuși biologic activi în fructelor de Josta. Pomușoarele de Josta au fost conservate prin procesul de congelare, liofilizare și uscare convențională. Rezultatele obținute au arătat că compoziția chimică a pomușoarelor de Josta și conținutul în biocompuși s-a păstrat bine în probele supuse congelării rapide la temperatură de -30°C cu păstrare ulterioară la temperaturi de $-18...-20^{\circ}\text{C}$, liofilizare prima etapă: presiunea 13Pa, temperatura -30°C , timp 10 h; etapa secundară: presiunea 13Pa, temperatura 20°C , timp 10 h și uscare la temperatura de 65°C timp de 10h.

Cuvinte cheie: liofilizare, congelare, uscare, produse vegetale

Introducere

Produsele vegetale, fiind adesea produse de sezon, impun necesitatea conservării pentru a putea fi savurate pe tot parcursul anului. Acest proces nu numai că extinde durata de consum a produselor, dar ajută și la menținerea valorilor nutritive și a gustului autentic al acestora. Printre acestea se numără și pomușoarele de Josta, un produs autohton care își găsește locul în zona de centru și sud a Republicii Moldova.

Pomușoarele de Josta sunt un hibrid între coacăz negru (*Ribes nigrum*) și agri (*Ribes uva-crispa*), fiind cunoscute pentru adaptabilitatea lor la diferite condiții climatice [1], inclusiv cele din zonele de centru și sud ale Republicii Moldova. Acest hibrid a fost dezvoltat pentru a combina caracteristicile pozitive ale ambelor plante părinte, astfel încât să aibă fructe mai mari și o rezistență mai bună la boli și dăunători [2].

Avantajele pomușoarelor de Josta

- Valoare Nutrițională Ridicată:** Pomușoarele de Josta sunt bogate în vitamine (în special vitamina C), minerale, antioxidanți și fibre. Consumul lor poate contribui la întărirea sistemului imunitar, poate îmbunătăți sănătatea pielii și poate ajuta la prevenirea anumitor boli [3].
- Rezistență la Boli și Dăunători:** Hibridul a fost creat pentru a fi mai rezistent la boli și dăunători decât plantele sale părinte, ceea ce înseamnă că ar putea necesita mai puține tratamente cu pesticide, fiind astfel mai prietenos cu mediul [4].
- Adaptabilitate:** Fiind adaptabile la condiții climatice variate, pomușoarele de Josta sunt o opțiune bună pentru agricultorii din diverse regiuni, inclusiv din Republica Moldova, unde clima poate varia de la temperaturi scăzute în timpul iernii la veri călduroase și uscate [5].

4. **Productivitate:** Pomușoarele de Josta tind să aibă o producție bună de fructe, ceea ce le face eficiente pentru cultivatorii care doresc să obțină o recoltă bogată de pe urma spațiului cultivat. Productivitatea medie pentru fructele de Josta constituie 8t/ha [6].
5. **Versatilitate în Utilizare:** Aceste fructe pot fi consumate proaspete sau prelucrate în gemuri, sucuri, sau pot fi conservate pentru consumul pe tot parcursul anului [7].
6. **Perioadă de cultivare:** Pomușoarele de Josta pot avea o perioadă de coacere mai îndelungată comparativ cu alte fructe de pădure, ceea ce extinde perioada în care pot fi culese proaspete [8].

Pomușoarele de Josta reprezintă astfel nu doar o parte a biodiversității și patrimoniului horticol autohton din Republica Moldova, ci și o sursă valoroasă de nutrienți și oportunități agricole pentru locuitorii acestei regiuni.

În plus, promovarea pomușoarelor de Josta pe piețele naționale și internaționale poate crește conștientizarea și aprecierea acestui fruct aparte, stimulând economia locală și încurajând practicile agricole sustenabile în regiune, în special că pomușoarele respective combină caracteristicile nutritive ale ambelor specii părinte. Analiza compoziției nutriționale a Jostei dezvăluie un profil bogat în antioxidanți, vitamine și minerale, toate esențiale pentru promovarea unui stil de viață sănătos [9].

Antioxidanți: Josta este remarcabilă pentru conținutul său înalt de antioxidanți, inclusiv antocianine, flavonoide și taninuri. Acești compuși pot reduce stresul oxidativ din organism, protejând celulele împotriva daunelor cauzate de radicalii liberi și reducând riscul de boli cronice, cum ar fi afecțiunile cardiovasculare, inflamația, anumite tipuri de cancer și declinul cognitiv asociat cu vârsta [10].

Vitamine: Fructele de Josta sunt o sursă excelentă de vitamina C, un nutrient vital care contribuie la întărirea sistemului imunitar, la sinteza colagenului și la absorbția fierului. De asemenea, pot conține vitamine din complexul B, în special B6, care este importantă pentru metabolismul energiei și funcționarea creierului, precum și vitamina K, esențială pentru coagularea sângelui și sănătatea oaselor [11].

Minerale: Mineralele pe care le poate conține Josta includ potasiu, care este crucial pentru echilibrul fluidelor corpului, reglarea tensiunii arteriale și funcționarea musculară. Alte minerale care pot fi prezente în cantități mai mici includ calciu, magneziu și fier [12].

Fibre: Consumul de Josta poate contribui la aportul zilnic de fibre, esențiale pentru digestie sănătoasă, controlul glicemiei și menținerea senzației de sațietate, ajutând astfel la gestionarea greutății [13].

Cu un conținut ridicat de apă și o cantitate moderată de zaharuri naturale, Josta poate fi inclusă în diete alimentare pentru o varietate de beneficii pentru sănătate. Antioxidanții și nutrienții pe care îi conține pot ajuta la prevenirea bolilor cronice, la îmbunătățirea funcției imune și la promovarea sănătății generale [14]. Consumul de Josta ca parte a unei diete echilibrate, împreună cu un stil de viață activ, poate contribui la menținerea sănătății și a bunăstării pe termen lung.

Metode de conservare a pomușoarelor de Josta

În ceea ce privește utilizarea metodele de conservare a fructelor de pădure, tehnologiile moderne oferă o varietate de opțiuni și anume:

1. **Deshidratarea** – procesul de îndepărtare a apei din fructe, ceea ce inhibă dezvoltarea microorganismelor și prelungeste durata de păstrare a produsului [12].
2. **Vidarea** – păstrarea fructelor în ambalaje ermetic închise sub vid, care reduce contactul cu oxigenul și încetinește procesele de oxidare.
3. **Pasteurizarea** – încălzirea fructelor la o temperatură care distruge microorganismele patogene, însă păstrează majoritatea proprietăților nutritive [15].
4. **Congelarea rapidă** – congelarea rapidă a fructelor la temperaturi foarte scăzute, care păstrează structura celulară și valorile nutritive aproape intacte [16].

5. **Tratamente cu pulsații de câmp electric** – o metodă neconvențională care utilizează impulsuri de electricitate scurte pentru a inactiva microorganismele fără a afecta calitatea nutrițională sau organoleptică a produselor [17].
6. **Utilizarea gazelor inerte** – ambalarea produselor în atmosferă modificată, unde oxigenul este înlocuit cu gaze inerte precum azotul sau dioxidul de carbon, pentru a preveni oxidarea [18].

Toate aceste metode au ca scop prelungirea termenului de valabilitate al produselor și păstrarea cât mai fidelă a gustului, texturii și proprietăților benefice ale pomușoarelor, asigurând disponibilitatea lor pe tot parcursul anului pentru consumatori.

Scopul prezentei lucrări a fost identificarea parametrilor optimi pentru conservarea pomușoarelor de Josta prin congelare, liofilizare și uscare.

Materiale și metode:

Pomușoare de Josta recepționate de la producător local din Cimișlia, situat în partea de sud a Republicii Moldova, recolta anului 2023.

Pentru realizarea proceselor tehnologice de conservare a pomușoarelor de Josta a fost folosit echipament de laborator. Procesul de congelare a fost realizat în camera frigorifică Binder MKF 720. Pentru realizarea procesului de uscare s-a utilizat etuva Pol-Eco-Aparatura. Procesul de liofilizare a fost realizat la liofilizatorul Christ Gamma 2/16 LSCplus.

Rezultate și discuții

Congelarea, liofilizarea și uscarea sunt metode de conservare care influențează compoziția chimică și conținutul de compuși bioactivi ai produselor vegetale. Fiecare metodă are avantajele și dezavantajele sale în ceea ce privește efectul asupra calității nutriționale și a compușilor fenolici.

Procesul de congelare a fost realizat la temperatură de -29 ± 1 °C, cu păstrare ulterioară la temperatură de $-18 \dots -20$ °C. La congelarea pomușoarelor de Josta își păstrează bine structura, fructele rămân întregre datorită formării de cristale de gheață mici în produs, care provoacă mai puține daune structurale țesuturilor fructului, păstrând astfel mai bine calitatea acestora în special compușii bioactivi, inclusiv polifenolii și antioxidanți.

A doua metodă de conservare utilizată este liofilizarea, care s-a realizat în două etape. La prima etapă implică aplicarea următorilor parametri: $P = 13$ Pa, $t = -29 \pm 1$ °C, $\tau = 10$ h, și etapa a II $P = 13$ Pa, $t = 19 \pm 1$ °C, $\tau = 10$ h. Aceasta metodă de uscare a permis menținerea structurii produsului și a demonstrat o capacitate excelentă de a conserva a compoziției chimice, conținutului de polifenoli și activitatea antioxidantă. Acest efect este atribuit absenței apei și temperaturilor moderate folosite în proces, care minimizează degradarea compușilor sensibili la căldură și procese de oxidare. Cu toate acestea, este important de menționat că, deși liofilizarea este cea mai eficientă metodă în păstrarea compușilor bioactivi, costurile de producție asociate cu această metodă pot fi semnificativ mai mari comparativ cu celelalte metode de conservare.

De asemenea pomușoarele de Josta au fost prelucrate prin proces de uscare clasică, realizată la $t = 65 \pm 1$ °C, $\tau = 10$ h. S-a înregistrat o concentrare a compușilor bioactivi, ca urmare a reducerii volumului de apă. Cu toate acestea, expunerea la căldură pe durata procesului de uscare ce poate reduce conținutul unor vitamine a afectat activitatea antioxidantă a produsului finit.

Alegerea metodei de conservare trebuie să echilibreze necesitatea de a menține calitățile nutritive și gustative cu cea de a asigura siguranța și durabilitatea alimentelor pe termen lung [18].

Concluzii

Conținutul de nutrienți și compuși bioactive din fructe în general depinde de parametrii specifici utilizați în procesul de conservare, cum ar fi temperatura, timpul și viteza de congelare sau uscare. Optimizarea acestor parametri este crucială pentru maximizarea calității produsului final. Rezultatele obținute, reieșind din structura fructului, păstrarea culorii, caracteristici organoleptice și activitate antioxidantă, au demonstrat că cea mai bună metodă de conservare pentru pomușoarele de Josta este prin congelare urmată de conservarea prin liofilizare.

Mulțumiri: Proiect instituțional Optimizarea tehnologiilor de procesare a alimentelor în contextul bioeconomiei circulare și schimbărilor climatice.

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ANALIZA CANTITATIVĂ A CONȚINUTULUI DE FLAVONOIDE ÎN CĂTINA ALBĂ (*Hippophae rhamnoides L.*) CULTIVATĂ ÎN REPUBLICA MOLDOVA

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Rezumat. În Republica Moldova, în ultimii ani, cătina albă (*Hippophae rhamnoides L.*) este recunoscută ca o cultură nutraceutică versatilă, cu un mare potențial economic, ceea ce a condus la lărgirea plantațiilor. Fructele de cătină albă sunt bogate în componente bioactive, cum ar fi fenolii, flavonoidele, vitaminele și carotenoidele, care au o varietate de beneficii pentru sănătatea umană, cum ar fi efectele lor antioxidante și antiinflamatorii. Flavonoidele sunt un grup mare de compuși fenolici cu funcții biologice benefice pentru sănătatea umană, sunt unul dintre câțiva constituenți importanți ai fructelor de cătină și sunt cea mai răspândită clasă de fenoli, printre care flavanolii și glicozidele acestora. La fel, izorhamnetin-3-rutinozida, izorhamnetin-3-glucozida-7-ramnozida și epigallocatechina prezintă un conținut ridicat în fructele de cătină albă. Scopul prezentei lucrări a fost analiza cantitativă al conținutului de flavonoide prin metoda de cromatografie lichidă de înaltă performanță în patru soiuri cum ar fi: Clara, Cora, Dora, Mara aflate în stare de maturare deplină.

Cuvinte cheie: vegetale, substanțe naturale, antioxidanți, compuși fenolici, cromatografie lichidă de înaltă performanță

Introducere

Cătina albă (*Hippophae rhamnoides L.*) este un arbust fructifer care face parte din familia Elaeagnaceae, își are originea din Europa și Asia, iar aria plantațiilor cu suprafețe mari se află în nordul Europei, China, Mongolia, Rusia, Canada, inclusiv și în Republica Moldova [1]. În prezent, solicitarea pentru alimentele funcționale, care au posibilitatea de a reduce apariția bolilor civilizației este în continuă dezvoltare [2]. Diverse produse alimentare de origine horticolă (de exemplu: fructele de cătină albă) care au potențial înalt de utilizare, care promovează sănătatea și care conțin substanțe bioactive, pot oferi o aplicare cu latență înaltă, de exemplu ca aditiv natural în produsele alimentare [3]. Fructele de cătină sunt considerate o sursă bogată de substanțe bioactive, printre care izoflavonele și flavonoidele, fiindcă oferă efecte benefice asupra sănătății, cum ar fi efecte antioxidante, anticancerigene și anti-bacteriene [4]. Flavonoidele formează un grup de substanțe naturale cu structuri moleculare variabile [5], sunt de câteva ori mai abundente decât în alte fructe bogate în flavonoide, cum ar fi păducelul, cireșul și afinul [6, 7]. Glicozidele flavonoide, inclusiv izorhamnetina, sunt unii dintre cei mai abundenți compuși fenolici din cătina albă, dar conține și cantități mici de proantocianidine, catechine, saponine triterpenice și unii compuși polari și hidrofobi [8].

Pe baza materialului expus, scopul acestui studiu reprezintă analiza cantitativă al conținutului de flavonoide în cătina albă (*Hippophae Rhamnoides L.*) cultivată în Republica Moldova.

Materiale și metode

Materiale

Pentru determinări au fost utilizate fructe de cătină albă, soiurile „Clara”, „Cora”, „Dora”, „Mara”, recoltate în anul 2022 de pe plantațiile din satul Pohrebea, raionul Dubăsari, latitudinea 47°10'34"N, longitudinea 29°10'4"E și 23 m deasupra nivelului mării. Mostrele de fructe au fost prelevate conform standardului SM SR ISO 874: 2006 [9].

Metode

Pentru analiza cantitativă și identificarea flavonoidelor a fost utilizată metoda de cromatografie lichidă de înaltă performanță cu faza inversă C₁₈ pe coloana PHOENOMENEX (150mm*4,6mm*5mcm) prin metoda eluției cu gradient [10]. Faza mobilă A conține acidtrichloroacetic 0,01% în apă, faza B conține 0,1 acid acetic în acetonitril. Viteza fluxului 0,5 mL/min, flux 5% faza B, temperatura coloanei 30 °C, temperatura detectorului PDA 31 °C. Schema gradientului de concentrație (timpul-faza B): 0 min - 5 %, 5 min - 5 %, 12 min - 85 %, 13,5 min - 85 %, 14,5 min - 5%, 20 min - 5 %, conținutul de flavonoide a fost identificate la lungimea de undă de 355 nm. Valorile înregistrate reprezintă media a trei determinări independente ± abaterea standard, P≤0,05

Rezultate și discuții

Polifenolii sunt cea mai abundentă și larg răspândită clasă de metaboliți în produsele de origine horticolă. Ei sunt de obicei clasificați pe baza numărului de inele fenolice și a altor elemente structurale. Cătina conține fenoli, iar concentrația depinde de varietatea specifică, de maturitatea fiziologică, de condițiile pedoclimatice și de locația geografică [11]. În Tab. 1 este reprezentat conținutul de flavonoide în cătina albă, unde se observă că conținutul total de flavonoide diferă în cele 4 soiuri. Cel mai înalt conținut este reprezentat de soiul „Cora”, unde conținutul total de flavonoide este de 392,1 ± 16,5 mg/100g (I etapă) până la 322,3 ± 13,2 mg/100g (III etapă), urmată de soiul „Mara” unde conținutul total de flavonoide este de 290,1 ± 12,7 mg/100g (I etapă) până la 255,4 ± 9,9 mg/100g (III etapă), urmată de soiul „Clara” unde conținutul total de flavonoide este de 275,3 ± 11,0 mg/100g (I etapă) până la 180,0 ± 7,0 mg/100g (III etapă) și de soiul „Dora” unde conținutul total de flavonoide este de 290,1 ± 12,7 mg/100g (I etapă) până la 157,1 ± 6,1 mg/100g (III etapă).

Tabelul 1

Conținutul total de flavonoide în cătina albă, mg /100g

Stadiul de maturitate, data recoltării	Soiuri de cătină albă			
	Clara	Cora	Dora	Mara
I etapă (08.09.2022)	275,3 ± 11,0	392,1 ± 16,5	180,0 ± 7,0	290,1 ± 12,7
II etapă (18.09.2022)	238,5 ± 9,3	355,0 ± 14,4	165,2 ± 6,4	263,0 ± 11,4
III etapă (28.09.2022)	230,3 ± 9,0	322,3 ± 13,2	157,1 ± 6,1	255,4 ± 9,9

Valorile reprezintă media a trei determinări independente ± abaterea standard, P≤0,05

Identificarea a flavonoidelor din cătina albă prin metoda HPLC: isoramnetin-3-soforozidă-7-glucozidă (iRH-3s-7r) și izoramnetin-3-diglucozidă-7-ramnozidă (iRH-3dg-7r) s-a făcut pe baza timpului de retenție și a analizei spectrului de masă în comparație cu standardele specifice. Izoramnetina, la rândul ei, este derivat metoxilat al quercitinei, cunoscută pentru activitatea sa biologică benefică.

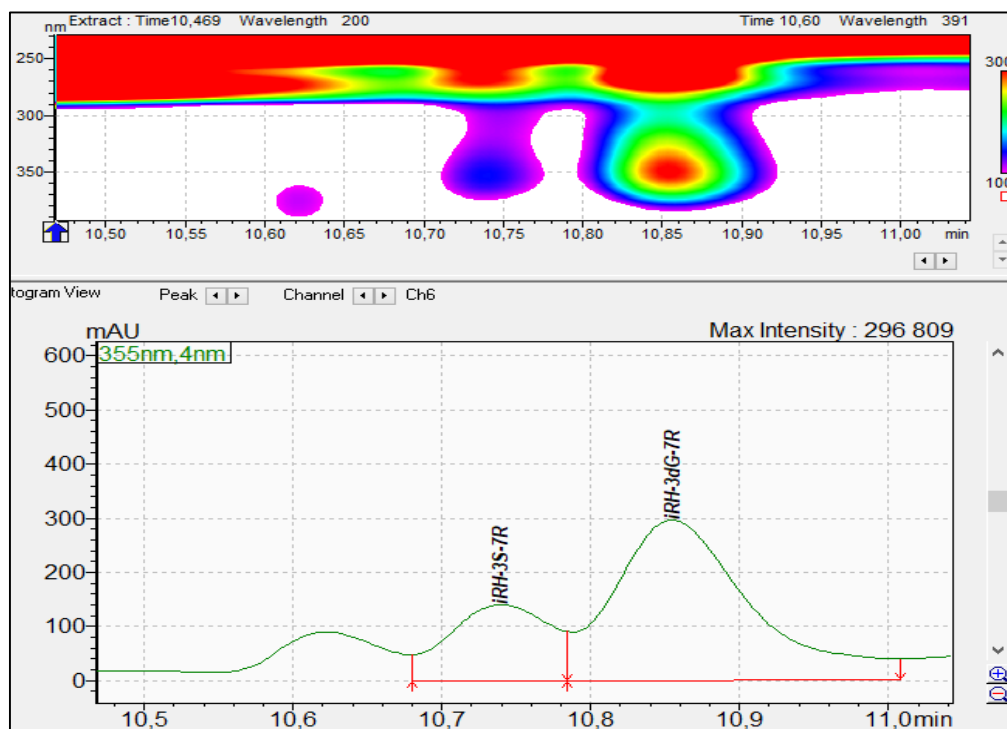
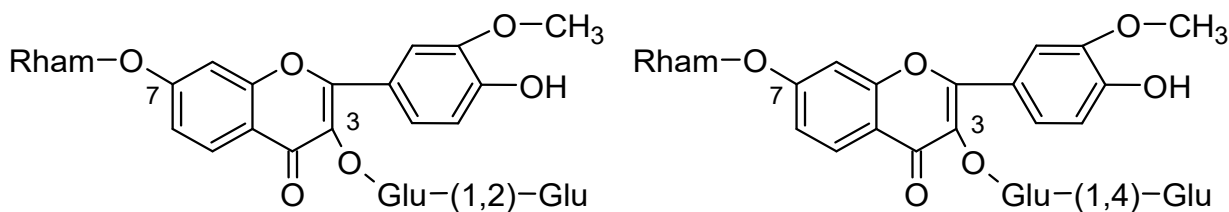


Figura 1. HPLC a Flavonoidelor din FSC: Isoramnetin-3-sofrozidă-7-glucozidă (iRH-3s-7r) și izoramnetin-3-diglucozidă-7-ramnozidă (iRH-3dg-7r)

Au fost raportate diferențe semnificative în ceea ce privește conținutul și profilul compușilor fenolici, sugerând că profilul glicozidelor flavonolice din fructe poate fi un parametru util pentru a distinge între diferite specii de cătină albă [12, 13].



Izoramnetin-3-sofrozidă-7-glucozidă

Izoramnetin-3-diglucozidă-7-ramnozidă

Figura 2. Structura triglicozidelor izoramnetinei

Un studiu recent asupra fructelor de cătină albă din Polonia [12] a raportat un conținut total de flavonoide de la 463 la 393 mg/100 g, adică un rezultat similar cu cele obținute în acest studiu. Alt studiu efectuat de Republica Cehă a investigat fructele de la șase soiuri de cătină albă: „Botanicky” și „Buchlovicky” care sunt de origine cehă; „Hergo” și „Leicora” care sunt de origine germană; „Ljubitelna” și „Trofimovskij” care sunt de origine rusă [14]. Conținutul de flavonoide raportat în cadrul studiului a variat de la 418 până la 385 mg/100 g, în timp ce [15] a raportat că, printre soiurile cultivate în Polonia, fructele „Botaniceskaja-Lubitelskaja” au avut cea mai mică concentrație de flavonoli (212 mg/100 g).

Analiza cantitativă a conținutului de flavonoide acumulate în fructele de cătină albă demonstrează influența multiplilor parametri ca: soiul, metoda de cultivare, data recoltării, condițiile pedoclimatice, transportul și depozitarea [16], ceea ce a indicat necesitatea studiului, pentru a determina care soiuri de cultivare vor produce cele mai mari randamente.

Concluzii

Pe baza rezultatelor obținute, s-a demonstrat că cercetarea soiurilor de cătină albă (*Hippophae rhamnoides L.*), utilizând metoda de determinare prin cromatografie lichidă de înaltă performanță în fază inversă, a prezentat rezultate valoroase. Astfel, la etapa de maturare industrială, la toate soiurile studiate, se observă o tendință de scădere a conținutului substanțelor fenolice din clasa derivaților izoramnetinei, datorită acumulării altor substanțe biologice active. S-a constatat că soiul „Cora” se caracterizează prin cel mai înalt conținut de flavonoide: de la $392,1 \pm 16,5$ mg/100g (I etapă) până la $322,3 \pm 13,2$ mg/100g (III etapă).

Mulțumiri: Cercetarea a fost susținută de Proiectul Instituțional, subprogramul 020405 „Optimizarea tehnologiilor de procesare a alimentelor în contextul bioeconomiei circulare și a schimbărilor climatice”, Bio-OpTehPAS, implementat la Universitatea Tehnică a Moldovei.

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OBȚINEREA β -GLUCANILOR DIN PERETELE CELULAR AL DROJDIEI REZIDUALE DE VINIFICAȚIE

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Rezumat. Industria viti-vinicolă produce cantități mari de produse secundare, inclusiv tescovină, ciorchine și sedimente de drojdii. Este important să fie dezvoltate noi strategii de reducere a deșeurilor și totodată valorificarea produselor secundare generate prin transformarea în produse cu valoare adăugată. Subproduse de vinificație sunt o sursă importantă de compuși bioactive. Drojdiile reziduale din vinificație, considerate în mod tradițional drept deșeuri, reprezintă o sursă neconvențională de β -glucani, molecule cu proprietăți multifuncționale și valoare adăugată semnificativă. Dacă β -glucanii din cereale sunt destul de studiați, în ultimi ani sunt studiate drojdiile reziduale din industria berii, cele din vinificație abia încep să fie valorificate. β -glucani fac parte din clasa polizaharidelor care sunt polimeri ai glucozei cu diferite legături glicozidice. Acest articol explorează oportunitățile de valorificare a drojdiilor reziduale, în special, cele mai eficiente metode de extragere a β -glucanilor, metodele de purificare și determinarea gradului de puritate a β -glucanilor extrași. Se investighează provocările și oportunitățile legate de diversele aplicații ale β -glucanilor obținuți din drojdii, incluzând: industria alimentară, farmaceutică, cosmetică și altele.

Cuvinte cheie: vinificație, drojdii reziduale, β -glucani, extragere, purificare

Introducere

Se cunoaște că 100 kg de struguri procesați generează aproximativ 20–25 kg de tescovină, 3–5 kg de tulpini și 8–10 kg de sediment de drojdie, în funcție de soiul de struguri și de metodele de vinificare aplicate [1]. Sedimentul de drojdie de vin poate fi clasificat în trei grupe în funcție de stadiul de vinificare: drojdie din prima și a doua fermentare, care se formează în timpul fermentației alcoolice și malolactice, și drojdiile de vin de maturare, formate în timpul maturării vinului. Pe de altă parte, sedimentele de drojdii de vin pot fi clasificate și în funcție de dimensiunea particulelor: sedimentele de drojdii grele (între 100 μ m și 2 mm, care se depun în 24 de ore) și ușoare (<100 μ m, între 1 și 24 μ m, și care rămân în suspensie la cel puțin 24 de ore după agitare) [2].

1. Prezentarea generală a drojdiilor reziduale din vinificație

Sedimentul de drojdie de vin este definită ca „sedimentul care se depune în rezervoarele de vinificație după fermentare, în timpul depozitării sau după tratament autorizat sau care se obține după filtrarea sau centrifugarea vinului” [3]. Dacă drojdiile reziduale din industria berii sunt deja valorizate pentru extragerea β -glucanilor, a extractele de drojdie sau drojdia de bere uscată, sedimentul de drojdii reziduale din vinificație sunt utilizate în mare parte pentru recuperarea alcoolului etilic și acidului tartric [4]. Figura 1 ilustrează etapele vinificației și tipurile de subproduse generate în fiecare etapă.

2. Compoziția biomasei de drojdii de vinificație

Compoziția sedimentului depinde de mai mulți factori, precum condițiile de mediu, regiunile de origine și caracteristicile agronomice ale acestora, soiul de struguri și timpul de maturare a vinului [2]. Sedimentul de drojdie de vin este format din partea lichidă și partea solidă. Frația solidă este

o combinație de drojdii, acizi organici (în principal acid tartric), carbohidrați insolubili (cum ar fi materiale celulozice sau hemicelulozice), săruri anorganice, lignină, proteine, compuși fenolici, pulpă și alte părți ale strugurilor. Frația lichidă este compusă în principal din etanol și acizi organici, cum ar fi acidul lactic și acetic [5].

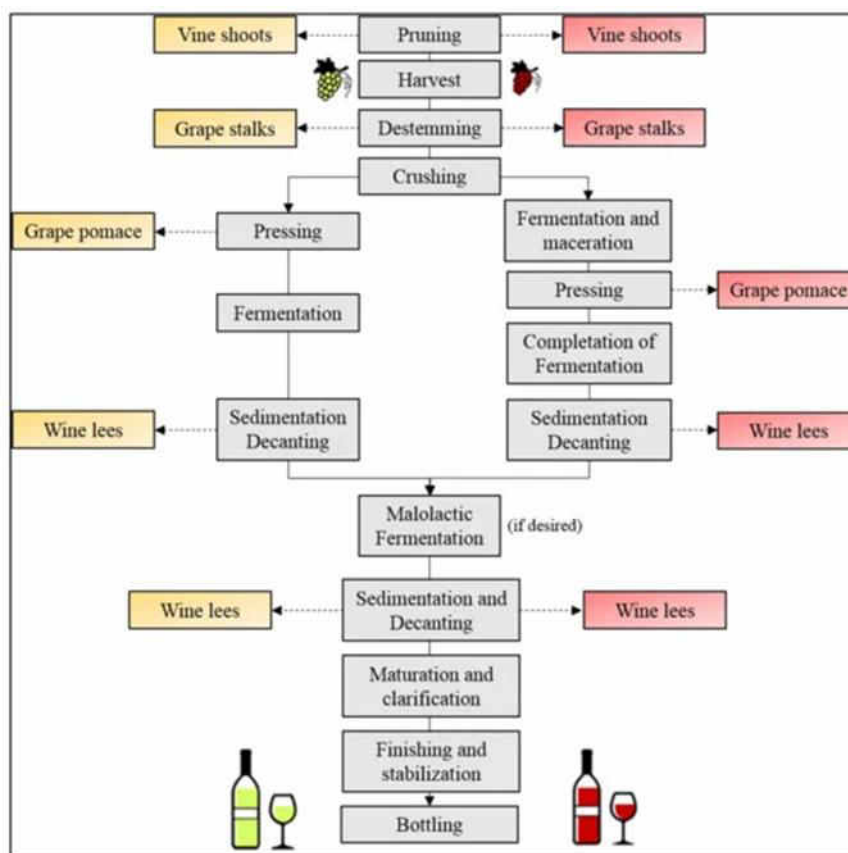


Figura 1. Schema proceselor de vinificație și deșeurile solide de vin [4]

3. Obținerea β -glucanilor din drojdii reziduale

β -glucani se găsesc în peretele celular al celulei de drojdie și este format 85%–90% dintr-un amestec de manani solubili în apă, 10–48% glucani solubili și 15–48% insolubili în alcali, precum și cantități minore de chitina. Datorită rigidității și grosimii peretelui, celula de drojdie *S. cerevisiae* este rezistentă la acțiunea litică și unele procese singulare nu sunt foarte eficiente pentru a sparge peretele celular [6]. Pentru obținerea β -glucanilor din drojdii reziduale sunt nevoie de mai multe etape, care sunt prezentate în Figura 2.



Figura 2. Etapele de extragere a β -glucanilor [7]

3.1. Pretratate

Pentru a elimina alți compuși și a asigura siguranța alimentară, drojdia reziduală trebuie supusă unor tratamente preventive înainte de extragerea β -glucanilor. Prin urmare, este necesar ca nămolul de drojdie să fie mai întâi centrifugat pentru a îndepărta partea lichidă. Sedimentul trebuie suspendat în apă și trecut prin site micrometrice pentru a îndepărta componentele de tescovine care mai pot rămâne [8].

3.2. Liza celulei de drojdie

Distrugerea celulelor este necesară pentru extracția și recuperarea produselor dorite, deoarece distrugerea celulelor îmbunătățește semnificativ recuperarea produselor biologice. Distrugerea celulelor nu poate fi considerată un proces izolat, deoarece afectează proprietățile fizice ale suspensiei celulare, influențând astfel indirect procesele ulterioare din aval. Cele mai răspândite metode de liza a celulelor de drojzii sunt ilustrate în Figura 3.

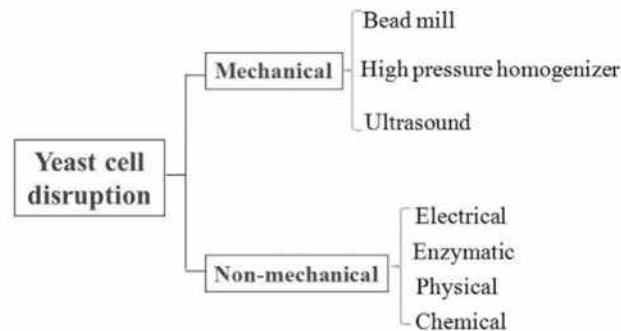


Figura 3. Tipurile de liza a celulelor de drojzii [7]

Eficiența ruperii celulelor a fost determinată ca diferența dintre greutatea suspensiei de 5 ml după uscare, înainte și după liza celulelor (ecuația (1)):

$$\text{Eficiența întreruperii} = \frac{m_0 - m_1}{m_0} \cdot 100 \quad (1)$$

unde m_0 este biomasa uscată inițială înainte de liză și m_1 este biomasa uscată reziduală după liză [7].

3.3. Metode de extragere a β -glucanilor din drojdiile reziduale de vinificație

După liza celulelor de drojzii, urmează extragere propriu zisă a β -glucanilor din peretele celular. Cele mai utilizate metode de extragere sunt: metoda de extragere acido-bazică, metoda de extragere cu apa fierbinte/ omogenizare la presiune înaltă, extragerea enzimatică, extragerea asistată cu ultrasunete, extracție asistată cu microunde.

3.3.1. Metoda de extragere acido-bazică

Una dintre cele mai frecvent utilizate și mai sigure metode de extracție este extracția alcalină. Procesul de extragere este în mai multe etape și implică tratarea unui volum de suspensie celulară la cinci volume de hidroxid la temperaturi ridicate (+90°C). După îndepărtarea supernatantului, care conține proteine, lipide și acizi nucleici, se utilizează un tratament cu acid - în special, acid acetic în aceeași proporție de volum - pentru a îndepărta glicogenul și compușii amorfi [19]. Pe lângă NaOH și CH₃COOH se mai folosesc și alte combinații de baza-acid, precum: NaOH/HCl, NaOH/NaClO și NaOH + NaClO/DMSO [9].

3.3.2. Metoda de extragere cu apă fierbinte/omogenizarea la presiune înaltă

Această metodă utilizează apă fierbinte pentru a extrage β -glucanii din peretele celular al drojdiei. Este o abordare mai simplă în comparație cu alte metode, dar poate avea o puritate mai mică sau poate necesita o prelucrare ulterioară. Inițial suspensia de biomasa de drojzii este încălzită până la +121°C timp de 4 ore și apoi răcită la +45°C, după care este omogenizată cu un omogenizator de înaltă presiune [10].

3.3.3. Extragerea enzimatică

Ca și metoda descrisă mai sus aceasta este folosită în combinație cu alte metode și are ca scop înlăturarea proteinelor și a lipidelor din suspensie. Astfel suspensia de drojdie este încălzită la +45 C și incubată cu adaos, mai întâi de protează, urmată de centrifugare, după care se efectuează incubarea cu adaos de lipaze, la fel urmată de centrifugare [10].

3.3.4. Tratarea cu solvenți organici

Pe lângă apă fierbinte, o serie de solvenți organici pot fi utilizați pentru extragerea β-glucanilor din drojdie. Fiecare solvent are propriile avantaje și dezavantaje, influențând randamentul, puritatea și proprietățile β-glucanilor obținuți. În calitate de solvent sunt utilizați etanolul [11], izopropanol, eter de petrol [12] sau acetone [10].

3.3.5. Extragerea asistată cu ultrasunete

Extragere asistată cu ultrasunete este considerată o tehnică eficientă pentru extragerea polizaharidelor bioactive din resursele naturale. Extragerea asistată cu ultrasunete are mai multe avantaje față de metodele tradiționale, precum creșterea difuziei, având un timp de extragere scurt fiind eficient și ecologic. În general, eficiența extragerii asistate cu ultrasunet este influențată de diverși factori, cum ar fi amplitudinea ultrasunetelor, timpul de extragere și raportul dintre lichid și materia primă, iar efectele acestora pot fi independente sau interactive [13], [14]. Cele mai răspândite frecvențe aplicate pentru extragerea β-glucanilor din drojdiile reziduale sunt: 22 kHz [15], 20 kHz [16], 40 kHz [17]. Combinarea mai multor metode este cea mai utilizată deoarece permite extragerea mai eficientă a β-glucanilor.

3.4. Purificarea finală

După procesul de extracție, probele trebuie supuse mai multor etape de purificare pentru a elimina alte substanțe precum proteine, compuși fenolici, monozaharide, aminoacizi sau alte molecule înrudite. Purificarea este necesară pentru a atinge valori de puritate de 80% a β-glucanilor din drojdiile, stabilită de UE prin Decizia (EU) 2017/2048 în 2017 [18]. Metoda de purificare poate fi repetarea metodei de extragere sau o metodă alternativă față de extragere. După cum arată studiile, cele mai eficiente metode de purificare (95.25%) sunt autoclavarea (tratarea la +125°C a suspensiei de 13% (g/g) timp de 5 ore) combinată cu purificarea enzimatică, precedată de extragere acido-bazică. La fel rezultate satisfăcătoare a arătat purificarea prin omogenizarea la presiune înaltă, urmată de tratarea cu acetone și proteaze (93.12%), precedată de extragerea cu apă fierbinte [19].

3.5. Uscarea

Pentru depozitarea β-glucanilor extrași pot fi aplicate 3 metode de conservare: uscare la aer, uscare prin pulverizare și liofilizare. Uscarea prin pulverizare este efectuată la temperaturi de intrare de +180°C. Liofilizarea sedimentului se efectuează prin congelarea la - 80°C, timp de 24h, urmata de liofilizarea vacuum la - 50°C, timp de 24h [20].

Determinarea conținutului de β-glucani extrași

Pentru a înțelege cât de eficientă a fost metoda aplicată de extragere a β-glucanilor este nevoie de a determina conținutul acestora în produsul obținut. Una din metodele de analiză este utilizarea unui kit enzimatic specific pentru glucani. Conținutul de β-glucani obținut este determinat cu ajutorul formulei (ecuația (2)):

$$B\text{-glucan} = AE \times F \times \frac{10.836}{W} \quad (2)$$

unde AE este absorbanta față de martor, F este conversia de la absorbanta la standardul μg (150 μg de D-glucoză) împărțit la absorbanta GOPOD a acestor 150 μg, iar W este greutatea probei analizate în mg, 10,836 -constant [7].

4. Aplicații ale β -glucanilor din drojzii reziduale

Proprietățile bioactive, efectele prebiotice, antioxidante, antitumorale și de reglare a lipidelor și glucozei din sânge a făcut din β -glucani ingrediente atractive pentru alimente funcționale. Pe lângă rolul său în nutriție și sănătate, mulți cercetători folosesc β -glucani pentru capacitatea lor de stabilizare în produse precum supe, sosuri și băuturi [21]. În produsele lactate sunt utilizate în calitate de texturizanti [22] și substituent parțial al grăsimilor în mezeluri sau brutărie [18, 23].

Concluzii

Drojdiile reziduale din vinificație reprezintă o sursă valoroasă de β -glucani cu proprietăți funcționale multiple. Extractele de β -glucani din drojzii pot fi utilizate în diverse domenii, oferind o gamă largă de beneficii. Această lucrare sintetizează etapele principale și metodele de extragere a β -glucanilor din peretele celular al drojdiilor reziduale. Putem notifica că sunt necesare studii suplimentare a drojdiilor reziduale din vinificație pentru a putea fi valorificate în mai multe etape, extrăgând compuși valoroși.

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ANALIZA TESCOVINEI DE GUTUIE PENTRU OBȚINEREA CONCENTRATELOR DE FIBRE ALIMENTARE SOLUBILE

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Rezumat. Valorificarea deșeurilor și subproduselor alimentare a devenit un subiect major de cercetare îmbunătățirea durabilității lanțului alimentar. Subprodusele alimentare (în principal a celor de origine vegetală) reprezintă o sursă importantă de zaharuri, acizi organici, fibre dietetice, substanțe fenolice, flavonoizi, substanțe minerale, vitamine, ceea ce demonstrează un potențial înalt al aplicării subproduselor alimentare în obținerea produselor lactate. Fibrele alimentare (FA) au demonstrat efecte fiziologice precum tehnologice înalte și au devenit un ingredient important în industria alimentară datorită aplicabilității sale ridicate în formulările alimentare. În cadrul investigației, s-a propus de urmărit impactul diferitor metode de extracție asupra concentratelor de fibre alimentare solubile și insolubile obținute din tescovina de gutui. Au fost aplicate trei metode de extracție: enzimatică clasică; enzimatică asistată cu ultrasunet și enzimatică asistată cu microunde. Randamentul a pectinei din concentrat de fibre solubile este cuprinsă între 14 și 20%. Sa raportat că conținutul total de fibre alimentare variază între 1,4-4,3%. S-a analizat și indicii de tehnologici a concentratelor, capacitatea de reținere a emulsiei a fost stabilă timp de 16 ore, greutatea echivalentă e 329,49-535,42 mg, conținutul metoxil este 5,64-10,29 %. Prin urmare, rezultatele acestui studiu pot promova utilizarea completă a tescovinei de gutuie și a deșeurilor industriale similare și, de asemenea, pot ajuta la evitarea unei posibile poluări.

Cuvinte cheie: subproduse vegetale, gutuie, fibre alimentare, tescovină din gutuie, concentrate de fibre alimentare

Introducere

Un interes pentru dezvoltarea alimentelor funcționale a apărut în ultimii ani în principal pentru că acestea pot oferi beneficii fiziologice și nutriționale. Aceste alimente conțin ingrediente despre care se știe că au efecte benefice asupra sănătății umane. Cu toate acestea, funcționalitatea nu este legată numai de sănătate sau fiziologie, ci și de modificările fizice sau chimice ale unui produs alimentar dat, care îmbunătățesc proprietățile dezirabile specifice. Aceasta din urmă este cunoscută și sub numele de funcționalitate tehnologică. Fibrele alimentare au demonstrat efecte fiziologice precum tehnologice înalte și au devenit un ingredient important în industria alimentară datorită aplicabilității sale ridicate în formulările alimentare [1].

În ultimii 40 de ani, au fost efectuate mai multe cercetări pentru a demonstra beneficiile pentru sănătate atribuite ingerării de, de exemplu, riscul redus al obezității, diabet și hipertensiune arterială. Din acest motiv, guvernele și organizațiile internaționale au crescut recent aportul zilnic recomandat de fibre alimentare până de la 25 - 30 g pentru o dietă de 2000 kcal. În plus, consumatorii sunt mai preocupați de consumul de alimente sănătoase cu conținut ridicat de fibre alimentare și valoare calorică scăzută. Cu toate acestea, consumatorii preferă și ingredientele nesintetice obținute din resurse naturale. Prin urmare, industria alimentară, pentru a se conforma

recomandărilor guvernamentale și a satisface cerințele consumatorului, caută în permanență noi surse de fibre alimentare [2].

Tendențele actuale indică o creștere a interesului pentru utilizarea acestor subproduse pentru obținerea de fibrelor alimentare. Industria alimentară și cercetarea au început să exploreze tehnologii inovatoare pentru extragerea și valorificarea eficientă a acestor componente, contribuind astfel la dezvoltarea unei economii alimentare mai durabile și a unor produse alimentare funcționale [3].

Unele studii epidemiologice au relevat că există o relație directă între consumul de alimente bogate în fibre alimentare și riscul reducerii unor boli cronice precum, cancerul colonorectal, bolile cardiovasculare, obezitatea, diabetul, constipația [4]. De asemenea, mai multe fibre alimentare au demonstrat *in vitro* și *in vivo* capacitatea lor de a absorbi agenți cancerigeni [5].

Fibrele alimentare sunt definite ca componente ale alimentelor, care sunt disponibile în mod obișnuit în cereale, fructe și legume, foarte rezistente la enzimele de digestie, nu pot fi digerate în intestin, și fermentate total sau parțial în intestinul gros [6].

Studiile recente demonstrează că utilizarea tescovinei de gutuie pentru obținerea de compuși cu valoare adăugată este relevantă pentru sectorul de procesare a fructelor din Republica Moldova. Producerea gutuie este un sector care înregistrează o dezvoltare vertiginoasă în ultimii ani în Moldova. Cererea de gutuie pe piața internațională este tot mai mare, în acest sens producătorii moldoveni au investit considerabil în producerea de gutuie în ultimii ani. Volumul de producție a crescut exponențial, deoarece livezile intensive au intrat pe rod. Subprodusele și reziduurile rezultate din urma procesării gutuilor (cojile, sâmburii și pulpa neutilizată generate în diferitele etape ale procesului de producție), care sunt în cea mai mare parte aruncate, cauzează nu numai poluarea mediului înconjurător dar sunt și surse de biocomponente.

În general reziduurile vegetale constituie o sursă naturală bună de carbohidrați, polizaharide, proteine, vitamine, minerale, antioxidanți în timp ce produsele secundare pot prezenta un conținut foarte ridicat de compuși bioactivi. Sâmburii și uleiurile care pot fi recuperate din acestea sunt bogate în diferiți compuși bioactivi cum ar fi tococromanoli, acizi grași esențiali, fitosteroli și scualene în timp ce coaja de caise este o sursă bogată în pectine, carbohidrați, fibre și minerale. Recuperarea compușilor cu valoare ridicată permite utilizarea acestora ca aditivi alimentari și/sau nutraceutice [7].

Materiale și metode

Noile tehnologii de extracție a concentratelor de fibre alimentare au captat recent atenția, inclusiv metode precum microundele și ultrasunetele, inclusiv și clasică. Extracția enzimatică asistată de ultrasunete generează forțe intense de cavitație și forfecare, care perturbă structura celulară a țesutului vegetal. Aceste acțiuni cresc accesibilitatea solventului la nivelul structurii interne, facilitând eliberarea componentelor celulare într-un mod mai eficient și amplificând astfel eficiența procesului de extracție [8].

Extracția enzimatică asistată de microunde utilizează unde electromagnetice neionizante, cunoscute ca microunde, pentru a produce modificări în structura celulelor vegetale. În acest proces de extracție, se observă fenomene de transfer unidirecțional al căldurii și masei. Energia cu microunde este aplicată direct materialului, iar această energie este transformată în energie termică prin interacțiunile moleculare cu câmpul electromagnetic. Ulterior, căldura generată trebuie dispersată volumetric în interiorul probei. Aceste fenomene contribuie la îmbunătățirea penetrării celulare, facilitând difuzia atât internă, cât și externă a compușilor, rezultând în final randamente îmbunătățite ale procesului de extracție.

În cadrul acestei investigații, s-a propus evaluarea impactului diferitelor metode de extracție asupra caracteristicilor fizico-chimice ale concentrației de fibre alimentare. Au fost analizați indicii tehnologici, capacitatea de emulsionare și calculat randamentul concentratelor de fibre alimentare obținute în urma celor trei proceduri de extracție aplicate [9, 10].

În acest scop, au fost identificate și analizate trei proceduri distincte de extracție:

- Extracția enzimatică clasică;
- Extracția asistată cu ultrasunete;
- Extracția asistată cu microunde.

Rezultatele obținute în urma acestui studiu au potențialul de a oferi o bază solidă pentru obținerea ulterioară a tescovinei de gutuie ca o sursă inovatoare de fibre alimentare în aplicații în industria alimentară.

Tabelul 1

Protocolul de extracție și obținere a concentratelor din fibre alimentare utilizat în cadrul cercetărilor

Metoda de extracție	Etapele de lucru
Extracția enzimatică	Pulberea de tescovină a fost amestecat cu apă într-un raport de 1:20, iar pH-ul a fost ajustat la 1,5; 2,0; 2,5. Amestecul a fost tratat la temperatura de 80°C timp de 3 ore. După răcire, amestecul a fost centrifugat (8000 r/min, 10 min); supernatantul a fost decantat iar sedimentul rămas (concentratul de fibră alimentară insolubilă) a fost uscat și cântărit. supernatantul a fost precipitat cu două volume de etanol 95% timp de 24 ore. precipitatul a fost colectat prin centrifugare (8000 r/min, 10 min), uscat și cântărit, (concentratul de fibră solubilă).
Extracția asistată de microunde	Pulberea de tescovină a fost amestecat cu apă într-un raport de 1:20, iar pH-ul a fost ajustat la 1,5; 2,0; 2,5. Amestecul a fost plasat într-un sintetizator cu reacție chimică cu microunde (putere cu microunde, 180 W, 300 W, 450 W) pentru extracție timp de 7 minute intermitent. După răcire, amestecul a fost centrifugat (8000 r/min, 5 min); supernatantul a fost decantat iar sedimentul rămas a fost uscat și cântărit. supernatantul a fost precipitat cu două volume de etanol 95% timp de 24 ore. precipitatul a fost colectat prin centrifugare (8000 r/min, 10 min), uscat și cântărit, (concentratul de fibră solubilă).
Extracția asistată de ultrasunet	Pulberea de tescovină a fost amestecat cu apă într-un raport de 1:20, iar pH-ul a fost ajustat la 1,5; 2,0; 2,5. Amestecul a fost plasat în baia cu apă cu ultrasunet (frecvența 37 kHz) pentru extracție timp de 15, 30 și 45 minute la temperatura de 75 °C. După răcire, amestecul a fost centrifugat (8000 r/min, 5 min); supernatantul a fost decantat iar sedimentul rămas a fost uscat și cântărit. supernatantul a fost precipitat cu două volume de etanol 95% timp de 24 ore. precipitatul a fost colectat prin centrifugare (8000 r/min, 10 min), uscat și cântărit, (concentratul de fibră solubilă).

Rezultate și discuții

În studiul dat, s-a cercetat tescovina de gutuie: soiul Bereczki: fructul de mărimea de 225-900g, luna recoltării octombrie- ianuarie.

Pulpa este tare, suculentă iar în jurul inimii formează un strat subțire de celule lignificate, are un gust dulce cu conținut ridicat de zahăr, puțin acidulat aromat.

Fruitele pot fi valorificate pentru consum în stare proaspătă sau prin prelucrare sub forma de suc natural, compot, dulceață, gem.

Tescovina de gutuie obținută la fabricarea sucului se caracterizează printr-un conținut de umiditate de 39%, prin urmare a fost necesară asigurarea stabilității tescovinei de gutuie pe durata cercetărilor. Pentru aceasta tescovina de prune a fost uscată la temperatura de 50°C timp de aproximativ 20 ore, până la umiditatea de 4,2%. Ulterior tescovina de prune uscată a fost măcinată până la obținerea unei pulbere fine și omogene.

Pulberea de tescovină de gutuie s-a caracterizat prin pulbere omogenă, de particule mici, de culoare portocaliu specific culorii gutuiei, gust și miros plăcut, specific fructelor de gutuie.

Variabilitatea proprietăților funcționale ale concentratelor fibrelor alimentare este strâns legată de tehnica specifică de extracție utilizată în procesul de obținere. Fiecare metodă de

extracție, fie că este vorba despre procedee extracția clasică, tehnici asistate de microunde sau ultrasunete, aduce cu sine modificări distincte în structura și compoziția fibrelor rezultate.

Influența procesului de extracție asupra indicilor tehnologic concentraților de fibre solubile alimentare stabilitatea cremei de emulsie Fig. 1, după 8 h -16 h a fost stabile, greutatea echivalentă a constituit 300-535mg; gradul de esterificare a pectinei a fost de 51-56%.

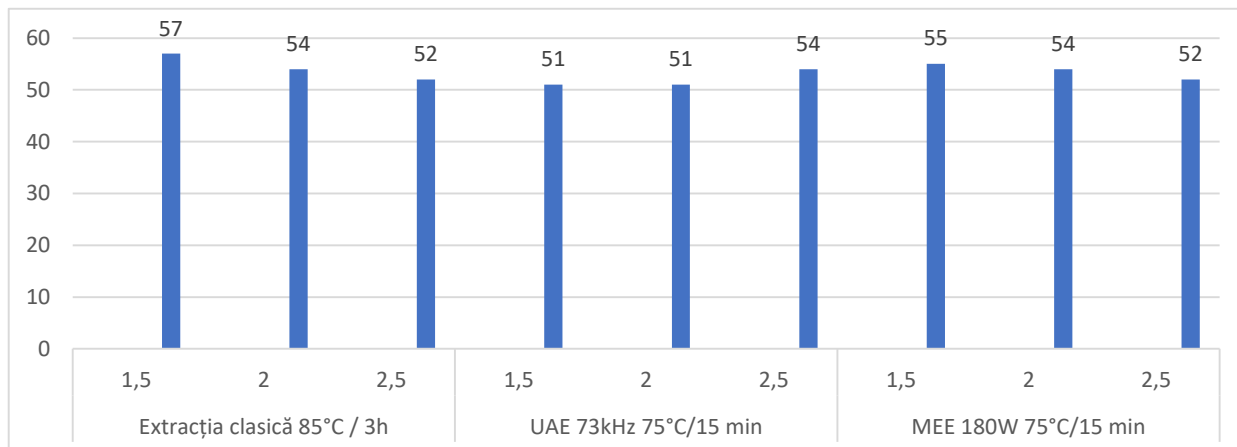


Figura 1. Influența procesului de extracție asupra indicator tehnologic concentraților de fibre solubile alimentare a indicelui de staabilitate a emulsiei ESI, %

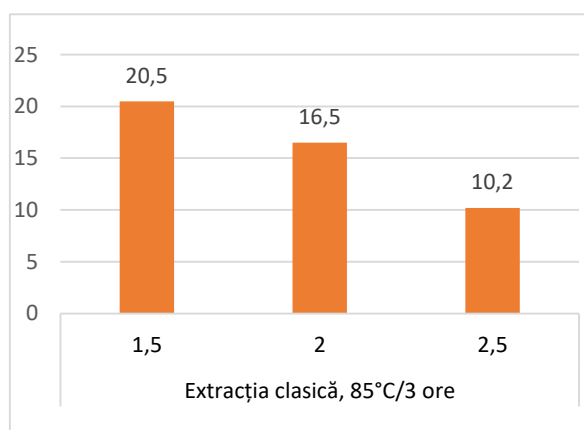


Figura 2. Influența procesului de extracție asupra randamentului concentraților de fibre alimentare

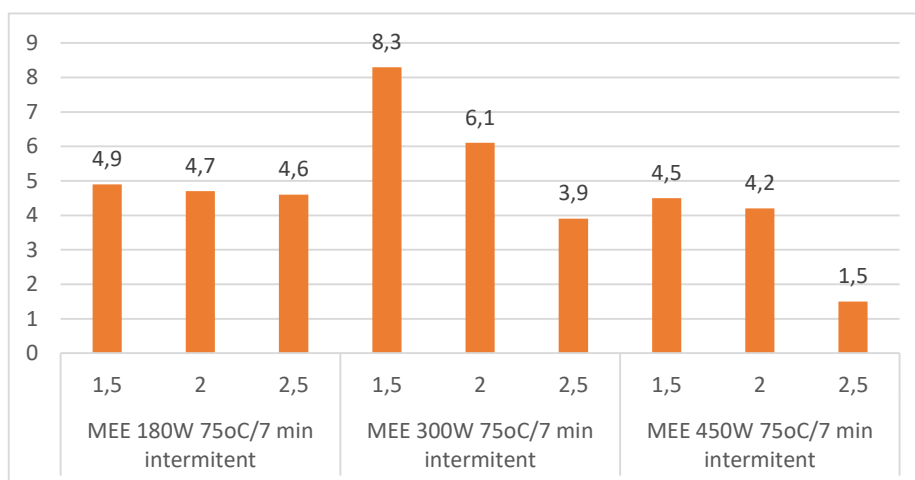


Figura 3. Influența procesului de extracție asistată de microunde asupra randamentului concentraților de fibre alimentare

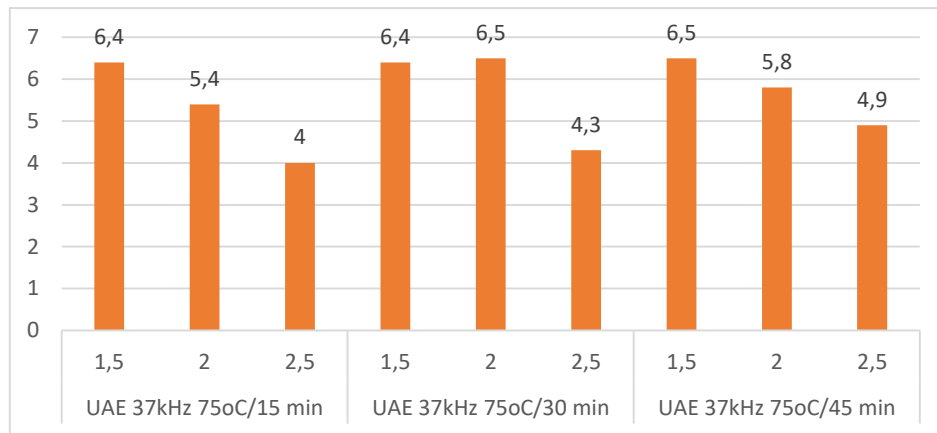


Figura 4. Influența procesului de extracție asistată de ultrasunet asupra randamentului concentratelor de fibre alimentare

Influența procesului de extracție asupra randamentului de obținere a concentratelor de fibre alimentare din tescovina de gutuie Fig. 2, Fig. 3, Fig. 4, arată că tescovina de gutuie cuprinde o cantitate semnificativă de fibre alimentare și compuși polifenolici. Acest studiu propune aplicarea extracției clasice (EE), extracției asistată de microunde (MEE) și extracției asistată de ultrasunet (UAEE) pentru a extrage fibrelor alimentare solubile și insolubile din tescovina de gutuie și analiza influenței diferitelor metode asupra randamentului, proprietăților fizico-chimice al concentratelor de fibre alimentare extrase.

Concluzii

- Valorificarea deșeurilor și subproduselor alimentare a devenit un subiect major de cercetare pentru îmbunătățirea durabilității lanțului alimentar.
- Subprodusele alimentare (în principal a celor de origine vegetală) reprezintă o sursă importantă de zaharuri, acizi organici, fibre dietetice, substanțe fenolice, flavonoizi, substanțe minerale, vitamine, ceea ce demonstrează un potențial înalt al aplicării subproduselor alimentare în obținerea produselor lactate.
- Fibrele alimentare (FA) au demonstrat efecte fiziologice precum tehnologice înalte și au devenit un ingredient important în industria alimentară datorită aplicabilității sale ridicate în formulările alimentare.
- Au fost aplicate trei metode de extracție: enzimatică clasică; enzimatică asistată cu ultrasunet și enzimatică asistată cu microunde pentru a obține concentrate de fibre alimentare solubile și insolubile obținute din tescovina de gutui.
- Randamentul a pectinei din concentrat de fibre solubile este cuprinsă între 14 și 20%
- Indicii de tehnologici a concentratelor, capacitatea de reținere a emulsiei a fost stabilă timp de 16 ore și a constituit 1-2%, greutatea echivalentă e 329.49-535.42 mg, conținutul metoxil este 5.64-10.29 %.
- Rezultatele acestui studiu pot promova utilizarea completă a tescovinei de gutuie și a deșeurilor industriale similare și, de asemenea, pot ajuta la evitarea unei posibile poluări.

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ТЕХНОЛОГИЯ ПРОИЗВОДСТВА ДЕСЕРТНОГО ПРОДУКТА С ВЫСОКОЙ БИОЛОГИЧЕСКОЙ ЦЕННОСТЬЮ

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Резюме. Данная работа направлена на теоретическое и практическое исследование повышения биологической ценности десертного продукта, за счет добавления в рецептуру порошка из кожицы красного винограда. Концентрация добавки составляла от 5 до 10 % к общей массе. Виноградные кожицы, полученные после переработки винограда сорта Мерло, выращенного в южном регионе Республики Молдова, были высушены методом конвективной сушки при температуре 65°C до влажности $6,8\pm 2\%$. В полученном порошке содержание полифенолов составляло 407,26 мг/л и антиоксидантная активность - 97,39 %. Было выявлено, что введение порошка виноградной кожицы положительно влияет как на физико-химические характеристики продукта, так и на его органолептические свойства. Повышение биологической ценности разработанного десерта обусловлено увеличением содержания полифенолов от 127 мг/л в образцах с 5% добавлением порошка до 233,68 мг/л с 10% порошка и повышенной антиоксидантной активностью от 21,13 до 32,73 % соответственно. В ходе работы, был произведен микробиологический анализ, который показал положительный эффект добавления порошка виноградной кожицы на стабильность продукта. Так, после семи дней хранения обогащенные образцы были наиболее стабильны в сравнении с контрольным образцом.

Ключевые слова: десертный продукт, виноград, биологическая ценность, кожица, антиоксидант

Введение

В настоящее время огромное количество исследований направлено на разработку продуктов питания, обогащенных полезными компонентами с антиоксидантными свойствами [1]. Антиоксиданты направлены на замедление окислительных процессов, поглощая свободные радикалы и сохраняя действие витаминов от окисления кислородом. В данной работе представлен вариант обогащения десерта с использованием антиоксиданта натуральной природы [2]. Помимо антиоксидантов, для улучшения здоровья человека, используются студнеобразующие вещества, такие как агар-агар, пектин или желатин [3]. Представленная работа является актуальной, так как наша страна является передовой в производстве и переработке винограда. Кожица красного винограда содержит в себе огромное количество антиоксидантных веществ, в том числе и ресвератрол. Использование кожицы винограда как сырья для извлечения антиоксидантов с последующим употреблением для обогащения широкого спектра пищевых продуктов имеет теоретический и практический интерес [4].

Материалы и методы

Виноградные кожицы, от переработки винограда сорта Мерло [6], выращенного в южном регионе Республики Молдова, были высушены методом конвективной сушки [5] при температуре 65°C до влажности $6,8\pm 2\%$, измельчены и просеяны. Десерт типа маршмелоу был приготовлен с добавлением в рецептуру от 5 до 10% порошка.

Органолептическая оценка образцов показала их высокие потребительские качества. Также были определены: содержание сухих веществ, эластичность и пышность изделий, активность воды, кислотность, содержание полифенолов и антиоксидантная активность, микробиологическая стабильность. Образцы хранились в сухом, темном месте в течение месяца. Все определения выполнены стандартными общепринятыми методами.

Выводы и обсуждения.

Органолептический анализ выявил, что по всем показателям лидирует десерт с добавлением порошка 10%. У данного вида десерта наиболее благоприятный цвет, вкус, форма и эластичность по сравнению с другими образцами (Рис.1).

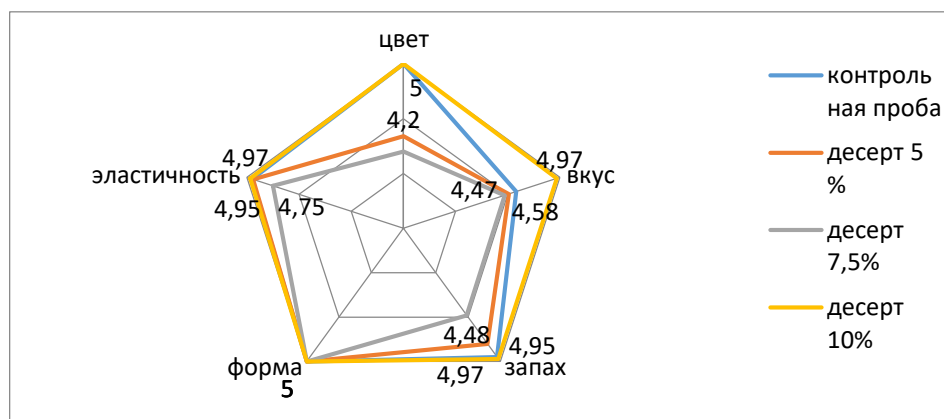


Рисунок 1. Органолептическая оценка образцов десерта с различной концентрацией добавленного порошка виноградной кожицы

Некоторые физико-химические показатели образцов представлены в Таблице 1.

Таблица 1.

Некоторые физико-химические показатели исследуемых образцов

	СВ, %		Активность воды			рН		
	до покрытия сах.пудрой	после покрытия сах.пудрой	Свежий продукт	14 дней хранения	28 дней хранения	Свежий продукт	Через 14 дней хранения	Через 28 дней хранения
Контрольная проба	51,5	81,7	0,672	0,659	0,626	3,57	3,76	5,54
Образец с 5% пудры винограда	78,43	84,29	0,627	0,600	0,519	3,40	4,13	4,77
Образец с 7,5% пудры винограда	81,75	86,07	0,656	0,643	0,465	3,61	4,36	4,93
Образец с 10% пудры винограда	77,75	82,42	0,536	0,467	0,426	2,62	3,18	5,20

Выявлено, что активность воды снижается у всех образцов по мере хранения. Определение рН показывает, что среда у всех образцов кислая. После определения эластичности и пышности продукта выявлено, что у образца с 7,5% пудры самый высокий показатель по твердости и клейкости, образец с 5% пудры является самым эластичным. Самый стабильный образец по всем показателям является образец с 10% пудры. Для

исследования биологической ценности продукта было определено содержание полифенолов [7] (Рис. 2).

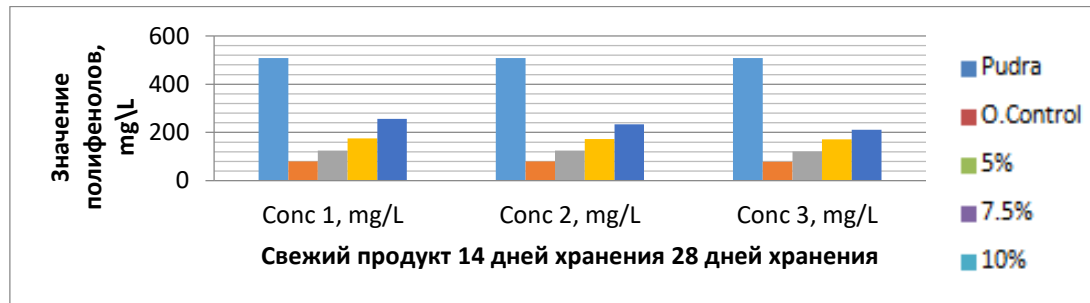


Рисунок 2. Зависимость содержания полифенолов от концентрации виноградного порошка и продолжительности хранения образцов

Данная диаграмма показывает, что количество полифенолов снижается. Среди образцов самое высокое значение полифенолов у образца с 10% кожицы винограда.

Антиоксидантная активность образцов представлена на рисунке 3.

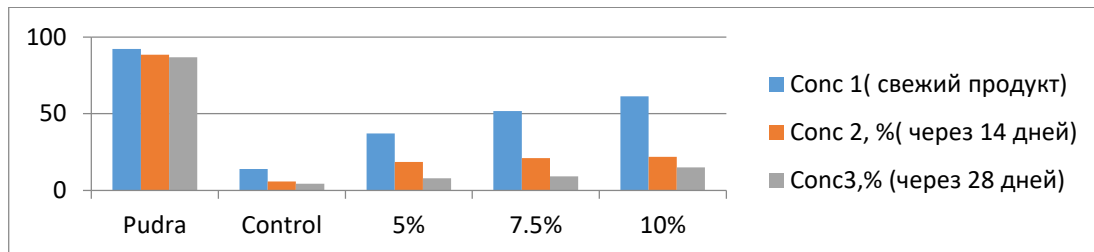


Рисунок 3. Антиоксидантная активность в зависимости от концентрации виноградного порошка и продолжительности хранения образцов

Для выявления связи между содержанием полифенолов и антиоксидантной активностью, был сделан график зависимости между этими двумя компонентами (Рис. 4).

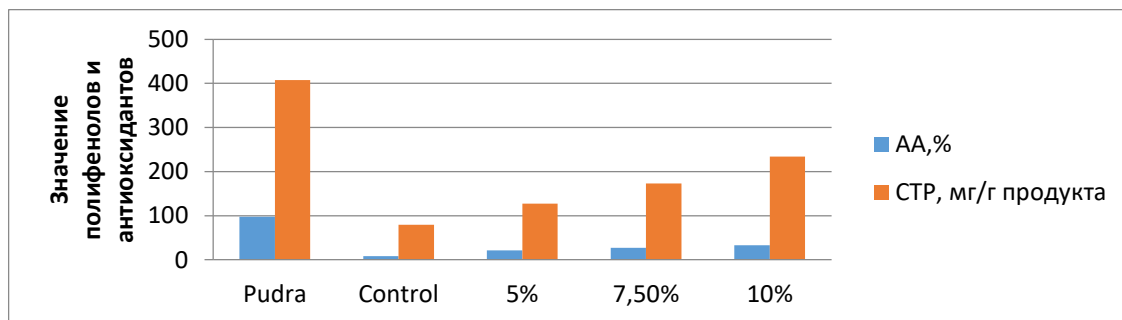


Рисунок 4. Динамика зависимости содержания полифенолов и антиоксидантной активности в образцах

Исходя из данных результатов, можно сделать вывод, что самое высокое содержание антиоксидантов у пудры и у образца 10%, такие же результаты и у содержания полифенолов. При изготовлении нового продукта важную роль играет микробиологический контроль. На протяжении всего времени хранения, первые признаки порчи продукта были замечены спустя 2 недели с момента приготовления продукта. Тем самым, можно сделать вывод, что в данных условиях хранения, исследуемый продукт может храниться не более 2 недель.

Выводы

В результате работы было выявлено, что добавленная кожица винограда влияет на антиоксидантную активность, на активность воды и pH.

Самое высокое значение антиоксидантов и полифенолов у образца с добавлением 10% порошка. Концентрация антиоксидантов=32,73%, концентрация полифенолов=233,68. По характеристике эластичности и твердости: самым твердым образцом является 7,5%, самый эластичный- 5%. По результатам исследования активности воды, можно сделать вывод, что чем больше добавление виноградного порошка, тем меньше активность воды.

Результаты исследования показывают, что добавление порошка из виноградной кожицы усиливает значение антиоксидантной и полифенольной активности, что говорит о том, что данная процедура является целесообразной. Выяснено, что добавление порошка из виноградной кожицы благоприятно влияет на органолептические и химические показатели.

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SURSE DE PROTEINE VEGETALE PENTRU OBTINEREA PRODUSELOR ALIMENTARE DE NOUĂ GENERAȚIE

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Rezumat. Modelul actual de consum al produselor alimentare este considerat unul nesustenabil, prin prisma creșterii numărului de consumatori cu probleme de sănătate obținute în urma unei alimentații incorecte (subnutriție, obezitate, deficiență de micronutrienți) precum și prin impactul sistemelor agroalimentare asupra mediului înconjurător (emisii de gaze cu efect de seră), producția animalelor fiind cea mai îngrijorătoare ramură. O altă problemă este provocarea de a produce produse alimentare de calitate în cantități suficiente pentru populație. În acest context, în domeniul industriei alimentare este un interes în creștere pentru obținerea de formule alimentare noi pe bază de proteine vegetale, cu potențial nutrițional de a înlocui proteinele de origine animală, în special din carne, având în vedere dezavantajele creșterii efectivelor de animale (bovine) și consumul de carne. Astfel, proteinele vegetale câștigă în mod constant popularitate, fiind o sursă bună de macronutrienți vitali și desigur fiind cultivate în cantități suficiente, aspecte ce corespund principiilor securității alimentare.

Cuvinte cheie: leguminoase, cereale, metode emergente, analogi de carne

Astăzi există o mare preocupare de a utiliza sursele de proteine vegetale în calitate de înlocuitori pentru proteine derivate de la animale având în vedere impactul creșterii animalelor asupra gradului de poluare a mediului înconjurător, și anume procesul de creștere a animalelor care este responsabil pentru 15 % din totalul emisiilor de gaze cu efect de seră, consumul a 70 % din apă și 26 % din suprafața terenurilor [1, 2].

De asemenea, industria alimentară se confruntă cu o mare provocare privind satisfacerea necesarului de produse alimentare de calitate care să poată hrăni mai mult de nouă miliarde de oameni până în 2050, respectând principiile unui mod durabil și accesibil din punct de vedere ecologic. În acest context, consumatorii conștientizează importanța reducerii risipei de produse alimentare dar și introducerea în dieta alimentară a produselor bogate în proteine de origine vegetală care sunt mult mai accesibile și au mai multe beneficii pentru sănătate în comparație cu cele de origine animală [3].

Proteinele vegetale datorită proprietăților fizico-chimice și funcționale pe care le posedă pot fi un ingredient de bază în obținerea unui sortiment larg de produse alimentare, un grup aparte fiind analogii de carne.

Analogii de carne sunt caracterizați ca produse alimentare care simulează și reproduc caracteristicile organoleptice, fizico-chimice și estetice ale produselor din carne, având o valoare nutritivă similară cărnii. Materii prime recomandate în fabricarea analogilor de carne sunt leguminoasele, cerealele, pseudo-cerealele, semințe. Proteinele din soia, glutenul de grâu, proteinele din semințe de bumbac și alte proteine vegetale au fost folosite cu succes pentru prepararea analogilor de carne, fiind o materie primă accesibilă economic, cu un aport important de aminoacizi esențiali, săruri minerale și vitamine.

Sunt cunoscute 3 tipuri de analogi de carne:

- tip emulsie - au o textură și un profil senzorial unic, ca rezultat al capacităților de reținere a apei și de legare a grăsimilor similare cu cele demonstrate de proteinele țesutului muscular animal tocate fin – miozina și actina, atunci când sunt solubilizate.
- tip tocătură – se clasifică după tipul de tocătură: fină și grosieră. Această grupă de substituenți de carne se manifestă printr-un grad de succulență și fermitate înalt.
- tip mușchi întreg – imită structură cărnii natural. În cazul dat, calitatea proteinelor vegetale și tehnicile de procesare joacă un rol decisiv în obținerea structurii stratificate fibroase, precum și a succulentei analogilor de carne tip mușchi întreg [4].

Procesul de extrudare (cu umiditate scăzută și umiditate ridicată) este cel mai des utilizat în obținerea analogilor de carne din materii prime vegetale sustenabile.

Procesul de extrudare cu umiditate scăzută (<40%) este utilizată pentru obținerea unei structuri anizotrope. În cazul dat se obțin produse cu structuri expandate, poroase, datorită evaporării apei, din cauza temperaturilor ridicate ale materialului (>100°C). Acest gen de extrudare se caracterizează prin lipsa unui tunel de răcire [5]. În extrudarea cu umiditate ridicată, evaporarea apei și expansiunea matricei proteice sunt prevenite la trecerea produsului prin tunelul de răcire [6]. Tehnologia de extrudare cu umiditate ridicată este utilizată pe scară largă pentru a prepara proteine vegetale texturate cu conținut de umiditate cuprins în limitele 40-70% și, ulterior, pentru a crea diferite tipuri de analogi de carne, în special tip carne tocată și tip emulsie. De asemenea, este un proces continuu de obținere a analogilor de carne în care este bine reprodus aspectul și textura fibroasă a cărnii naturale (mușchi întreg) [7, 8].

Dezvoltarea de produse alimentare noi cu utilizarea materiilor prime vegetale sustenabile și utilizarea tehnologiei de extrudare cu umiditate ridicată, care este cea mai fezabilă, simplă și ușor adaptabilă pentru dezvoltarea analogilor de carne, ar fi o contribuție importantă în industria alimentară națională.

Mulțumiri: Proiect bilateral moldo-turc 23.80013.5107.3TR Dezvoltare durabilă de produse alimentare de nouă generație, bogate în nutrienți: evaluarea relației dintre ingrediente, metodele de procesare utilizate și proprietățile tehnico- și bio-funcționale.

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ИСПОЛЬЗОВАНИЕ ПРОДУКТОВ ПЕРЕРАБОТКИ СЕМЯН МАСЛИЧНЫХ КУЛЬТУР В МЯСНОЙ ИНДУСТРИИ

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Резюме. Неадекватное обращение с отходами и побочными продуктами, полученными при переработке сельхозсырья является серьезной проблемой. В связи с тем, что масла и жиры являются важнейшими элементами рациона питания человека, в мире наблюдается тенденция к увеличению объемов выращивания масличных культур. В результате производства масел образуется большое количество отходов – шротов, которые используются в основном в качестве корма для животных. Известно, что шроты масличных культур имеют богатый химический состав, в частности содержат белок, минеральные вещества, биологически активные соединения, такие как фенольные вещества, пищевые волокна и лигнаны, таким образом представляя огромный интерес для пищевой промышленности, а также в производстве биологически активных добавок для обогащения продуктов питания. Правильная переработка отходов масложирового производства позволяет получить ряд новых продуктов – пищевые пленки, белковые концентраты, изоляты, эмульгаторы. Доказано, что рациональное использование шротов масличных культур способствует достижению целей безотходного производства. Статья посвящена анализу химического состава, свойств, потенциальной роли шротов масличных культур для пищевой промышленности, а также возможности применения данных агроотходов, в частности, в мясном производстве. Обсуждаются технологические решения, аспекты производства и рекомендации для мясной индустрии. Дальнейшие исследования в производственных технологиях и сотрудничество внутри отрасли могут привести к внедрению эффективных и устойчивых решений в мясную отрасль.

Ключевые слова: шрот, производство масла, химический состав, агроотходы, мясная отрасль, фенольные вещества, пищевые волокна, безотходное производство

Введение

Современные тенденции пищевой промышленности стремятся предоставить потребителю не только качественный и безопасный продукт, соответствующий всем нормам и стандартам государства, но и принести дополнительную пользу и функциональность продукта на организм человека (например, хлеб с повышенным содержанием белка, кисломолочные продукты с бифидобактериями, напитки с пищевыми волокнами).

Целью использования шротов различных масличных культур, таких как облепиховый шрот, кукурузный, шрот рапсового, подсолнечника, льна, винограда (Рис. 1), является обогащение продуктов питания дополнительными качественными характеристиками, расширение ассортимента продукции, увеличение потребления функциональных продуктов

питания, поддержание системы безотходного производства и внедрение концепции использования отходов одного вида производства, как сырья для другого вида.

Дополнительное обогащение белком, углеводами, витаминами, клетчаткой, макро- и микроэлементами способствует повышению пищевой и питательной ценности готового продукта, улучшению сенсорных и физико-химических показателей, что благоприятно влияет на мясные продукты.



Рисунок 1. Шроты масличных культур

Химический состав шротов

Шроты – это побочный продукт переработки маслосодержащего сырья. Характеризуется низким содержанием жира, и высоким содержанием белка, витаминов и клетчатки. Отличительные характеристики содержания веществ, находящиеся в шроте после отделения масляной фракции отмечены в Таб. 1.

Таблица 1

Химический состав шротов [1-14]

Виды шротов	Процентное соотношение веществ, (%)
Шрот облепиховый	Белки – 28; Сахара – 2,4; Пищевые волокна – 32; Клетчатка – 19,5-20,5; Пектиновые вещества – 1,54-1,6.
Шрот расторопши	Белки – 21,88; Сахара – 2,7; Клетчатка – 27,38; Пектиновые вещества – 5,96, Зола – 6,0, массовая доля флаволигнинов – 2,5.
Кукурузный шрот	Белки – 26,5; Клетчатка – 12; Зола – 1,5; Жир – 3,0.
Ореховый шрот	Белки – 26-27; Сахара – 13; Пищевые волокна – 30; Зола – 4-5.
Льняной шрот	Белки – 26; Сахара – 40; Пищевые волокна – 30; Клетчатка – 9,3; Зола – 7,2
Тыквенный шрот	Белки – 32-55; Сахара – 21,2; Пищевые волокна – 16,4; Клетчатка – 38; Пектиновые вещества – 2,36.
Горчичный шрот	Белки – 38 – 50; Сахара – 14; Клетчатка – 4-5.
Шрот подсолнечника	Белки – 40,5; Сахара – 5,5; Пищевые волокна – 21; Клетчатка – 13,7.
Шрот винограда	Белки – 13; Сахара – 29; Пищевые волокна – 46; Клетчатка – 25; Зола – 5.

Методы экстрагирования масел из маслосодержащего сырья

Существует 2 основных метода получения масел, в процессе которых получают шрот: прессование и экстракция. Особенности методов отмечены в Таб. 2. Прессование может быть однократным, двухкратным, холодным и горячим прессованием, а также в комбинации с экстракцией.

Методы экстракции масел из сырья [15,16]

Прессование		Экстракция
Горячий отжим	Холодный отжим	
Не обеспечивает полного извлечения жировой фракции и получения обезжиренного шрота.		Наиболее большой выход масел из сырья. Метод основан на диффузии между растворителем и жировой фракцией. Ослажен многоступенчатыми этапами очистки масел от растворителя
Нагрев семян до 110-120°C – более полное извлечение масел. Нагрев влияет на химический состав получаемого шрота.	Температура извлечения масел – 25-35°C – сохранность биологически активных веществ. Извлечение масел на 27-30%.	

Метод экстракции позволяет сделать заключения о химическом составе получаемого шрота и о его качестве. Остаточное содержание жиров, процентное содержание белка и других макро- и микронутриентов в получаемом шроте влияют на качество и биологическую ценность готового продукта.

Ассортимент и способы обогащения мясных продуктов

- Добавки к мясным продуктам (паштеты мясные, эмульгированные колбасы)

Возможность внедрения шрота в продукт разнообразна, в силу используемых технологий. Одним из простых и целесообразных способов внесения шрота в продукт является производство паштета с добавлением растительного сырья. Органолептические требования к паштетам не регламентированы строго. Согласно требованиям, запах, вкус, цвет продукта должен соответствовать мясному и мясосодержавшему продукту [17]. Цветовой спектр (визуальная эстетика) готовой продукции разнообразен, что позволяет не использовать красители для сохранения классического цвета продукта, понятного потребителю. Внесение шрота также не изменяет показатели внешнего вида, консистенции, вида на разрезе, вкуса и запаха.

- Использование для производства смеси приправ для мясного производства

При производстве мясных и колбасных изделий используется широкий ряд специй и их смеси. Одним из вариантов внесения шрота, может стать смесь специй с измельченным растительным шротом, которая будет использоваться в производстве как полуфабрикатов, так и готовых мясных и колбасных изделий. Нынешний рынок производства промышленных миксов специй для мясной промышленности, а также технологический прогресс позволят внести шрот масличных культур с максимально сохранившимися показателями качества. Внесение шротов позволят обогатить питательной ценностью как готовый продукт, так и данный микс, что может привести к дополнительным рынкам сбыта.

- Использование шротов в смеси с костной мукой

Данный метод является одним из способов обогащения продукции минералами. Следовательно, может стать эффективным методом по улучшению качественных и количественных показателей готового продукта, снижению себестоимости готовой продукции, а также внедрению системы безотходного производства мясной промышленности. Использование растительных шротов в смеси с костной мукой позволит сформировать функционально-лечебный ассортимент для потребителей с особенностями пищеварения [18].

- Экстракция белковых концентратов из шротов

Возможно получение белковых концентратов из шротов масличных культур. Существует большое количество технологий, технических рекомендаций и патентов для выработки белковых концентратов. Одним из целесообразных способов является способ изготовления белковых концентратов из шрота подсолнечника. Водопроводную воду с солью и гидроксидом натрия перемешивают с подсолнечным шротом в емкости. Композицию перемешивают в течение 60 минут и отделяют экстрагент через фильтр с помощью вакуума. Затем добавляют техническую соляную кислоту для достижения pH 3,5,

при котором белки осаждены. Осадок белка отделяют фильтрованием, сушат и упаковывают в водонепроницаемую тару. Соотношение шрота и раствора должно быть 1:7,5 для эффективной экстракции белка. Полученный концентраты подвергают процессу высушивания на распылительной сушилке. Полученные белковые концентраты способствуют улучшению качества готового продукта, при использовании аномального вида мяса, продуктов в составе которого присутствует жир, могут использоваться для избежания пороков в готовом продукте [19].

Выводы и рекомендации

Исходя из аспектов, отраженных в данной статье, можно сделать следующие заключения о целесообразности использования растительных шротов. Шроты являются перспективным сырьем для производства широкого ряда продуктов, не только мясных и колбасных. Тенденции пищевой промышленности стремятся производить не только безопасные и качественные продукты, но и функциональные. Обзор информации о химическом составе шротов обосновывает и подтверждает, что шроты богаты белками, клетчаткой, витаминами, микроэлементами, что благоприятно влияет на готовый продукт. Шрот – универсальное сырье по способу внесения его в продукт, в зависимости от степени измельчения. Разнообразие методов и технологий использования шротов велико и позволяет максимально полно использовать данное сырье, как в мясной индустрии, так и в других отраслях пищевой промышленности. Современные технологии позволяют не только напрямую использовать сырье в виде шрота, но и извлекать экстракты белка, а также производить концентраты.

Рекомендации

- Использование шрота разнообразит ассортимент продукции, откроет новые рынки сбыта и привлечет потребителей.
- Так как продукт с добавлением шрота будет являть функциональным, данный факт способствует привлечению новых потребителей и будет покрывать их дополнительные потребности.
- Увеличится экономическая выгода, за счет снижения себестоимости.
- Низкая стоимость сырья, как следствие и себестоимость, позволит увеличить прибыль, улучшить экономическую составляющую предприятия.
- Благодаря использованию шротов, ставится акцент на здоровье потребителей, а не только на экономической части.
- Тенденции современного питания стремятся к улучшению качества продуктов питания, как следствие и поддержанию здоровья человека. Производитель, заинтересованный в предоставлении безопасных, качественных, а главное полезных продуктов, привлечет к себе больше потребителей.
- Обратите внимание на предприятия по производству масел, готовых к сотрудничеству, используйте их отходы как вторичное сырье.
- Возможно наладить коммерческие отношения с масло перерабатывающими предприятиями для организации прямых поставок, во избежание лишних затрат ресурсов и времени.

Проблемы, связанные с рациональным использованием растительного сырья, в том числе и вторичного, достаточно полно изучены. Однако, потенциальные возможности данных сырьевых ресурсов в производстве продуктов питания ещё недостаточно исследованы.

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ANALIZA CALITĂȚII MAIONEZEI VEGETALE

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Rezumat. În contextul evoluțiilor recente în industria alimentară, maioneza vegetală a devenit un subiect de interes major datorită eforturilor de a dezvolta opțiuni alimentare mai sănătoase și sustenabile. Scopul prezentei lucrări a fost analiza indicilor de calitate a maionezei vegetale cu utilizarea apei de fierbere (aquafabei) de la năut și a altor ingrediente vegetale. Au fost elaborate 5 variante de maioneză vegetală cu 10%, 15%, 20%, 25%, 30% aquafaba de năut. Probele de maioneză cu 10% și 15% aquafaba sau evidențiază prin caracteristici organoleptice și tehnologice excelente, datorate proprietăților apei de fierbere de la năut care este un emulgator alternativ viabil, cu proprietăți excelente de stabilizare a emulsiilor. Maioneza vegetală obținută a prezentat un conținut ridicat de acid oleic, indicator care îmbunătățește potențialul funcțional al maionezei datorită acizilor grași omega-3, care sunt asociați cu un risc redus de boli cardiovasculare și controlul glicemiei pe termen lung. Probele de maioneză au prezentat un indice de peroxid mai mic în comparație cu proba martor, sugerând o mai bună protecție împotriva oxidării datorită conținutului crescut de antioxidanți.

Cuvinte cheie: năut, aquafaba, sosuri, emulsie, indici de calitate

Introducere

Năutul (*Cicer arietinum L.*) este un aliment consumat pe scară largă în întreaga lume, fiind o importantă sursă de proteine, grăsimi, fibre și alți carbohidrați. În contextul creșterii populației globale, cererea pentru componenta proteică a acestui aliment este în continuă creștere, ceea ce a condus la dezvoltarea diferitelor tehnici pentru extragerea proteinei din năut. Proteinele din năut au proprietăți funcționale excelente, cum ar fi solubilitatea, capacitatea de absorbție a apei și a uleiului, emulsionarea, spumarea și gelificarea. Studiile de cercetare au identificat diverse aplicații ale ingredientelor proteice din năut și ale coproduselor acestora, subliniind potențialul acestor ingrediente pentru dezvoltarea de noi produse și pentru îmbunătățirea profilului nutrițional al alimentelor existente [1, 2]. Aquafaba este apa vâscoasă reziduală obținută din gătitul năutului și altor leguminoase, conținând o cantitate semnificativă de carbohidrați, proteine și saponine. Cercetările au demonstrat că aquafaba poate forma spume și emulsii și, ca atare, poate fi utilizată ca înlocuitor de ou în diverse produse [3, 4]. Apa de fierbere a năutului, cunoscută sub denumirea de aquafaba, a fost recent utilizată ca emulgator vegan în bucătăria modernă și ca înlocuitor de ouă în maioneza vegană. Proprietățile funcționale ale aquafabei (emulsibilitatea, spumabilitatea, gelificarea și proprietățile de îngroșare) se datorează compoziției sale complexe, care include proteine, carbohidrați solubili și insolubili în apă (cum ar fi oligozaharidele, amidonul, celuloza, hemiceluloza și lignina), complexe de polizaharide-proteine, coacervați, saponine și compuși fenolici [5, 6]. Scopul prezentei lucrări a fost analiza indicilor de calitate a maionezei vegetale cu utilizarea apei de fierbere (aquafabei) de la năut și a alte ingrediente vegetale.

Metode de analiză. Indicilor organoleptici au fost apreciați conform Pradhananga et al., 2015 [7]. Conținutului de acid oleic a fost determinat în conformitate cu metoda descrisă în GOST 31762-2012 Maioneză și sosuri de maioneză. Reguli de acceptare și metode de testare. Indicele de

peroxide a fost determinat conform ISO 3960:2007 Grăsimi și uleiuri animale și vegetale - determinarea indicelui de peroxid.

Rezultate și discuții. Probele de maioneză vegetală obținute sau evidențiază prin caracteristici organoleptice și tehnologice bine definite, în special maioneza cu adaos de 15% și 20% aquafaba. Apa de fierbere de la năut a manifestat proprietăți excelente de emulgare și stabilizare a emulsiilor. Maioneza vegetală obținută a prezentat un conținut ridicat de acid oleic, indicator care îmbunătățește potențialul funcțional al maionezei datorită acizilor grași omega-3. Probele de maioneză au prezentat un indice de peroxide în descreștere în comparație cu proba martor. Pentru proba de maioneză cu 10% aquafaba indicele de peroxide fiind de 2 ori mai mic iar pentru P 15% de 3,5 ori mai redus. Aceste rezultate pot fi explicate prin acțiunea compușilor cu activitate antioxidantă din aquafaba care pot preveni sau întârzia oxidarea lipidelor din maioneză. Prin evaluarea aspectelor organoleptice, nutriționale și funcționale ale produsului final, s-a evidențiat potențialul acesteia în contextul unei alimentații sănătoase și sustenabile, luând în considerare atât proprietățile proteinei vegetale de năut, cât și procesul de obținere a apei de fierbere și formularea maionezei vegetale. Acest studiu subliniază importanța inovării în industria alimentară. Maioneza vegetală cu utilizarea apei de fierbere de la năut reprezintă o soluție promițătoare, oferind avantaje nutriționale și funcționale semnificative față de produsele tradiționale pe bază de ouă. Îmbunătățirea calității produselor alimentare și promovarea alternativelor vegetale contribuie la promovarea unui stil de viață sănătos și la protejarea mediului înconjurător.

Concluzii

Apa de fierbere de la năut este o materie primă secundară cu indici fizico-chimici și proprietăți antioxidante înalte care poate înlocui proteina de origine animală. În acest context, aquafaba devine o materie primă vegetală care va permite diversificarea sortimentului de produse alimentare de post, inclusiv maioneza, cu indici de calitate sporțiți.

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VALORIFICAREA MATERIILOR PRIME VEGETALE SECUNDARE LA OBȚINEREA COMPUȘILOR FUNCȚIONALI

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Rezumat. În prezent, este relevant conceptul de producție cu zero deșeuri, bazat pe principiul prelucrării profunde a materiilor prime (inclusiv a materiilor prime vegetale regenerabile). Aproximativ 70 % din materiile prime secundare sunt furnizate agriculturii în formă brută, însă mai mult de 10 % nu sunt utilizate. O direcție promițătoare pentru organizarea utilizării deșeurilor este valorificarea lor, care oferă posibilitatea de a obține substanțe nutritive din ele în fabricarea produselor alimentare. Diferite tipuri de deșeuri regenerabile în mod constant și relativ ieftine din industria alimentară (industria uleiurilor și grăsimilor) obținute în timpul prelucrării culturilor și semințelor oleaginoase - coji de semințe, făină, turte etc. pot fi utilizate ca materii prime pentru producția de proteine vegetale. Lucrarea de față a evaluat conținutul de proteină în semințele de dovleac (32...56%), în semințele de in (25...45%), în nuci (până la 50%), în semințele de floarea-soarelui (19...44%) și în semințele de struguri (10...12%). Este prezentată analiza metodelor eficiente de extracție a proteinelor din șroturi pentru utilizarea ulterioară în diverse produse alimentare. S-a stabilit că cea mai avansată metodă de extracție este metoda cu ultrasunet, pe lângă extracția cu microunde, cu apă subcritică și câmp electric pulsat.

Cuvinte cheie: semințe oleaginoase, proteină, șrot, tescovină, ultrasunet, metode de extracție, produse alimentare nutritive

Introducere

În contextul actual al conceptului de producție cu zero deșeuri, care se bazează pe prelucrarea profundă a materiilor prime, inclusiv a celor vegetale regenerabile, se observă o creștere a interesului în valorificarea deșeurilor din industria alimentară pentru obținerea substanțelor nutritive utilizabile în fabricarea produselor alimentare. Această abordare oferă oportunitatea de a maximiza utilizarea resurselor disponibile și de a reduce impactul asupra mediului înconjurător. În acest sens, diferite tipuri de deșeuri regenerabile, cum ar fi cojile de semințe, făina, turtele etc., provenite în timpul prelucrării culturilor și semințelor oleaginoase, devin subiect de interes pentru valorificarea lor în producția de proteine vegetale [1, 2].

Șroturile obținute din semințe oleaginoase sunt adesea folosite pentru hrană, îngrășământ sau compost datorită conținutului lor bogat în proteine, carbohidrați, minerale și azot (Tab. 1).

Tabelul 1

Compoziții chimică a șroturilor [1-4]

Substanțe	Din semințe de dovleac	Din semințe de in	Din nuci	Din semințe de floarea-soarelui	Din semințe de struguri
Proteine, %	32-56	25-45	<50	19-44	10-20
Glucide, g	21.2	9	8	13	1
Lipide, g	2.6	10	18	18	5.2
Fibră brută, %	<38	7.02	20.57	12.64-31.88	
Vitamine, săruri minerale	Zn, K, Ca, Mg, Fe	A, niacin	-	Ca, P, Fe, Vit. E, B	Antioxidanți

Metode de obținere a șroturilor din seminte oleaginoase

Extragerea uleiului din semințe sau fructe se realizează prin două metode: prin presare sau cu solvenți chimici. Produsul obținut prin presare se numește șrot, iar prin extracție cu solvent obținem miscelă și șrot. Producția de turte de ulei se realizează prin unul dintre cele două procese mecanice (presele cu șnec și extrudele). Cea mai frecventă metoda de obținere a șroturilor și uleiurilor comestibile este metoda de presare [5]. Avantajul acestei metode constă în conservarea nutrienților și a gustului cu o calitate superioară a uleiurilor și a produselor secundare, dar cantitativ mai redus [6]. În Fig. 1 este prezentat procesul tehnologic standard de extragere a uleiurilor și obținere a șroturilor [7, 8].

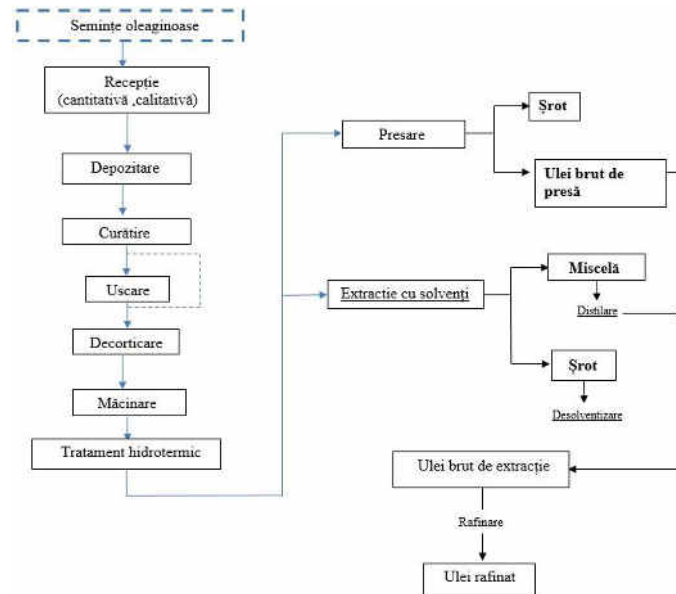


Figura 1. Procesul tehnologic de obținere a șroturilor și uleiului vegetal din seminte oleaginoase

Șroturile din semințe din dovleac. Șrotul de semințe de dovleac este un produs rezidual obținut din producția de ulei de dovleac, care conține o varietate de substanțe nutritive esențiale, cum ar fi vitamine, fibre, macro și microelemente. Acesta are o culoare crem sau fistic, în funcție de soiul de dovleac utilizat. Conținutul său de proteine variază între 32% și 55%, inclusiv toți aminoacizii esențiali, și poate ajunge până la 40% proteină brută. De asemenea, conține până la 38% fibre și cantități semnificative de vitamine. Datorită conținutului ridicat de proteine, disponibilității și costului scăzut, șrotul presat la rece din semințe de dovleac este o materie primă alternativă valoroasă pentru obținerea de izolate proteice, hidrolizate de proteine și compuși bioactivi (în principal oligopeptide) care posedă o gamă largă de funcții dietetice și terapeutice. Principalele proteine din semințele de dovleac sunt globulinele însoțite de gluteline și cantități mai mici de albumine și prolamine [9].

Șroturile din semințe de in. Inul reprezintă o specie anuală din familia *Linaceae*, înălțimea acesteia ajunge până la 1 m, care este cultivată pentru producerea de fibre textile și ulei de semințe de in. În ultimii ani, semințele de in au devenit cunoscute ca aliment funcțional datorită compoziției sale nutriționale care are efecte pozitive asupra prevenirii bolilor, oferind componente benefice pentru sănătate precum acidul alfa-linolenic, lignani și polizaharide [10]. Șroturile din semințe de in au un potențial utilizabil imens în lipide, proteine, fibre solubile și lignani [2, 11].

Șroturile din nuci au o importanță semnificativă în industria alimentară datorită conținutului lor nutritiv bogat (protein, fibre, grăsimi alimentare, vitamine) și versatilității în utilizare (aditiv și supliment alimentar, hrana animalelor). Ele reprezintă o resursă valoroasă care poate fi valorificată în diverse moduri pentru a îmbunătăți calitatea produselor alimentare și a asigura aportul optim de nutrienți pentru consumatori [12]. În plus, reziduurile de nucă au 18

aminoacizi, acidul glutamic (21,30%~21,70%), arginina (13,60%~15,20%) și acidul aspartic (10,20%~10,50%) care sunt principalii aminoacizi [13].

Șroturi din semințe de struguri. Strugurii sunt folosiți în principal pentru producerea vinului, care reprezintă una dintre principalele industrii din țară. Procesarea strugurilor în Republica Moldova nu se rezumă doar la producerea de vin, ci poate fi extinsă pentru a obține ingrediente valoroase și sustenabile din deșeurile rezultate în procesul de vinificație. Valorificarea acestor deșeuri poate aduce beneficii multiple, inclusiv reducerea impactului asupra mediului, valorificarea optimă a resurselor disponibile și diversificarea industriei vitivinicole [14]. Șroturile din semințe de struguri au un conținut de proteine în jur de 10...20% și au un conținut semnificativ de antioxidanți.

Șroturi din semințe de floarea-soarelui. În procesul de extracție a uleiului de floarea-soarelui, apare o modificare în solubilitatea substanțelor proteice din cauza denaturării acestora. Tratamentul cu umiditate și căldură duce nu doar la o scădere a solubilității, ci și la o anumită deteriorare a aminoacizilor. Astfel, proteinele extrase din șroturile obținute în acest proces prezintă o funcționalitate și o calitate organoleptică mai scăzută în comparație cu proteinele extrase din șrotul degresat. Șroturile sunt principalele produse secundare obținute după extragerea uleiului din semințe [15]. Șroturile de floarea-soarelui sunt mai bogate în fibre (12,64%) și proteine (21,60%), cu un profil de aminoacizi echilibrat. Șrotul de floarea-soarelui are conținut considerabil de substanțe anorganice, minerale, cum ar fi: magnesium (4,76 g/kg), selenium (1,99 g/kg), cesium (1,02 g/kg), calcium (1163,32 mg/kg), thallium (587,97 mg/kg), zinc (94.78 mg/kg) [16].

Metodele de extracție a proteinelor din șroturi

Metoda de extracție cu ultrasunete este utilizată pentru a sparge structura celulară a șroturilor și a elibera proteinele în soluție. Ultrasunetele pot îmbunătăți eficiența procesului de extracție și pot reduce timpul necesar. Această metodă implică utilizarea undelor sonore de înaltă frecvență (>20 kHz) pentru a descompune structura celulară a materialului vegetal și a elibera proteinele. Temperatura și presiunea pot atinge valori ridicate, facilitând eliberarea proteinelor [17].

Extracția asistată de ultrasunete a fost inițial studiată în anii 1950 pentru obținerea proteinelor din surse naturale, iar aplicarea sa în domeniul alimentar este relativ recentă. Extracția asistată de ultrasunete se bazează pe propagarea oscilațiilor de presiune într-un mediu lichid, generând microbule care duc la ruperea peretelui celular și la transferul substanțelor în mediu. Performanța metodei cu ultrasunete depinde de diferiți factori, solventul de extracție, timpul și temperatura de expunere, frecvența ultrasunetelor, puterea și tipul de echipament utilizat. Metoda de extracție cu ultrasunet are mai multe avantaje, inclusiv randament îmbunătățit, timp de procesare mai mic și este eficientă din punct de vedere energetic, ușor de instalat, cu un impact minim asupra mediului. În plus, necesită o investiție redusă și timpi de extracție mai scurți, reducând astfel durata procesului și costurile asociate. Astfel, fiind o tehnologie rapidă, rentabilă și ecologică, această metodă a fost utilizată pentru a extrage și modifica proteinele vegetale, îmbunătățind eficiența procesului de extracție. Recent, dovezile existente pentru extracția asistată de ultrasunete a proteinelor vegetale au fost rezumate de Rahman et al. [18, 19]. Extracția asistată cu ultrasunete a proteinei din făina de floarea soarelui a fost efectuată și testată pentru efectul acesteia asupra proprietăților fizico-chimice și funcționale ale proteinei. S-a constatat că în condiții optime de extracție de densitate de putere (220 W/l), temperatură (45°C), timp de extracție (15 min), s-a obținut un randament proteic de 54,26%. S-a constatat că metoda cu ultrasunet ajută la extragerea conținutului de proteine și la furnizarea de proprietăți funcționale, în continuare, produsul ar putea fi utilizat pentru sosurile de salate, pentru produsele din carne și lapte [17,18,20].

Metoda de extragere cu microunde este o tehnică eficientă care implică expunerea mostrelor la unde electromagnetice cu frecvență înaltă, care generează căldură și permit eliberarea proteinelor din matricea biologică în intervalul de la 300 MHz la 300 GHz [19]. Comparativ cu tehnologiile tradiționale, extragerea cu microunde aduce cu sine unele beneficii notabile. Printre acestea se numără reproductibilitatea crescută într-un interval mai scurt de timp și un consum mai

reduc de solvenți și energie. Aceste aspecte fac ca această metodă să fie potrivită pentru extragerea diverselor tipuri de compuși, inclusiv proteine, carbohidrați și polifenoli antioxidanți [20].

Utilizarea apei subcritice s-a dovedit în ultimii ani a fost o metodă ecologică, și rapidă pentru a obține compuși solubili în apă. Această metodă poate fi utilizată pentru extragerea compușilor bioactivi sau ca un înlocuitor al altor metode care utilizează substanțe acide, alcaline și medii enzimatică pentru hidroliza macromoleculor (proteine în peptide și aminoacizi și polizaharide în zaharuri fermentabile). Pentru a obține starea subcritică, apa este încălzită la temperaturi cuprinse între cele de punctul de fierbere (100°C) și temperatura sa critică (374°C). Metoda de extracție cu apă subcritică este o tehnologie eficientă, ieftină, rapidă și ecologică.

Tehnologia câmpului electric pulsat poate perturba membranele celulare și pereții celulari ceea ce duce la deschiderea porilor și eliberarea proteinelor din celule [21]. Metoda de extracție cu câmp electric pulsat constă într-o serie de impulsuri electrice de înaltă tensiune de scurtă durată care creează o intensitate a câmpului electric de la 1 la 80 kV/cm în interiorul camerei de tratament. Avantajele acestei metode constă într-un consum redus de energie, eficiență sporită și conservarea structurii și activității proteinelor dar cu costuri inițial ridicate [22].

Concluzii

Valorificarea șroturilor în obținerea compușilor funcționali este un aspect important al gestionării durabile a resurselor și al dezvoltării de produse alimentare inovatoare și sănătoase. Acest proces poate implica diverse tehnologii și metode, în funcție de natura șroturilor și de compușii funcționali doritori de a fi obținuți. Au fost identificate direcțiile de valorificare a șroturilor în obținerea ingredientelor funcționali: extracte din plante și fructe, fibre dietetice, proteine vegetale, uleiuri esențiale, antioxidanți și conservanți naturali. Prin valorificarea șroturilor în obținerea compușilor funcționali, industria alimentară poate reduce pierderile de resurse, poate dezvolta produse alimentare mai sănătoase și mai sustenabile și poate satisface cerințele consumatorilor din ce în ce mai preocupați de originea și calitatea alimentelor pe care le consumă.

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VALORIFICAREA DEȘEURILOR AGROINDUSTRIALE DIN INDUSTRIA ULEIURILOR VEGETALE

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Rezumat. *Recent, deșeurile agroindustriale din industria uleiurilor vegetale, de obicei asociate cu problemele de mediu, au fost recunoscute ca o sursă importantă de nutraceutice și compuși valoroși. Procesarea semințelor oleaginoase, fie prin extracție cu solvent sau prin presare mecanică, generează o cantitate semnificativă de deșeuri, incluzând coji, semințe și șrot din semințe. Uleiul de cânepă, datorită compoziției sale unice, este considerat un produs extrem de valoros, folosit în industria alimentară, farmaceutică și cosmetice, ceea ce justifică prelucrarea cânepii industriale (*Cannabis sativa L.*). Cercetările au constatat prezența cantităților semnificative de proteine, fibre alimentare și alți compuși bioactivi în uleiul de cânepă, oferind beneficii semnificative pentru sănătatea umană. Proprietățile funcționale ale semințelor de cânepă derivă din valoarea lor nutrițională ridicată și din prezența diverselor compuși bioactivi, cum ar fi compușii fenolici cu efecte antioxidante și antiinflamatoare, peptide bioactive, precum și două dintre principalele grupe de canabinoizi: tetrahidrocannabinol și cannabidiol. De asemenea, șrotul din semințe a fost identificat ca un produs secundar valoros, potrivit pentru valorificare. După extragerea uleiului, șrotul, care conține substanțe nutritive benefice, este utilizat în dezvoltarea de noi produse multifuncționale și este promovat pe scară largă ca un produs nutritiv.*

Cuvinte cheie: *Cannabis sativa L., valorificare, alimentație, deșeu, uleiuri, șrot*

Introducere

Industria oleaginoasă, care include producția de uleiuri vegetale din semințe și alte materii prime vegetale, este esențială pentru alimentația umană, dar și pentru diverse alte industrii, cum ar fi industria cosmetică, farmaceutică și a produselor chimice (Fig. 1). Cu toate acestea, această industrie generează și o cantitate semnificativă de deșeuri și reziduuri în timpul proceselor de producție (Tab. 1). Aceste deșeuri pot avea un impact semnificativ asupra mediului și necesită gestionare și eliminare adecvată pentru a minimiza impactul negativ [1].

Principalele tipuri de deșeuri rezultate în industria oleaginoasă includ șrotul din semințe, care este rezultatul procesului de extracție a uleiului din semințe și este compus în principal din resturi solide de semințe, fibre și alte materii organice. Acest tort de presare poate fi valorificat ulterior ca hrană pentru animale sau poate fi utilizat în alte procese industriale. De asemenea, în timpul procesului de extracție a uleiului, pot rămâne cantități mici de ulei sau grăsimi în diverse echipamente și rezervoare, constituind uleiuri și grăsimi reziduale. Aceste uleiuri reziduale pot fi colectate și reciclate sau pot fi supuse unor procese de tratare pentru a reduce impactul lor asupra mediului. Procesele de extracție și rafinare a uleiului pot, de asemenea, genera ape uzate contaminate cu substanțe organice și chimice, necesitând tratament adecvat înainte de a fi deversate în mediu pentru a preveni poluarea solului și apei. În plus, industria oleaginoasă utilizează o varietate de ambalaje pentru transportul și stocarea uleiurilor și a altor produse finite,

iar gestionarea adecvată a acestor ambalaje după utilizare este importantă pentru a minimiza deșeurile de plastic și alte materiale nebiodegradabile.

Gestionarea responsabilă a deșeurilor din industria oleaginoasă implică adoptarea practicilor durabile și a tehnologiilor eficiente pentru reducerea, reciclarea și tratarea acestor deșeuri. Inițiativele precum utilizarea eficientă a resurselor, reciclarea materialelor și implementarea unor procese de producție mai curate pot contribui la reducerea impactului negativ al acestei industrii asupra mediului înconjurător.

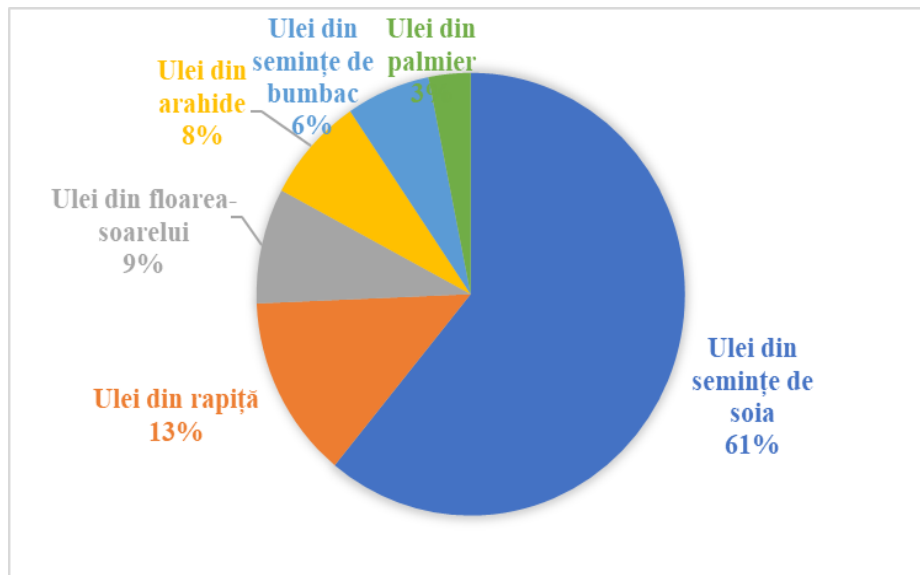


Figura 1. Date statistice privind producerea globală de ulei vegetal, în 2023/2024, pe tipuri, %

În tabelul de mai jos se analizează structura producerii diferitor tipuri de șrot la nivel global pentru anul 2022 și se poate observa faptul că deșeurile rezultate din industria oleaginoasă din floarea-soarelui, soia și rapiță dețin întâietate (Tab. 1).

Tabelul 1

Structura producerii diferitor tipuri de șrot la nivel mondial pe anul 2022, mln. tone

Nr.	Tipul de șrot	mln. tone
1	Șrot de floarea-soarelui	413.479
2	Șrot de soia	58.794
3	Șrot de rapiță	52.924
4	Șrot de in	38.879
5	Șrot de bumbac	28.373
6	Șrot de șofran	5.310

Compoziția chimică a plantei *Cannabis sativa* L.

Șrotul de cânepă este un produs secundar, ce este rezultat în urma procesului de extracție a uleiului din semințele de cânepă [2]. Compoziția chimică a șrotului de cânepă poate varia în funcție de mai mulți factori, inclusiv de calitatea și tipul de cânepă, procesul de extracție și alte caracteristici. Cu toate acestea, per general, șrotul de cânepă conține o multitudine variată de substanțe nutritive și compuși chimici, precum sunt [3]:

Proteinele: Șrotul de cânepă reprezintă o sursă abundentă de proteine, ce conține toți cei 9 aminoacizi esențiali de care organismul uman are necesitate. Proteinele reprezintă aproximativ 25-30% din compoziția șrotului de cânepă.

Grăsimi sănătoase: Semințele de cânepă sunt bogate în acizi grași esențiali, precum omega-3 și omega-6. Acestea pot fi prezente și în șrotul de cânepă în proporții variabile.

Fibrele: Cânepa reprezintă o sursă foarte bună de fibre, iar acestea rămân prezente și în șrotul de cânepă. Fibrele pot ajuta la menținerea sănătății intestinale și pot, de asemenea, contribui la o digestie sănătoasă.

Zaharidele: Șrotul de cânepă poate conține și carbohidrați în proporții variabile.

Mineralele: Printre mineralele prezente în șrotul de cânepă se regăsesc calciul (Ca), magneziul (Mg), fosforul (P), potasiul (K) și zincul (Zn).

Vitaminele: Cânepa și, în special, șrotul de cânepă, conține o varietate de vitamine, inclusiv vitaminele E, B și niacina (vitamina B3).

Este important de menționat că structura chimică a șrotului de cânepă poate fi afectată de diferiți factori, iar analiza specifică a compoziției ar trebui să fie realizată pentru fiecare lot de șrot de cânepă în parte. Utilizarea șrotului de cânepă în alimentație este în creștere datorită valorii sale nutritive și a beneficiilor pentru sănătate (Fig. 2) [4].

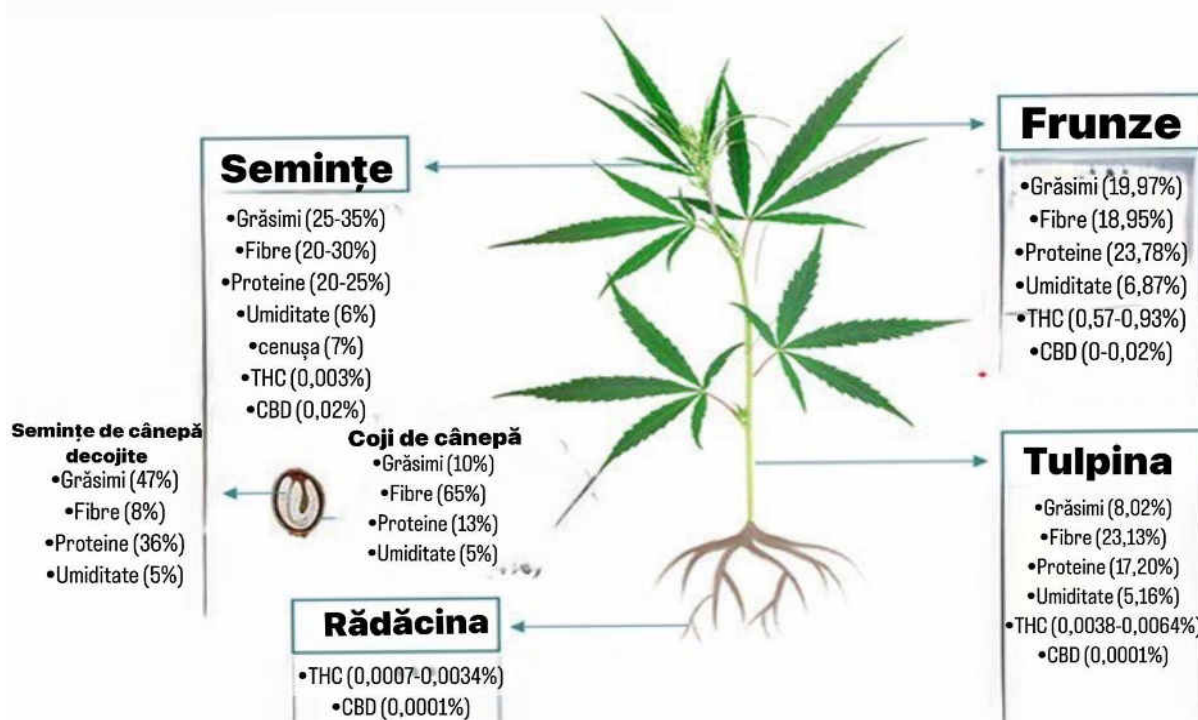


Figura 2. Părțile componente ale plantei *Cannabis sativa* L.

Proprietățile funcționale ale semințelor de cânepă derivă din:

- valoarea lor nutrițională ridicată
- prezența diverselor compuși bioactivi, cum ar fi compușii fenolici cu efecte antioxidante și antiinflamatoare,
- peptide bioactive
- două dintre principalele grupe de canabinoizi (tetrahidrocannabinol și cannabidiol) [5].

Utilizarea plantei *Cannabis sativa* L. în diverse industrii

Semințele de *Cannabis sativa* sunt utilizate în principal pentru producerea uleiului din semințe de cânepă, care poate fi folosit în gătit, în produse de iluminat, lacuri sau vopsele. Acestea pot fi, de asemenea, utilizate ca hrană pentru păsări în cuști, deoarece oferă o sursă bogată de nutrienți pentru majoritatea animalelor (Fig. 3) [6].

Florile și fructele, și într-o măsură mai mică frunzele, tulpinile și semințele, conțin compuși chimici psihoactivi cunoscuți sub numele de canabinoizi, care sunt consumați în scopuri recreative, medicinale și spirituale. Atunci când sunt utilizate în acest fel, preparatele din flori și fructe (numite marijuana) și frunzele și preparatele derivate din extract rășinos (de exemplu, hașiș) sunt consumate prin fumat, vaporizare și ingerare orală. De-a lungul istoriei, tincturile, ceaiurile și unguentele au fost, de asemenea, metode comune de utilizare.

În medicina tradițională, în special în India, cannabisul sativa a fost utilizat ca agent halucinogen, hipnotic, sedativ, analgezic și antiinflamator.

Terpenele au câștigat o mai mare conștientizare publică odată cu creșterea și educarea în domeniul cannabisului medical și recreațional. Organizațiile și companiile care operează pe piețele cannabisului au promovat educația și comercializarea terpenelor în produsele lor ca o modalitate de a diferenția gustul și efectele cannabisului [7].

Efectul de entourage, care descrie sinergia cannabinoidelor, terpenelor și a altor compuși ai plantelor, a contribuit, de asemenea, la creșterea gradului de conștientizare și cerere pentru terpeni în produsele din cannabis.

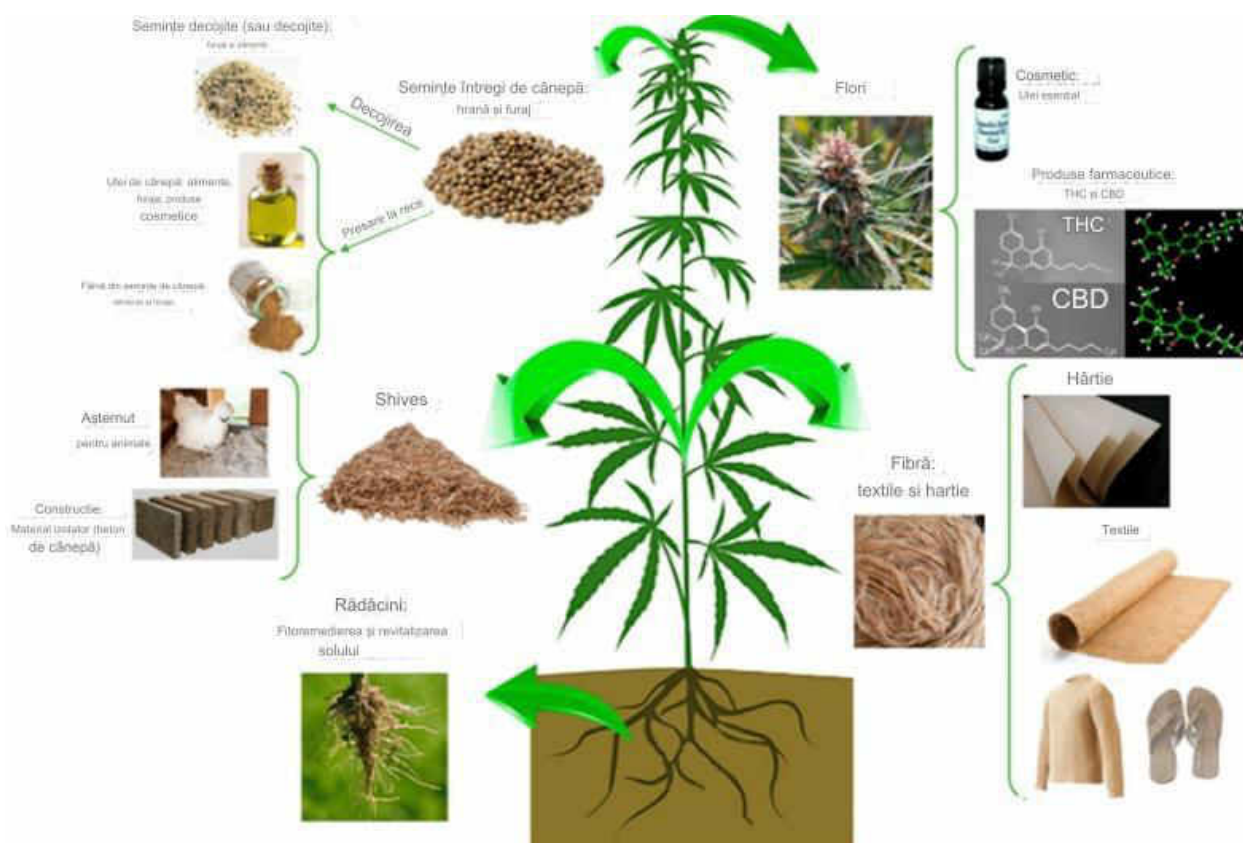


Figura 3. Utilizarea plantei de cânepă în diverse industrii

Utilizarea deșeurilor agroindustriale din industria oleaginoasă

În stil modern, există o tendință crescută de utilizare a deșeurilor agroindustriale din industria oleaginoasă în moduri inovatoare și sustenabile. Aceasta este în concordanță cu conceptul de economie circulară, care promovează reducerea deșeurilor și utilizarea eficientă a resurselor disponibile.

Drept propuneri de utilizare a deșeurilor rezultate din industria oleaginoasă și anume a șrotului de cânepă, ar fi introducerea acestuia în componența produselor multifuncționale și anume cu scopul creșterii valorii biologice și nutritive a produsului. S-a încercat realizarea pâinii din șrot de cânepă, dar și din inflorescență de cânepă, ceea ce a demonstrat că ceea ce era cândva utilizat doar pentru hrana animalelor, poate fi introdus cu ușurință în alimentația oamenilor. Cercetările au prezentat că valoarea nutritivă și biologică a pâinii cu inflorescență de cânepă în comparație cu cea din făină de grâu, a crescut și că în compoziția pâinii s-au constatat cantități considerabile de proteine, fibre alimentare, grăsimi, vitamine (B, C, E, PP), minerale (K, Ca, Mg, Mn), dar și compuși bioactivi, precum sunt compușii fenolici, peptide bioactive și principalele grupe de cannabinoidi.

Concluzii

În urma efectuării cercetării științifice la tema „Valorificarea deșeurilor rezultate din industria oleaginoasă”, s-a constatat că:

- problematica referitoare la deșeurile generate de industria uleiurilor este actuală, deoarece acestea nu sunt valorificate și de-obicei nu se utilizează;
- S-au analizat datele statistice la nivel mondial și la nivel național privind producerea uleiurilor pe categorii, dar și s-au analizat datele statistice privind acumularea deșeurilor generate de această industrie;
- S-a propus modalitatea de valorificare șrotului rezultat din industria oleaginoasă în alimente multifuncționale și s-a prezentat faptul că acesta are o importanță semnificativă pentru ridicarea valorii biologice active și nutriționale.

Mulțumiri: Cercetarea a fost susținută de Proiectul de Stat 23.70105.5107.06T „Valorificarea proteinelor vegetale din produse secundare ale industriei uleiurilor și grăsimilor autohtone”, ProVeg, derulat la Universitatea Tehnică a Moldovei și Bursa Națională a Federației Mondiale a Oamenilor de Știință.

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VALORIFICAREA SEDIMENTULUI DE DROJDII DIN VINIFICAȚIE ÎN PATISERIE

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Rezumat. Conform Biroului Național de Statistică din RM, strugurii a ocupat locul 6 în anul 2022 din totalul de producție vegetală iar reziduurile din producția vinului constituie 30% din masa totală a strugurilor. Principalele deșeuri biologice obținute din industriile vinificatoare sunt tulpini, tescovină de struguri și drojdie reziduală. Peretele celular al drojdiei reziduale de vin conține până la 40% manoproteină și aproximativ 60% glucani. B-glucanii extrași din drojdia reziduală de vin sunt compuși bioactivi evidențiindu-se prin benefici în ceea ce privește sănătatea inimii, sistemul imunitar și controlul nivelului de glucoză în sânge. Astfel, producătorii din industria alimentară de patiserie ar putea să integreze β -glucanii în diverse produse pentru a răspunde cererii crescânde a consumatorilor pentru opțiuni alimentare sănătoase. Datorită proprietăților lor fizice specifice, cum ar fi (in)solubilitatea, vâscozitatea și gelificarea, β -glucanii sunt din ce în ce mai utilizați în industria alimentară. Scopul acestei revizuirii este de a oferi o perspectivă globală asupra posibilităților de utilizare a β -glucanilor în patiserie, influența acestora asupra modificării texturii, structurii, compoziției produselor de patiserie așa cum ar fi biscuiți, briose, pâine și alte produse potențiale cu valoare adăugată. Perspectivele indică că β -glucanii vor deveni tot mai relevanți în sectorul produselor alimentare de patiserie.

Cuvinte cheie: drojdie reziduală, beta glucani, produse de patiserie, produse cu valoare adăugată

Introducere

Activitatea complexului vitivinicol este strâns asociată de ciclul complet agro și biotehnologic. În această chibzuială tehnologic se obține, în paralel produse secundare, reziduuri, care, fiind stocate, aduc compensări semnificative mediului ambiant [1]. Situația actuală necesită o schimbare de la o economie liniară la una circulară în care subprodusele dobândesc o valoare adăugată și reintră în ciclul de producție [2].

Drojdia de vin este un produs secundar care reprezintă 25% din totalul deșeurilor vinului, constau, în principal, din celule plasmolizate natural de *S. cerevisiae*, acid tartric și alți compuși adsorbiți. Această drojdie este bogată în compuși fenolici, precum și fibre, proteine din peretele celular al *S. cerevisiae*. Într-adevăr, utilizarea subproduselor cu conținut ridicat de fibre și alți compuși bioactivi ca ingrediente noi este studiată în prezent pentru a obține alimente cu valoare nutritivă mai mare. În ciuda compoziției lor, drojdia reziduală este un produs secundar subevaluat folosit în cea mai mare parte pentru recuperarea acidului tartric și distilare pentru obținerea alcoolului. Cu toate acestea, unele studii au raportat posibilitatea revalorizării drojdiei de vin în industria panificației fiind utilizată pentru a îmbunătăți procesul de fermentare și schimbarea profilului volatil al pâinii [2], ca înlocuitor de grăsimi vegetale în briose [3], ca ingredient funcțional pentru producerea de biscuiți îmbogățiți cu polifenoli și fibre alimentare [4].

Prin urmare, scopul acestui studiu a fost de a urmări perspectivele globale asupra utilizării β -glucanilor în industria de patiserie, explorarea impactului acestora asupra texturii, structurii și compoziției produselor, cum ar fi biscuiți, briose, pâine și alte produse cu valoare adăugată. Pe parcursul anilor se prevede că β -glucanii vor deveni din ce în ce mai semnificativi în acest sector al industriei alimentare de patiserie.

Valorificarea drojdiei reziduale de vin la fabricarea pâinii

Un studiu a cercetat revalorificarea pâinii cu adaos de drojdie de vin spumant Cava [2]. Drojdia de Cava a fost liofilizată urmând metoda descrisă de Hernández-Macias, Comas-Basté [5]. A fost adăugată drojdia de vin liofilizată ca procent din greutatea făinii-5% (g/g) și s-a comparat cu un martor fără drojdie.

Adăugarea drojdiei liofilizate de Cava la aluat nu a stimulat creșterea bacteriilor lactice. În timpul procesului de fermentare și înmulțire a aluatului, pH-ul a scăzut în primele etape de fermentație și apoi s-a stabilizat, similar celor raportate în alte studii [6, 7] și în conformitate cu intervalul de pH al aluaturilor tradiționale (pH 3,5–4,5) [8]. Cu toate acestea, nu au existat diferențe semnificative statistic între aluaturi.

În urma analizei pentru a evalua efectul drojdiei de Cava asupra fracției volatile a pâinii a fost analizat profilul volatil al drojdiei deoarece ea este capabilă să rețină substanțe aromatice precum esterii, aldehide și unii compuși fenolici. În general, pâine cu drojdie de Cava a avut cea mai mare concentrație și număr de compuși volatili diferiți, în special în acizi și esterii.

Prin urmare formularea pâinii cu 5% drojdie de Cava (g/g) a îmbunătățit creșterea microbiană în fermentațiile scurte. Adăugarea de drojdie de cava la pâine a crescut concentrația de substanțe volatile care se găsesc de obicei în pâine cu maia și cea obișnuită [2].

Valorificarea drojdiei reziduale de vin ca ingredient funcțional pentru producerea de biscuiți îmbogățiți cu polifenoli și fibre alimentare

Una dintre cele mai critice probleme cu privire la biscuiți este oxidarea grăsimilor compromițând perioada de valabilitate. În acest context drojdiile reziduale de vin conțin antioxidanți și polifenoli care ar putea acționa ca regulatori ai stabilității la oxidare [9].

Pentru prepararea făinii din drojdia reziduală de vin din soiuri de struguri roșii, drojdia s-a filtrat și apoi liofilizat pentru a ajunge la o umiditate finală mai mică de 3%. Drojdia liofilizată a fost zdrobită și cernută separând particule cu dimensiuni egale sau mai mici de 300 μm [10].

Au fost dezvoltate trei formulări de biscuiți prin înlocuirea făinii de grâu cu făină din drojdie reziduală, cantitatea de drojdie reziduală de vin egală cu 10% și 20% a fost aleasă pentru a atinge mențiunile nutriționale „sursă de fibre”, conform Regulamentului CE 1924/2006 [11]. Procesul a constat în amestecarea făinii de grâu, făinii obținute din drojdia reziduală de vin, zahărului și uleiului, adăugarea de lapte parțial degresat și bicarbonat de amoniu, frământarea, modelarea, gătirea în cuptor timp de 16 min la 160 °C [4].

Tabelul 1.

Compoziția biscuiților cu făină din drojdie reziduală [4]

Nr. d/o	Parametrii	Unitatea de măsură	Proba martor	Proba cu 10%	Proba cu 20%
1	Umiditate	g/100 g	4,80 ± 0,03	9,1 ± 0,06	9,2 ± 0,2
2	Proteine		8,5 ± 0,01	9,9 ± 0,2	9,56 ± 0,3
3	Lipide		16,5 ± 0,1	17,8 ± 0,3	17,3 ± 0,04
4	Cenușă		0,5 ± 0,01	1,5 ± 0,04	2,7 ± 0,01
5	Carbohidrați		67,1 ± 0,02	57,0 ± 0,02	53,2 ± 0,9
6	Fibre alimentare		2,7 ± 0,09	4,7 ± 0,12	8,04 ± 0,3
7	ABST	μmol TE/g	1,2 ± 0,09	2,4 ± 0,1	4,3 ± 0,08
8	DPPH		0,5 ± 0,00	2,6 ± 0,05	4,8 ± 0,13
9	TPC	mg GAE/g	0,3 ± 0,03	0,7 ± 0,05	1,5 ± 0,01

Tabelul 1 raportează rezultatele compoziției biscuiților. Biscuiții îmbogățiți cu făină din drojdie reziduală de vin au prezentat valori de umiditate semnificativ mai mari decât martorul. Această creștere s-a datorat probabil prezenței fibrelor în drojdia reziduală de vin, care sunt cunoscute pentru capacitatea de a reține și legare a apei [12]. Conținutul de proteine a crescut în biscuiții unde a fost adăugată făină reziduală de vin care se datorează conținutului de proteine din drojdia de vin. O creștere a fibrelor alimentare proporțională cu adăugarea de făinii din drojdia

reziduală de vin a fost observată în proporția de 10% și 20%, permițându-le să fie etichetate drept „bogată în fibre” conform Regulamentului 1924/2006 [11]. Cele mai mari valori ale conținutului total de fenoli și activității antioxidante au fost observate în înlocuirea a 20% din făină de grâu cu făină din drojdia reziduală de vin [4].

Valorificarea beta glucanilor din drojdia reziduală de vin încorporat în briose, impactul asupra calității aluaturilor și a produselor coapte prin înlocuirea grăsimii

Principalul biopolimer care formează peretele celular de drojdie reziduală de vin și este responsabil pentru menținerea rezistenței acestuia este glucanul. Produsele de panificație conțin cantități mari de grăsime, cercetătorii încearcă să reducă conținutul de grăsimi și acizi grași saturați al alimentelor și să introducă ingrediente bioactive care cresc valoarea pentru sănătate.

Studiul de față a realizat biscuiți din făină de grâu, ulei, lapte, zahăr, ouă proaspete, bicarbonat de sodiu și carbonat acid de amoniu. Preparatul de β -glucan a fost adăugat în cantitate de 1%, 2%, 3% și 4% din întreaga masă de aluat. Conținutul de grăsime a fost redus cu 20, 40, 60 și 80% în comparație cu proba de control fără înlocuirea grăsimi. Reducerea conținutului de grăsime și, prin urmare, creșterea adaosului de preparat de β -glucan a determinat o creștere semnificativă a durității cu până la aproximativ 67%. Cea mai mică duritate a fost găsită în produsele semifabricate fără adaos de β -glucan și produse cu un conținut de grăsime redus cu 20%

Această tendință ascendentă, împreună cu creșterea cantității de înlocuitor de grăsime utilizat, poate fi explicată prin capacitatea mare de absorbție a glucanului de apă. Studiile anterioare au arătat că o scădere a capacității de legare a glutenului din cauza absorbției mari de apă a ingredientelor utilizate în formulările de aluat duce la formarea unei structuri lipicioase [13].

Au fost notate volume diferite ale produselor obținute, briosele de control au avut cea mai mare valoare a acestui parametru. Adăugarea de β -glucan a provocat o scădere a volumului fără un efect semnificativ statistic asupra modificării masei în timpul coacerii. Briosele cu cel mai mare conținut de β -glucan au fost caracterizate de cea mai mare densitate a firimiturii.

Rezultatele indică posibilitatea eliminării grăsimii din briose prin înlocuirea acesteia cu β -glucan, într-o măsură limitată. Înlocuirea grăsimilor peste 40% cu β -glucan, a dus la scăderea calității produselor atât după coacere, cât și în timpul depozitării acestora. Introducerea a 3% și mai mult de β -glucan în compoziție și reducerea grăsimii (60% și mai mult), a provocat o creștere nedorită a durității aluatului și deteriorarea calității pesmetului de briose, după coacere și în timpul depozitării.

Concluzie

Unul dintre principalele deșeuri reziduale ale procesului de vinificație este drojdia reziduală de vin care necesită o reutilizare industrială deoarece are un impact negativ asupra mediului înconjurător. Industria de panificație constituie o gamă largă de produse în care ar putea fi adăugată drojdia reziduală de vin pentru a crește valoarea nutritivă a produselor de panificație care constituie o barieră pentru persoanele care suferă de diabet, obezitate, boli cardiovasculare, digestive, astfel adăugarea de drojdie reziduală de vin ar putea reduce indicele glicemic al produselor de panificație. Unul din beneficiile furnizate de drojdia reziduală de vin este înlocuirea acesteia cu o parte din grăsimea utilizată în produsele de patiserie astfel prevenind râncezirea timpurie a produselor și extinzând termenul de valabilitate ale acestora. Pe lângă aceasta componentul major care se găsește în peretele celulei de drojdie reziduală de vin o constituie β -glucanii care sunt determinați ca fibre alimentare ce îmbunătățesc digestia, curăță organismul de radicali liberi prevenind riscul de apariție a cancerului. Prin urmare reutilizarea durabilă a deșeurilor alimentare cum ar fi sedimentul de drojdie din vinificație poate contribui la tranziția către un sistem alimentar mai circular și mai sustenabil. Este esențial să se promoveze educația și conștientizarea publicului cu privire la importanța reducerii și reutilizării deșeurilor alimentare, în timp ce se susține și se implementează politici și practici care să sprijine această tranziție către un model de consum și producție mai sustenabil.

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IMPACTUL NUTRIȚIEI ASUPRA BOLII CORONARIENE

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Rezumat. *Boala coronariană (BC) este principala cauză de morbiditate și mortalitate la nivel mondial și a fost caracterizată ca o boală cronică imunoinflamatoare, fibroproliferativă alimentată de lipide. S-au făcut progrese mari în elucidarea interacțiunilor mecanice complexe dintre factorii de risc asociați cu BC, producând un succes abundent în ceea ce privește măsurile preventive și dezvoltarea de produse farmaceutice pentru prevenirea și tratarea BC prin atenuarea riscului mediat de lipoproteine. Cu toate acestea, rămâne un risc rezidual semnificativ. Câțiva factori de risc BC potențial modificabili care contribuie în mod aparent la acest risc rezidual au ieșit în prim-plan, inclusiv inflamația sistemică, diabetul zaharat, lipoproteinele de înaltă densitate, trigliceridele plasmatică (TG) și lipoproteinele rămase (RLP), lipoproteina(a) și disfuncția endotelială vasculară (DE). Primul pas în gestionarea factorilor de risc pentru BC implică manipularea macronutrienților din dietă. În Trialul de Prevenție Primară Coronară a Clinicilor de Cercetare Lipidă, s-a stabilit că fiecare scădere cu 1% a colesterolului LDL (LDL-C) a fost asociată cu o scădere cu 2% a riscului de BC. Aceste constatări au stat la baza Programului Național de Educație pentru Colesterol (PNEC) recomandate atât pentru bărbați, cât și pentru femeile cu hipercolesterolemie.*

Cuvinte-cheie: *boala coronariană, nutriție, lipoproteine, diabet zaharat, dieta mediteraneeană*

Introducere

Boala coronariană (BC) și manifestările sale clinice reprezintă pluralitatea morbidității și mortalității la nivel mondial. Aterogeneza este inițiată de retenția și acumularea de particule bogate în apolipoproteină B (apoB), (în mod obișnuit, >90% dintre acestea sunt formate din LDL) care conțin colesterol în inima arterială. Inflamația, disfuncția endotelială vasculară, hipertensiunea arterială, dislipidemiile, rezistența la insulină, expunerile la mediu și agenții patogeni contribuie toate la inițierea și progresia aterosclerozei. Aterogeneza a fost descrisă ca o boală cronică imunoinflamatoare, fibroproliferativă alimentată de lipide.

Odată cu apariția ultracentrifugării analitice, care permite separarea lipoproteinelor purtătoare de colesterol în funcție de densitate, lipoproteinele cu densitate joasă (LDL) au fost identificate ca un factor de risc cheie pentru dezvoltarea bolii aterosclerotice. Ulterior, un corp vast de cercetări de-a lungul mai multor decenii, inclusiv studii genetice, studii epidemiologice prospective, studii de randomizare mendeliană și studii de control randomizate au stabilit definitiv LDL ca un contribuitor ocazional la BC.

Mai multe studii au concluzionat că riscul de BC se corelează mai puternic cu concentrația de particule care conțin apoB, spre deosebire de încărcătura agregată de colesterol transportată în lipoproteinele non-HDL. Deși rolul dăunător al LDL este reflectat în ghidurile actuale de practică clinică care promovează identificarea și tratamentul farmacologic al LDL-C crescut ca piatră de temelie a terapiei preventive, analizele datelor din studiile clinice relevă un risc rezidual anual de aproximativ 9% chiar și în rândul celor cu LDL optim [1].

Lipoproteine cu densitate scăzută

Dintre nenumărații factori de risc asociați cu dezvoltarea BC, LDL este fără echivoc cel mai bine stabilit. Mai multe studii de referință, randomizate, dublu-orb, controlate cu placebo, care au testat efectul scăderii LDL-C asupra riscului de BC, au stabilit că statinele sunt piatra de temelie a terapiei preventive pe întregul spectru de risc de BC. Odată cu succesul demonstrat al scăderii LDL-C de către statine, a apărut întrebarea dacă riscul persistent de BC ar putea fi atenuat în continuare prin terapii adjuvante de scădere a lipidelor. Studiul IMPROVE-IT și-a propus să răspundă la această întrebare, incluzând peste 18.000 de pacienți care au suferit un sindrom coronarian acut (SCA) cu LDL-C relativ scăzut (în medie 93 mg/dL) și au fost randomizați să primească fie 40 mg de simvastatină și 10 mg ezetimib față de 40 mg simvastatină și placebo. După 6 ani de urmărire, terapia combinată hipolipemiantă a obținut o reducere relativă modestă a LDL-C (53,7 mg/dl față de 69,5 mg/dl în grupul tratat cu simvastatină în monoterapie), ceea ce a dus la reducerea rezultatului compozit al morții cardiovasculare, infarctului miocardic (IM) non-fatal, anginei instabile care necesită rehospitalizare, revascularizare coronariană precoce sau accident vascular cerebral non-fatal.

În mod liniștitor, studiile care urmăresc să descopere un efect dăunător al reducerilor extreme farmacologice sau mediate genetic ale LDL-C nu au demonstrat niciun risc crescut (de exemplu, nicio creștere a riscului de malignitate, afectare neurocognitivă sau accident vascular cerebral hemoragic) [2].

Lipoproteină de densitate înaltă

Lipoproteinele de înaltă densitate (HDL) au fost recunoscute de mult timp a avea o relație inversă cu riscul de BC, datorită includerii actuale a HDL-colesterol (HDL-C) în modelele de risc cardiovascular larg promulgate. Această observație a fost susținută de mai multe linii de dovezi observaționale și experimentale. Studiile mecaniciste au sugerat că particulele de HDL sunt ateroprotectoare deoarece participă la transportul invers al colesterolului și au proprietăți antioxidante, antiinflamatorii și antitrombotice.

Tratamentul cu niacină laropirant a dus la mai multe efecte adverse semnificative, inclusiv un risc crescut de apariție a diabetului zaharat incident, incidență crescută a tulburărilor de control al diabetului, efecte secundare gastrointestinale, musculo-scheletice și ale pielii, precum și risc crescut de infecții. Terapia ideală direcționată pe HDL ar avea ca scop îmbunătățirea funcțiilor cardioprotectoare ale particulei HDL, spre deosebire de creșterea HDL-C. Un mic studiu recent al pacienților cu hipercolesterolemie familială homozigotă a demonstrat o regresie semnificativă a ateromului, așa cum a fost evaluată prin angiografie coronariană computerizată după 7 perfuzii săptămânale de plasmă îmbogățită cu preβ-HDL autologă delipidată. Particulele HDL pot purta atât microARN pro- și anti-aterogeni și pot exercita, de asemenea, atât efecte pro- cât și anti-inflamatorii de-a lungul peretelui vasului.

Rezistența la insulină și diabetul zaharat

Prevalența în creștere a diabetului zaharat la nivel mondial este alarmantă și este asociată cu un risc substanțial crescut de mortalitate și morbiditate, determinat în principal de BC. Caracteristicile centrale ale diabetului zaharat includ atât rezistența la insulină, cât și hiperglicemia, fiecare dintre acestea contribuind în mod unic la inițierea și progresia plăcii aterosclerotice. Numeroase studii in vivo au implicat rezistența la insulină în promovarea aterogenezei și a progresiei avansate a plăcii prin mecanisme multiple, inclusiv:

- modificări nefavorabile ale compoziției și funcției lipoproteinelor,
- promovarea hipertensiunii sistemice,
- activarea receptorilor produselor finale de glicaj avansată (RAGE),
- creșterea producției de substanțe proinflamatorii mediatore,
- semnalizarea perturbată a insulinei în celulele endoteliale, celulele musculare netede vasculare și macrofage.

Recent, introducerea inhibitorilor de co-transportator de sodiu-glucoză-2 (SGLT 2) și agoniștilor receptorului peptidei-1 de tip glucagon (GLP-1) au demonstrat o capacitate remarcabilă de a avea un impact benefic asupra rezultatelor cardiovasculare.

Două studii ulterioare privind rezultatele cardiovasculare care au utilizat inhibitori SGLT2 au confirmat capacitatea acestei clase de medicamente de a reduce insuficiența cardiacă incidentă și decesul cardiovascular la pacienții diabetici. Au fost propuse o serie de mecanisme presupuse, inclusiv reduceri observate ale tensiunii arteriale sistemice secundare, reducerii volumului intravascular, niveluri crescute de corpi cetoni circulanți (acetoacetat, acetonă, β -hidroxibutirat) care pot promova creșterea eficienței metabolice a miocitelor cardiace și creșterea eritropoiezei, toate acestea ar fi de așteptat să afecteze în mod favorabil raportul dintre oferta și cererea de oxigen miocardic.

Acești agenți imită GLP-1, un hormon gastrointestinal care stimulează sinteza și secreția de insulină pancreatică dependentă de glucoză, suprimă secreția de glucagon al celulelor insulare α și întârzie golirea gastrică, promovând sațietatea. Studiile clinice timpurii au sugerat o îmbunătățire semnificativă a hemoglobinei glicozilate A1c (HbA1c), atunci când este utilizată ca terapie adjuvantă în plus față de terapiile standard pentru diabet, determinând investigarea potențialelor efecte și beneficii cardiovasculare în lumina autorităților de reglementare care impun evaluări ale siguranței cardiovasculare a noilor tratamente pentru diabet [3].

Importanța alimentației asupra bolii coronariene

Boala coronariană (BC) este o afecțiune a arterelor coronare care alimentează inima. Este o îngustare a uneia sau mai multor artere coronare. Este cauzată de ateroscleroza care se datorează acțiunii depozitelor grase de colesterol. Când fluxul sanguin este încetinit de o arteră blocată, miocardul nu mai este oxigenat corespunzător. Boala coronariană reprezintă o provocare socio-economică majoră. Pe lângă genetică, principalii factori de risc pentru boala coronariană sunt lipsa activității fizice, fumatul, abuzul de alcool și alimentația necorespunzătoare. Dieta joacă un rol cheie în această patologie. Poate avea rol protector atunci când este echilibrată (dieta mediteraneană) pentru că este bogată în vitamine (vitamina B, C) și minerale (magneziu, calciu); acizi grași (AG) (omega-3); fibre alimentare și proteine. Pe de altă parte, este dăunătoare atunci când este bogată în acizi grași saturați (AG), acizi grași trans (TFA), sare și carbohidrați [4].

Dintre multiplele bioactive derivate din plante, *polifenolii* sunt unul dintre cele mai importante grupuri de agenți naturali cardioprotectori, antioxidanți și antiinflamatori găsiți în alimentele umane, inclusiv fructele, legumele, cerealele, ierburile și semințele. Aceste molecule sunt metaboliți secundari responsabili de pigmentare, reproducere, creștere și protecție împotriva agenților patogeni din alimentele pe bază de plante. Având un reziduu de zahăr legat de scheletul de carbon, structura chimică a polifenolilor diferă numai prin legăturile lor suplimentare cu alți compuși. Polifenolii pot fi împărțiți practic în trei subgrupe: flavonoide, non-flavonoide și acizi fenolici. În colon, polifenolii sunt inițial digerați în structuri fenolice mai mici de către microflora intestinală. Polifenolii pot îmbunătăți sănătatea cardiovasculară folosind inhibarea agregării plachetare, reducerea inflamației vasculare, modularea proceselor apoptotice, limitarea oxidării LDL a lipoproteinelor cu densitate scăzută și îmbunătățirea profilului lipidic [5].

Multe studii au sugerat că citricele, produsele bogate în cacao și ciocolata neagră conțin concentrații mari de flavonoide legate de reducerea riscului de BC. De asemenea, ceaiul verde și extractele sale au un nivel ridicat de molecule de flavan-3-ol, epigallocatechin-3-galat (EGCG), care se numără printre antioxidanții cardioprotectori importanți. Ceaiul negru are și o capacitate antioxidantă puternică, dar mai mică decât extractul de ceai verde. Ambele ceaiuri/extracte ajută la scăderea tensiunii arteriale la oameni, ceea ce poate afecta pozitiv profilul de risc CV.

Resveratrolul este un antioxidant polifenolic care se găsește în plante, cum ar fi strugurii, murele, roșiile, coacăzele roșii și afinele. Resveratrolul stimulează producerea proteinei sirtuin-1 (SIRT 1) numită „gena longevității” și astfel ajută la menținerea sănătății celulare, încetinind procesul de îmbătrânire. Resveratrolul este considerat un ingredient cheie în prelungirea duratei

de viață. Resveratrolul protejează sistemul cardiovascular datorită proprietăților sale antiinflamatorii, reduce riscul de ateroscleroză, reduce agregarea trombocitelor și fibroza miocardică.

Carotenoizii găsiți în morcov, dovleac, caise, sunt molecule liposolubile valoroase. Au activitate provitamina A și au potențial antioxidant, scăzând riscul apariției mai multor boli cronice, precum cancerul sau BC, degenerescența maculară și transformările biologice asociate vârstei.

Acizii grași omega-3, inclusiv acidul omega-3 docosahexaenoic (DHA) și acidul eicosatetraenoic (EPA), sunt responsabili pentru dezvoltarea normală a creierului, vederea normală și un risc mai mic de boli CV. EPA și DHA au efecte antiinflamatorii și cardioprotectoare, inclusiv proprietăți anti-aritmice, anti-trombotice. Ele declanșează, de asemenea, o scădere a tensiunii arteriale, întăresc funcția endotelială și diminuează creșterea plăcii aterosclerotice, așa că par a fi biomolecule promițătoare cu efecte antihipertensive, antioxidante, antidepresive, antiîmbătrânire și antiartrite [6].

Beneficiile constituenților bioactivi derivați din plante și schimbările stilului de viață asupra factorilor de risc în bolile cardiovasculare sunt prezente în Tabelul 1.

Tabelul 1.

Factorul de risc și efectele benefice a unor constituenți bioactivi derivați din plante

Factorul de risc cardiovascular	Fiziopatologia	Beneficiu
Stil de viață sedentar	↑Rezistență la insulină, ↑obezitate, ↑glicemie, ↑lipide plasmatic, ↑factori protrombotici	Modificări ale stilului de viață, activitatea fizică scade riscul de mortalitate prin boli cardiovasculare : ↑activitatea fizică, ↓consumul de alcool, nu fumatul ↓Obezitatea: ↓riscul de insuficiență cardiacă incidentă în 50% din cazuri
Hipertensiune	↑Hipertensiune arterială și polimorfisme legate de factorul de creștere endotelial, ↑leziune vasculară	Berberină, ceai verde, cacao, licopen, extract de usturoi învechit, resveratrol, extract de semințe de struguri, suc de sfeclă roșie, ulei de măsline și acid ascorbic: ↓tensiune arterială Hidrolizate proteice din semințe de caise și măsline: ↓ACE, Resveratrol, ↑producție de oxid nitric, ↑vasodilatație
Fumat	↑Stres oxidativ, ↑spasm coronarian, tulburări ale mecanismelor de coagulare, ↑agregare trombocitară, creșterea fibrinogenului, tulburări ale funcției endoteliale, ↑LDLc, ↓HDL	Extract de usturoi, Angelica gigas, țelină, Artemisiae annuae Herba, extracte de ovăz, scorțișoară, extracte de soia, hibiscus, semințe de in, fructe de lup, licopen, busuioc și cacao, ↓ateroscleroză Proantocianine (afine): efect antiinflamator, ↓prokinin inflamator, ↓chemokine (TNFa, IL-1, IL-6, IL-8)
Stres	Tulburarea axului hipotalamo-hipofizo-suprarenal, ↑cortizolul seric din cauza stresului, ↑inflamarea peretelui arterial (endotelial), ↑ateroscleroza, ↑tonusul sistemului nervos vegetativ simpatic	L-teanina din ceaiul verde: ↑relaxare, ↓hiperforină de cortizol post-stres: ↑serotonina din creier, asemănătoare cu medicamentele antidepresive ginseng: acțiune antistres, ↓oboseală fizică și psihică, ↑putere de concentrare, ↑memorie, ↑performanță la muncă
Obezitatea	↑Dislipidemie, hipercoagulabilitate, disfuncție trombocitară, ↑rezistență la insulină și diabet de tip 2, ↑inflamație	Polifenoli (struguri, ceai, ginseng, fructe de culoare roșie spre violet) beneficii: ↓ agregarea trombocitară, ↓inflamația vasculară, ↓apoptota, ↓oxidarea LDL EPA și DHA: efecte antiinflamatoare și cardioprotectoare Carotenoizi: ↑potențial antioxidant: ↓resveratrol: ↓depozite de grăsime, reglează nivelul de insulină, ↓greutatea corporală, ↑proteina SIRT 1

Factorul de risc cardiovascular	Fiziopatologia	Beneficiu
Diabet	Alterarea pereților arteriali crescând inflamația la nivel endotelial, cu depunerea de particule de colesterol VLDL și LDL la acest nivel și formarea plăcii de aterom	Dieta mediteraneană: ↓risc de diabet polifenoli, flavonoide, terpenoide, saponine și lignani: efect antihiperglicemic Peptide (soia): previne debutul T2D
Dislipidemie	Creșterea efectului aterogen depunerilor de plăci de aterom pe pereții interni ai arterelor medii și mari, cu îngroșarea peretelui arterial și pierderea elasticității	Compuși fenolici, flavonoli: ↓TC, ↓LDLc, ↓niveluri TG, Fitosteroli: ↓LDLc Componente din soia, atât proteine cât și izoflavone: ↓LDLc, ↑HDLc

Studii recente au arătat că extractul din semințe de struguri este unul dintre cei mai eficienți antioxidanți datorită fitocomplexului său de trans-resveratrol și proantociani oligomerici. De asemenea, are un efect vasoprotector și cardioprotector datorită capacității sale de a neutraliza radicalii liberi, de a reduce ateroscleroza și de a ameliora tulburările venoase induse de fumat.

Activitatea fizică joacă, de asemenea, un rol în prevenirea bolilor coronariene, de aceea este recomandată o activitate moderată care necesită nu mai mult de 30 de minute de mers rapid pe zi. În plus, un studiu cu 10.261 de adulți a constatat că persoanele care au o activitate fizică ușoară, moderată sau viguroasă au un risc semnificativ mai scăzut de mortalitate prin boală coronariană, indiferent de factorii lor de risc metabolic. *Tutunul* este un factor de risc incontestabil pentru BC, consumul său favorizează creșterea degradării NO care are acțiune citotoxică miocardică și vasculară, agravează efectul oxidării LDL și al infiltrației LDL oxidat prin creșterea nivelului de colesterol total [7].

Concluzii

Un nivel crescut de lipoproteine circulante care conțin apo-B a fost identificat de mult ca un factor de risc cauzal central pentru BC. Mai multe medicamente bine studiate sunt disponibile pe scară largă pentru a reduce riscul asociat apo-B, deși majoritatea pacienților chiar și cu risc ridicat nu reușesc să atingă reducerea apo-B la un nivel proporțional cu reducerea optimă a riscului. Chiar și printre cei cu o reducere adecvată a apoB, riscul rezidual semnificativ de BC persistă. Această povară a riscului rezidual este în mare măsură încapsulată de factori de risc BC alternativi, inclusiv HDL, hipertrigliceridemie, lipoproteine rămase, Lp(a), rezistență la insulină, diabet zaharat, inflamație sistemică și disfuncție endotelială vasculară.

Boala coronariană este în mod clar în creștere în țara noastră și în lume, este direct legată de lipsa activității fizice și de o alimentație de proastă calitate adoptată de majoritatea oamenilor. Acest tip de comportament determină o explozie a bolilor metabolice (hipertensiune, diabet, dislipidemie), iar singurul tratament pentru această patologie rămâne prevenirea secundară a factorilor de risc modificabili. Această prevenire necesită o dietă echilibrată de bună calitate precum dieta mediteraneană, a cărei calitate este deja demonstrată, precum și activitate fizică de intensitate moderată.

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НАПИТКИ ФУНКЦИОНАЛЬНОГО НАЗНАЧЕНИЯ ИЗ ВТОРИЧНОГО СЫРЬЯ МАСЛОЖИРОВОЙ ПРОМЫШЛЕННОСТИ

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Резюме. На сегодняшний день, вторичное сырье из масложировой промышленности получили широкое распространение и применение в различных отраслях промышленности. Вторичное сырье, как жмых, представляет собой недорогое сырье, которое ведет к производству недорогого продукта, что есть рентабельно с экономической точки зрения. Помимо преимуществ с экономической стороны, жмых характеризуется высоким содержанием белков, клетчатки, антиоксидантов, углеводов, что является преимуществом для сбалансированного питания человека. Однако, жмых влияет по-разному на вкус, цвет, текстуру, антиоксидантные свойства полученного продукта, все зависит от основного сырья. Благодаря своим преимуществам, жмых все больше получает широкое применение в производстве растительных напитков, а также может служить в качестве пищевой добавки, все это служит получению новых продуктов питания, богатых с биологической точки зрения и развитию пищевой промышленности.

В настоящем обзоре рассматриваются возможности повторного использования побочных продуктов, полученных из масличных культур (черного тмина, рыжика, кунжута, льна, арахиса, горчицы и миндаля), в пищевом секторе в будущем.

Ключевые слова: напитки, вторичное сырье, растительном сырье, пищевая ценность.

Введение

На сегодняшний день существуют различные исследования с применением вторичного масличного сырья для производства функциональных напитков. Был проведен литературный обзор, где были выявлены исследования по разработке напитков функционального назначения с использованием вторичного сырья масложировой промышленности, а именно жмыха [1].

По объемам производства масличного сырья и растительных масел Республика Молдова сохраняет значительный удельный вес в промышленном производстве.

В зависимости от использования в хозяйственной деятельности человека масличные растения делят на подгруппы, которые представлены на рис 1.

На сегодняшний день, интерес потребителей и исследования в области аналогов молочных продуктов на растительной основе в последние годы растут из-за все более негативного воздействия продуктов животного происхождения на здоровье человека, благополучие животных и окружающую среду. Ожидается, что сектор молочных продуктов растительного происхождения расширится в среднем на 12,5% и достигнет объема мирового рынка в 52,58 млрд долларов США к 2028 году [2].



Рисунок 1. Виды масличного сырья [3].

По сравнению с обычными молочными продуктами заменители молочных продуктов на растительной основе обладают многими привлекательными свойствами для потребителей, которые представлены на рис. 2.

Поиск новых источников белковых гидролизатов растительного происхождения для использования в пищевых продуктах имеет решающее значение, учитывая этически и экологически обоснованную необходимость снижения потребления мясных и молочных продуктов, которые являются основным источником белка в традиционных диетах. Растущая популярность этого рынка привела к расширению ассортимента заменителей молочных продуктов, включающих огромное разнообразие растительных матриц [4].

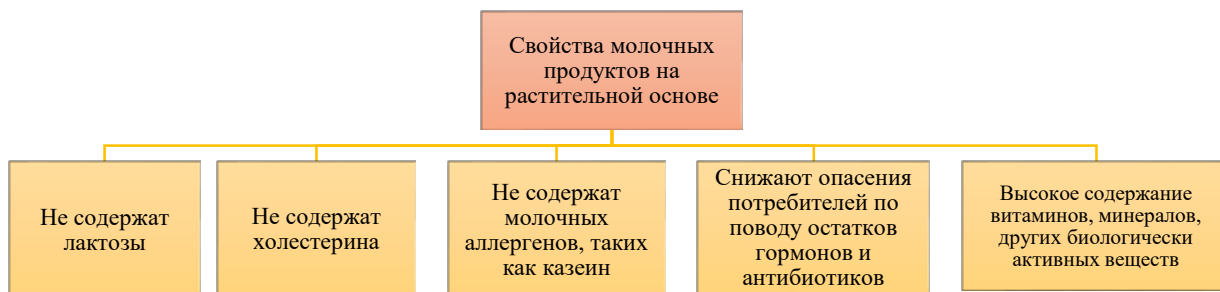


Рисунок 2. Свойства молочных продуктов на растительной основе [4].

Использование кедрового жмыха для получения кефира

В одном из исследований Галиахметов А.А. и Тригуб В.В. провели улучшение кефира за счет добавления кедрового жмыха. В исследовании получение кефирного напитка осуществлялся с использованием резервуарного метода сквашивания. Приготовление кефира на основе кедрового жмыха предполагает ряд процессов. Для начала

2% измельченного кедрового жмыха разбавили в холодном молоке, а затем смесь была пастеризована в течении 20 минут. После пастеризации, смесь была охлаждена до комнатной температуры. В охлажденную смесь была внесена закваска бифидобактерий в количестве 5 %. Затем всю смесь перемешали и подвергали сквашиванию, чтобы получить кислотность в районе 55-60 °Т. Данная кислотность достигается за 4 часа. Полученные данные показали, что биопродукты с кедровым жмыхом обладают высокими потребительскими свойствами и безопасны для потребления. Вкус и запах биопродукта мягче и нежнее, особенно приятен за счет свойственного аромата и вкуса ядра кедрового ореха. Полученные биопродукты по потребительскому показателю являются конкурентоспособными, поскольку использование пробиотических микроорганизмов и в качестве пищевых волокон жмыха ядра кедрового ореха обеспечивает натуральность, высокую полезность, приятную консистенцию без использования консервантов, стабилизаторов и красителей. В результате добавления жмыха в состав кефира продукты будут обогащены биологически активными веществами, пищевыми волокнами, микроэлементами, а также будет увеличена концентрация бифидобактерий, очищающих кишечник от токсинов, нормализующих функционирование кишечника [5].

Использование льняного жмыха для получения кефира

В одном из исследований, проведенный Łukasz Łopusiewicz и др., был изготовлен кефир на основе жмыха из льна. Жмых был оценен как потенциальный субстрат для производства нового кефироподобного ферментированного напитка. Три пробы, содержащие 5%, 10% и 15% жмыха, инокулировали кефирными зернами и инкубировали при 25°C в течение 24 часов. После обработки напитки хранились в холодильнике (6°C) в течение 21 дня. Оценивались изменения микробной популяции, pH, кислотности, содержания белков, полифенолов, флавоноидов, аскорбиновой кислоты и редуцирующих сахаров. Дополнительно определяли вязкость, твердость, цвет и антиоксидантные свойства. Результаты показывают, что дрожжи и молочнокислые бактерии могут хорошо развиваться в напитке с льняным жмыхом без дополнительных добавок. Когда микроорганизмы хранились в холодильнике, их жизнеспособность превышала рекомендованный минимум для разработанных продуктов. В результате ферментации напитки проявили отличную антиоксидантную активность. Также с экономической точки зрения, жмых из льна достаточно привлекателен, поскольку он довольно дешевый и доступен в течении всего года [6-8].

Использование семян рыжика (*Camelina sativa L.*) для получения йогуртоподобного напитка

Camelina sativa L. (также известная как “ложный лен”) - одна из старейших сельскохозяйственных культур (используется для производства масла уже 3000 лет. В анализируемом исследовании жмых из семян камелины (*Camelina sativa L.*) - 15% и 20% по массе) ферментировали с использованием йогуртовой закваски. Были исследованы физико-химические свойства образцов, включая pH, общую кислотность, цвет, вязкость, текстуру и реологические свойства. Кроме того, была определена жизнеспособность молочнокислых бактерий (LAB), биологически активные соединения и антиоксидантная активность. В заключение, исследование доказало, что полученные текстурные и реологические свойства могут имитировать структуру молочных йогуртов. Камелина также является хорошей средой для роста в лабораторных условиях, что было подтверждено результатами микробиологических анализов, и полученная жизнеспособность бактерий выше, чем рекомендовано для этого вида продукта. Наблюдалось значительное подкисление, потребление редуцирующих сахаров, увеличение содержания свободных аминокислот и полифенолов. Кроме того, ферментированные образцы на основе семян рыжика (*Camelina sativa L.*) показали хороший антиоксидантный потенциал. В свете полученных результатов

йогуртоподобные напитки на основе камелины, благодаря высокому содержанию биологически активных соединений (таких как полифенолы и флавоноиды) и высокой жизнеспособности ЛАВ в матрицах (более 1 010 КОЕ/г), могут быть предложены в качестве нового функционального продукта, подходящего для веганов и при различных диетах [9].

Использование жмыха из черного тмина для получения кефироподобного напитка

В анализируемом исследовании было два опытных варианта, содержащих 20% и 30% жмыха из семян черного тмина (*Nigella sativa L.*), которые были инокулированы кефирными зерновыми культурами и затем инкубированы при 25°C в течение 24 часов. Далее, после приготовления конечного продукта, его помещают в холодильник на 28 дней. Результаты показывают, что напитки из жмыха их семян черного тмина могут обеспечить подходящую среду для роста микроорганизмов, в частности лабораторных и дрожжевых. Во время хранения измеряли pH, общее количество свободных аминокислот, редуцирующих сахаров, изменения в микробной популяции, вязкость, текстурные параметры и цвет на дни 1, 5, 7, 14, 21, и 28. В течение всего срока хранения количество молочнокислых бактерий, а также дрожжей превышало рекомендуемый минимальный уровень. В тестируемых напитках в результате ферментации наблюдались многочисленные изменения параметров продукта по сравнению с неферментированными продуктами. В обоих образцах количество микробов не снизилось ниже уровней, рекомендованных для обычного кефира на основе молока. Более того, добавление жмыха их семян черного тмина проявлял не только антиоксидантные свойства, но и интересные текстурные характеристики. Это исследование указывает на возможность использования жмыха их семян черного тмина в качестве ценной матрицы для производства функционального напитка, подобного кефиру [10-13].

Использование амарантового жмыха для получения йогуртоподобного напитка

Амарант является довольно хорошей перспективой для производства функциональных напитков. В ходе литературного обзора, было изучено исследование, проведенное Антиповой.Л.В, где была разработана технология получения питьевого йогурта на основе экстракта из амарантового жмыха. В результате физико-химического анализа, было заметно нарастание кислотности с комбинацией молока 3:1. По сенсорным показателям полученные питьевые йогурты на основе амаранта, показали хорошие результаты и не уступают традиционным. Анализируемые образцы имеют приятный вкус, молочный цвет, запах ярко кисломолочный, консистенция однородная. Также, полученный напиток характеризуется содержанием пробиотиков и пребиотиков [12].

Выводы

Извлечение природных биологически активных соединений из побочных продуктов сельского хозяйства, особенно из семян масличных культур, вызывает растущий интерес ученых, особенно в пищевой промышленности, для разработки терапевтических, нутрицевтических или функциональных продуктов. Продукты на основе растительных компонентов приобрели популярность у различных слоев населения. При этом их стоимость значительно ниже стоимости продуктов животного происхождения.

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THE PROBLEM OF EXCESSIVE SALT CONSUMPTION IN THE REPUBLIC OF MOLDOVA

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Abstract. *Salt consumption has been researched in the Republic of Moldova as well as in the world. The article presents data on the amount of salt consumed daily globally and in the Republic of Moldova, as well as the need to reduce salt consumption. The amount of the types of diseases caused by excessive salt consumption, the vital risks that this excess can cause, and the possibility of creating a bakery product to promote healthy eating were analyzed. Following some studies, it has been shown that table salt has an essential role in the baking technology, thus recipes of Grissini with sunflower seeds were developed in which the amount of salt was reduced by 0.5 g for each sample, as well as no salt while water was replaced with kefir, whey and sour borscht, to bring taste in the achloride product and improve the quality of the obtained product. The research results showed that the sample with kefir and sour borscht had similar results to the other samples in which 0.5 g of table salt was added. It can be stated that the liquid phase used in the preparation of Grissini sticks can replace salt in bakery products, having an insignificant influence on the qualities of the finished product.*

Keywords: salt, disease, consumption, role, hypertension, WHO, Grissini

Introduction

Since the 1990s, the Republic of Moldova has gone through an epidemiological transition and as a result, diseases related to lifestyle and health-related behaviors-including cardiovascular disease (CVD), cancer, diabetes, chronic hepatitis and cirrhosis- are in continuous increase, becoming the main causes of mortality. Non-communicable diseases are considered the main cause of death in our country, being annually responsible for more than 85% of all deaths. Diseases of the circulatory system are the main cause of morbidity and deaths of the population, being responsible for every second death in 2016 [1].

The main risk factors of the cardiovascular diseases throughout the world and in the Republic of Moldova are unhealthy diet and high blood pressure. An extremely important determining factor for high blood pressure is increased salt consumption. Reducing salt consumption can directly improve population's health and indirectly reduce mortality through positive effects on blood pressure. The prevalence of high blood pressure among adults aged 18 and over in the Republic of Moldova in 2013 was 40%, with no gender differences. It is common for Moldovans to add salt to food both during cooking and at the table, but also to consume processed products with high salt content [2].

The purpose of the work

The purpose of this work is to analyze the causes and methods of solving excessive salt consumption in the Republic of Moldova. The European Action Plan in the field of Food and Nutrition recommends that countries adopt comprehensive strategies to reduce salt consumption. Within the European Region of the World Health Organization as well as in the Republic of Moldova, strategies to reduce sodium intake include monitoring and evaluation actions as basic pillars [3].

It is recommended that a comprehensive program to reduce salt intake among the population be implemented at the national level through systematic efforts, including raising public awareness and changing behaviors through communication (ex. Through health workers and education in schools). Structured programs must also be created;

- reformulation of industrially processed foods;
- establishing a framework for the food industry with the aim of reducing the salt content;
- the introduction of labeling in order to highlight the salt content in food products;
- monitoring and evaluation of salt consumption.

The role of salt in food industry

Salt is currently the most common ingredient used for flavoring food and is the only substance that gives a pure, salty taste [4]. Salt acts as a preservative for food products. It inhibits or slows down the development of pathogenic microorganisms and increases the shelf life of products. In the bakery industry it contributes to the texture of the dough by retaining water in the dough. In the meat industry it also helps retain water in the product and improves the color and flavor of the final product. Salt serves as a flavoring agent and can be used to balance flavors: sweet, sour, bitter, spicy. The World Health Organization recommends that the amount of salt consumed daily should not exceed 5 grams for adults, and even less for kids.

The negative effects of excessive salt consumption

The main disease caused by excess salt consumption is high blood pressure. Hypertension affects 1 billion people worldwide and is considered the leading cause of death. Sodium intake is reported to be a modifiable determinant of hypertension and reductions in sodium intake have been recommender worldwide. Various strategies have been proposed to combat this condition, especially in low and middle income countries [5]. Another disease is stomach cancer. Dietary factors, including a number of food groups including salt, can affect the risk of stomach cancer by directly damaging gastric mucus, eventually leading to loss of parietal cells and progression to gastric cancer [6]. Negative effects on the mental state of the body and increased depression are also other associated with high salt intake, only for women the excessive salt consumption and depression are inversely correlated [7].

Analysis of statistical data on the main causes of death in the Republic of Moldova

The main causes of death from excessive salt consumption and statistical data on the number of deaths for recent years shows that the death rate is actively increasing.

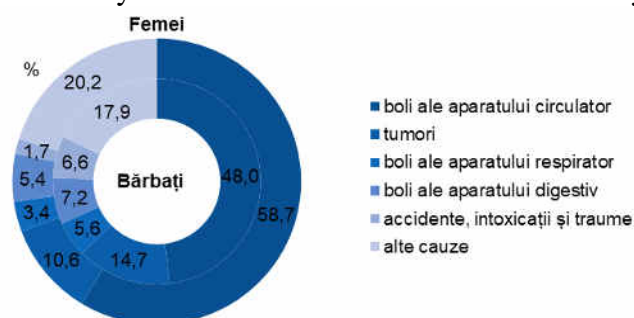


Figure 1. Share of deaths by main causes of death, by sex, in 2021 in the Republic of Moldova

Based on figure 1, it shows that the main cause of death are the diseases of the circulatory system and diseases of the digestive system. In case of the circulatory system disease the rate for women is 58,7% and for men is 48,0%. For the digestive system affections, the rate for women is 7,2 % and for men is 5,4. Can be observed that even if women consume less salt than men, they have higher risk to be affected by these diseases than representatives of the opposite sex.

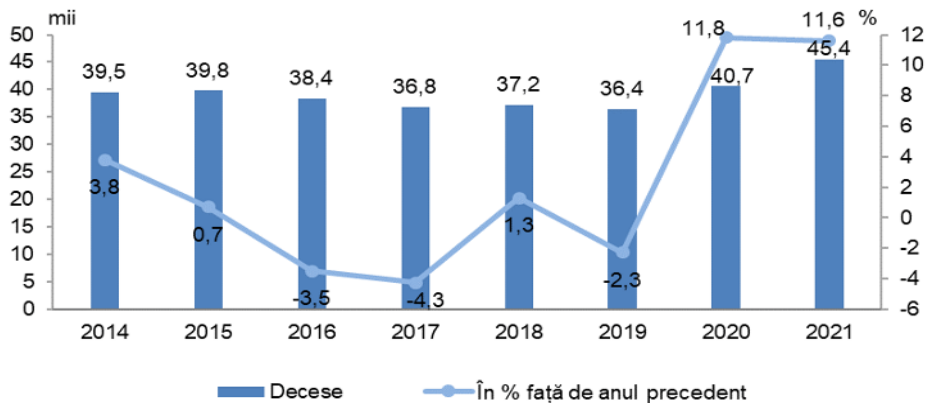


Figure 2. The evolution of the number of deaths in the Republic of Moldova in the years 2014-2021

As the Figure 2 shows, after the year 2019, the number of deaths is rising constantly. This is a sign which should guide us to take better care of health.

Analysis of salt consumption in the Republic of Moldova

- According to the WHO, bakery products are considered the main sources of salt in the diet. The consumption of pastry products ensures the intake of Na in a quantity of 75-85%.
- According to a study carried out by the Ministry of Health and the Ministry of Labor and Social Protection in partnership with the WHO office in the Republic of Moldova and Swiss Agency for Development and Cooperation (SDC), a study was launched which found that an adult between the ages of 18-69 years old from the Republic of Moldova consume 10-11,3 grams of salt daily.
- The amount consumed differs depending on gender, women consume less than men, and depending on the living environment, the population in the urban area consume more salt compared to those in the rural area.
- The amount of salt used per 100 grams of bread in the Republic of Moldova is 1-1,2 g, bread being one of the most consumed foods.
- The main source of NaCl is bread. In the Republic of Moldova, a person consumes an average of 333 grams of bread in a day, which is equivalent to 5,5 grams of salt, an amount that already exceeds the recommended daily dose.

The causes of high NaCl consumption and strategies for ensuring an adequate intake of salt

The main causes of excessive salt consumption are the following:

1. Advertising and marketing: advertisements and marketing are not the best solutions in choosing products.
2. Lack of awareness of the population: many people don't read product labels. Due to ignoring these actions, people end up consuming amounts of salt that exceed the recommended daily dose without realizing this fact.
3. Consumption of restaurant products or fast-food products: all products served are prepared with an increased amount of salt to satisfy and attract new customers.
4. Consumption of processed foods: processed foods are known to contain extremely high amount of NaCl. Products such as sausages, snacks and others are consumed for their pleasant taste, but the consequences can be very serious in case of regular abuse of these foods.
5. Using large amounts while cooking: an important tip is to add salt in the last stages of cooking or serving. It is not recommended to have salt on the table while eating, to avoid the abuse of salt in the diet.
6. Another strategy is to use bakery products with less salt or no salt at all. Thus, within the Food and Nutrition Department, bakery products with reduced salt content were prepared, which

require the development of normative documentation for placing on the market. The current objective is to develop the company standard for such a product.

An appropriate salt intake can be ensured by following the next steps:

- Monitoring the amount of salt consumed and following the recommendations of the World Health Organization to consume no more than 5 grams of salt per day;
- Reducing the salt content in the diet or to use salt where Na is partially replaced with K, Mg or Ca, cations known to lower blood pressure [8];
- Blood pressure monitoring. Salt has the role of maintaining the fluid in the tissues. If the symptoms as swelling around ankles or excessive thirst are present, it means that an excessive amount of salt has been consumed.

Conclusions

Excessive salt consumption is a current global problem. It has multiple negative effects on the health of the human body. The problem of salt abuse in food requires constant attention and urgent remedial methods. It is our responsibility, as specialists in the field, to contribute to the solution of this problem, to creation of products with a reduced salt content and their placement on the market.

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ALTERNATIVE DE EXPLOATARE ȘI UTILIZARE GASTRONOMICĂ A RESTURILOR VEGETALE

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Rezumat. Explorarea și utilizarea creativă a resturilor vegetale pot contribui la reducerea risipei alimentare, la crearea alimentelor noi cu proprietăți nutriționale ridicate, la elaborarea preparatelor cosmetologice, la obținerea suplimentelor nutritive, etc. Studiile multiple atestă valori nutritive importante pentru șroturile obținute ca urmare a prelucrării industriale a produselor vegetale autohtone precum: strugurii, mere, pere, cătina, gutui, piersic, coarne, care se acumulează în cantități considerabile. Spre exemplu în industria de vinificație produce reziduuri solide, cum ar fi tescovina de struguri (60% din totalul subproduselor), care este alcătuită în principal din pieliță de struguri (50%), pulpă, tulpini reziduale (25%) și semințe (25%). Procesarea fructelor de cătină pentru extragerea sucului duce la o cantitate mare de subproduse, conținând pentru 20% din greutatea totală a fructelor. Acestea sunt formate din pulpă, semințe și coji și sunt recunoscute ca fiind bogate în carotenoide, polifenoli, acizi grași și sterol. Procesarea merelor, perelor și gutuiului în funcție de soi, metoda de procesare și de presare permite obținerea a unui randament al șrotului de 15-40%.

Cuvinte cheie: resturi de coarne, cornus mas, tescovină de struguri, reziduuri alimentare

Scopul acestei lucrări este de a prezenta informații recente despre nutriții cireșului cornelian și a tescovinei de struguri albi și negri, proprietățile pro-sănătate și exemple de utilizare a acestuia în producția de alimente funcționale, alături de câteva determinări esențiale.

Boabele de corn reprezintă fructe comestibile derivate de la arbustul *Cornus Mas* din clasa pomușoarelor. Fructele de corn au ca parte componentă pielița, sâmburele și pulpa.

În constituția sa se găsește pielița cu un procent de 25%, sâmburele cu 40% și pulpă cu 35%, prezentat în figura 1.

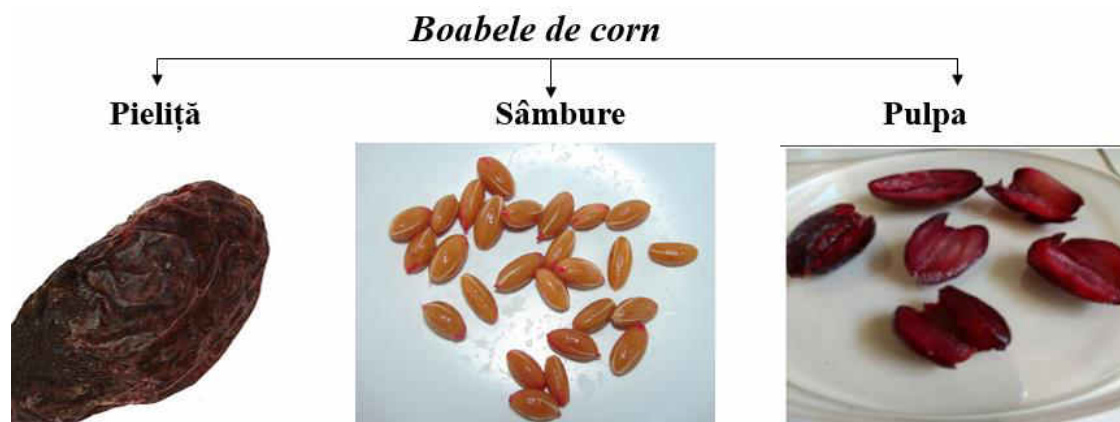


Figura 1. Constituția boabelor de corn

Compoziția chimică a fructelor de coarne este diversificată și depinde în mare măsură de soi, precum și de cultivare, precum și de condițiile de mediu și condițiile climatice.

După congelare, gustul fructelor se îmbunătățește semnificativ. Conțin până la 9% zaharuri, formate din glucoză și fructoză, până la 2,9% acizi organici (în principal malici), pectine, taninuri, substanțe azotate și colorante, ulei esențial, vitamine C și P. În ceea ce privește vitamina C, fructele de corn depășește uneori coacăzele negre. Există o mulțime de acizi grași în miezul sămburelui (până la 34%), fructele de corn sunt consumate crude și prelucrate. Diversele substanțe fitochimice găsite în diferite părți ale cireșului cornelian sunt rezumate în Tabelul 1.

Tabelul 1.

Compoziția chimică ale fructului de corn,% [2]

Nutrient	Cantitate	Norma	%din normă în 100 g	%din normă în 100 kcal 100
Beta caroten	0,0024mg	5mg		
Vitamina B1, tiamină	0,047mg	1,5g	3,1%	6,9%
Vitamina B2, riboflavină	0,024mg	1,8mg	1,3%	2,9%
Vitamina B5, pantotenic	0,21mg	5mg	4,2%	9,3%
Vitamina B6, piridoxină	0,036%	2mg	1,8%	4%
Vitamina B9, folați	50mcg	400mcg	12,5%	27,8%
Vitamina C, ascorbic	25,mg	90mg	27,8%	61,8%
Vitamina E, alfa tocoferol	0,15mg	15mg	1%	2,2%
Vitamina K, filochinonă	7,9mcg	120mcg	6,6%	14,7%
Potasiu, K	363mg	2500mg	14,5%	32,2%
Calciu, Ca	58mg	1000mg	5,8%	12,9%
Siliciu, Si	4mg	30mg	13,3%	29,6%
Magneziu, Mg	26mg	400mg	6,5%	14,4%
Sodiu, Na	32mg	1300mg	2,5%	5,6%
Sulf, S	0,7mg	1000mg	0,1%	0,2%
Fosfor, P	34mg	800mg	4,3%	9,6%

Studiile au fost efectuate în laboratorul instituției publice UTM, departamentul alimentație și nutriție. Au fost colectate mostre de fructe din soiul Cornus Mas.

Din fructele proaspete au fost înlăturate sămburii și în cele din urmă s-a deshidratat pulpa și pielea prin metoda uscarea prin convecție, pentru a obține praful de șrot vegetal.

Astfel, înlăturarea umidității libere din proba obținută a fost efectuată prin metoda uscării la etuvă, la 60 °C. Rezultatele obținute în cadrul experimentului indică valoarea umidității de 7,98%.



Figura 2. Pudra din pielea de coarne Cornus Mas

Caracteristica indicilor fizico-chimici și substanțelor bioactive în pielea și pulpa de coarne Cornus Mas.

Aciditatea titrabilă prezintă un indice de calitate a produsului. În cazul fructelor prezintă un parametru de bază în determinarea gradului de maturitate a fructelor și a gustului acru la citrice. Gradul de maturare a fructelor este unul dintre cei mai importanți factori care determină cât de bine se vor păstra fructele și ce proprietăți gustative vor avea. Astfel cu cât fructul este mai copt, se reduce nivelul acidității titrabile din produs.

În cadrul experimentului aciditatea a fost determinată prin metoda titrării probelor cu NaOH în prezența fenoftaleinei ca indicator. Titrarea continuie până la apariția culorii roz în proba. Valorile obținute în urma cercetării sunt prezente în figura 3.

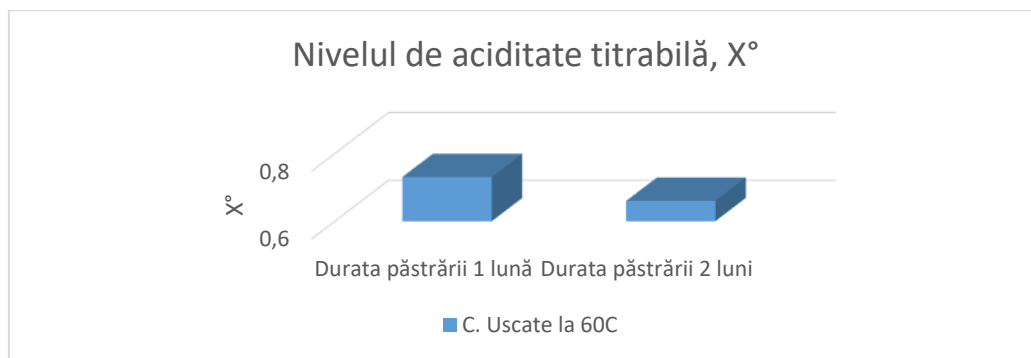


Figura 3. Caracteristica indicilor de aciditate în coarnele Cornus Mas, uscate la 60 °C

Se cunoaște că coarnele prezintă un produs bogat în polifenoli. Astfel, utilizând reactivul Folin Ciocăltău, a fost determinat conținutul total de polifenoli în soiul analizat de fruct. În urma experimentului sa depistat o cantitate de 10,49 mg GAE/g a polifenolilor în fructele de corn proaspete supuse studiului. Alte experimente menționează variația conținutului total a polifenolilor între limitele 219.08-976.51 mg/100g, ce este mult mai ridicat comparativ cu valorile obținute în lucrare. Un astfel de rezultat poate fi cauzat de mai mulți factori, precum: gradul de maturitate a pomușoarelor, condiții de culegere, influența procesului de oxidare, durata uscării produsului și altele. Astfel rezultate obținute în urma experimentului sunt prezentate în figura 4.

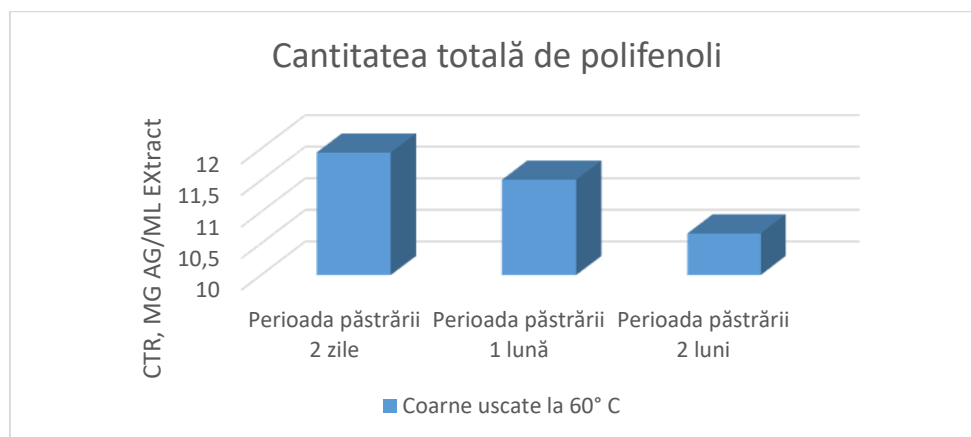


Figura 4. Cantitatea totală de polifenoli în coarnele Cornus Mas uscate la 60 °C

Pe parcursul studiului a fost determinată și valoarea activității antioxidante în probele din coarne. Valorile obținute în rezultatul cercetării prin utilizarea metodei radicalului liber DPPH, sunt reflectate în figura 5 sub forma grafică.

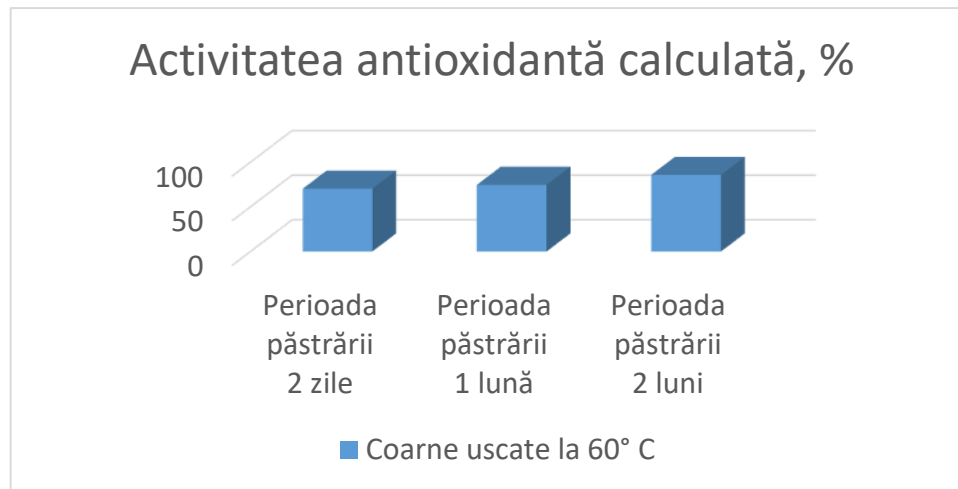


Figura 5. Activitatea antioxidantă DPPH în coarnele Cornus Mas uscate la 60 °C

Tescovina de struguri reprezintă sursa din rămășițele producției de vin, care constă din tulpini, coji și sămburi de struguri. Uleiul de sămburi de struguri este un produs bine cunoscut, având la baza ei anumite beneficii pentru organismul uman. Tescovina de struguri roșii a fost folosită o perioadă îndelungată, drept scop de a reface antocianinele, care mai apoi au fost aprobate ca coloranți alimentari. Numeroase studii au fost cointerestate caracterizării și extracției compușilor fenolici cum ar fi: catechinele, proantocianidinele, glicozidele flavonolice, acizii fenolici și stilbenele.

Extractele și fracțiile au fost studiate intens pentru proprietățile lor antioxidante și antimicrobiene, la care au fost publicate numeroase studii privind utilizarea acestora. Însăși tescovina de struguri care are la baza conținut de flavonide și antocianine, reprezintă un beneficiu enorm asupra organismului uman, deoarece acesta asigură un tonus vascular crescut, ceea ce are un impact asupra întăririi sistemului imunitar. Produsele secundare de prelucrare a materiilor prime fructe și fructe de pădure sub formă de tescovină reprezintă o resursă valoroasă pentru dezvoltarea de noi tipuri de produse funcționale care permit extinderea gamei și îmbogățirea acestora cu substanțe biologic active.

Compoziția chimică a tescovinei de struguri este similară cu cea a strugurilor. Ea se caracterizează printr-un conținut ridicat de compuși fenolici, a căror valoare principală constă în capacitatea lor antioxidantă pronunțată. Posibilitatea obținerii de pulbere alimentare din tescovină de soiuri de struguri albi și roșii și inclusiv eficiența ridicată a utilizării acestora în producerea produselor de cofetărie din făină, au fost fundamentate științific și confirmate experimental. Așadar, există o serie de studii care arată că produsele secundare ale prelucrării strugurilor din punct de vedere al compoziției chimice sunt materii prime valoroase.

Problema utilizării țintite a deșeurilor din prelucrarea materiilor prime din fructe și fructe de pădure continuă să fie o sarcină urgentă în producția de alimente funcționale. În acest sens, tescovină de struguri este o materie primă promițătoare. Unul dintre ingredientele funcționale importante ale materiilor prime din struguri, cele mai interesante pentru industria cofetăriei, sunt substanțele pectinice. Majoritatea substanțelor pectinice se găsesc în cojile și coamele strugurilor, iar conținutul de protopectină predomină asupra pectinei solubile în apă.



Figura 6. Pudra din pielea de struguri albi și negri

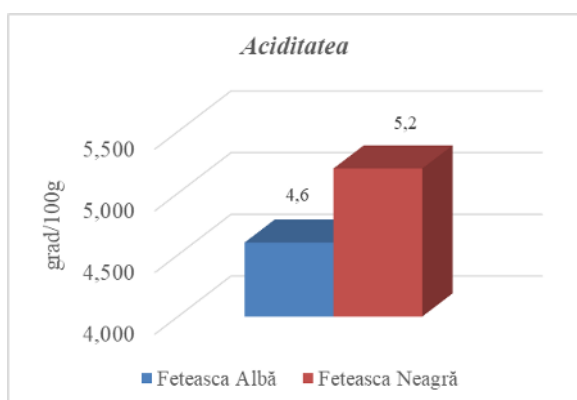


Figura 7. Conținutul de aciditate

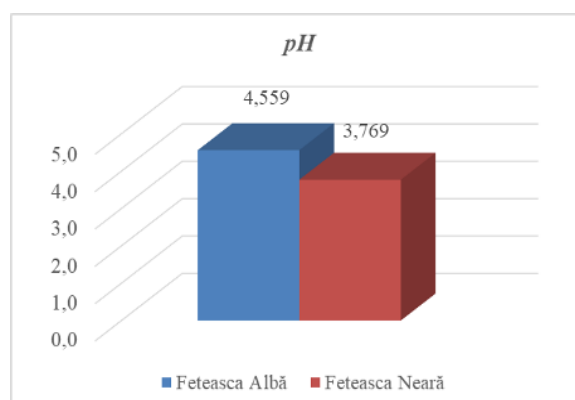


Figura 8. pH-ul în ambele soiuri de struguri

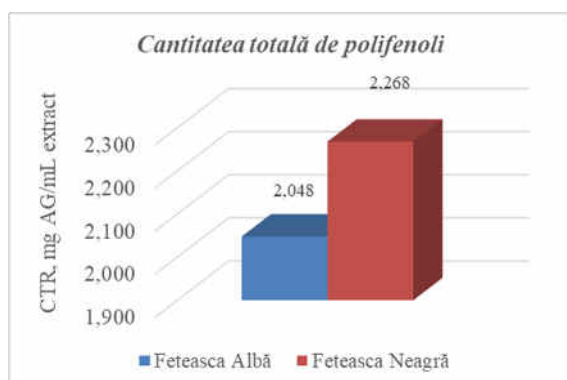


Figura 9. Cantitatea totală de polifenoli

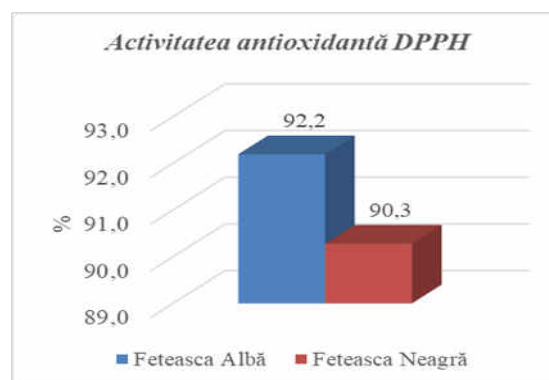


Figura 10. Activitatea antioxidantă

Concluzie

Ca urmare au fost reflectate concluzii esențiale, formularea cărora a reieșit din studiul bibliografic și partea experimentală aprofundată. Analizarea valorii biologice a fructelor de corn (*Cornus mas*) la nivel teoretic îl poziționează ca un produs extrem de valoros cu proprietăți fizico-chimice și nutritive ridicate. Compoziția chimică a produsului include totalitatea elementelor esențiale, precum: vitamine, minerale, fitocompuși, care cu siguranță pot menține o bună funcționare a întregului organism uman. Deține un efect protector, antiinflamator, tonifiant, antialergic, anticancerigen, reduce riscul bolilor cardiovasculare, diabetului zaharat și altele. Ca urmare cornul cu siguranță poate fi reconsiderat un super food.

Fructele de corn posedă un efect dual asupra organismului uman. Consumul fructelor de corn este interzis anumitor grupe de persoane ce suferă de boli gastrice, un nivel înalt pH a stomacului, femeilor însărcinate, femeilor ce alăptează, hipertonie, disfuncții nerologice. Cauza ecestuia prezintă compoziția chimică a produsului.

S-a dovedit că calitățile nutritive inițiale pot fi păstrate doar prin alegerea metodei optime de păstrare. Sa constat că cea mai eficientă metodă prezintă uscarea la 60⁰C și uscarea tradițională;

Tescovina de struguri care este alcătuită din piei, tulpini și semințe de struguri rămase după presare în procesul de vinificație - conține compuși utili care pot fi utilizați în suplimentele alimentare.

Pe măsură ce vinificatorii și oamenii de știință caută modalități de îmbunătățire a durabilității practicilor viticole și de vinificație, unii doresc să dea tescovinei de struguri o nouă viață. Acest produs secundar al vinificației, adesea nerevendicat, generează mii de tone de deșeuri în fiecare an. Diverse studii anterioare au sugerat o varietate de utilizări alternative, de la ulei din semințe de struguri la biocombustibili și produse cosmetice. Un studiu recent a constatat că acest produs secundar al vinificației poate fi un potențial supliment de sănătate.

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EVALUAREA MICROFLOREI INDIGENE ȘI VINIFICAREA STRUGURILOR MERLOT DIN REGIUNEA CIMIȘLIA ÎN CONDIȚII DE MICROVINIFICAȚIE

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Rezumat. Soiul european Merlot de origine franceză fiind unul din cel mai popular soi de struguri pentru vin cu bob roșu, foarte adaptabil la diverse tipuri de climă și terroir a fost procesat în secția de microvinificație. Utilizând diverse metode de analiză au fost apreciați indicii fizico-chimice, microbiota și caracteristicile organoleptice ale mustului și ulterior ale vinului. Rezultatele experimentale au descris prezența majoră a drojdiilor din genul *Saccharomyces* pe strugurii de studiu, ceea ce ar permite efectuarea fermentației alcoolice pe levuri indigene în condiții industriale, astfel, fiind posibilă reducerea considerabilă a cheltuielilor financiare pentru procurarea levurilor seci active și asigurarea autenticității vinurilor produse finite.

Cuvinte cheie: struguri roșii, indici fizico-chimici, fermentație spontană, microfloră

Introducere

Soiurile de struguri sunt temelia cunoașterii vinului. Dacă înțelegeți conceptul de soiuri de struguri, vă veți afla pe calea cea bună în dezlegarea misterelor ce se ascund în gustul vinului. Unele lucrează mai bine când sunt combinate – ”efortul echipei”, Altele preferă să fie lăsate în pace – „singuraticii”, precum este și Merlotul. Soi adaptabil, cu productivitate sporită de 10-12 t/ha, greutatea strugurelui ajungând până la 150 g. Cunoscut pentru textura fină și senzuală și pentru stilul abordabil, Merlot-ul poate fi catifelat sau cu arome de prună, mure, bomboane aromate, cu note de stejar, o textură și o catifelare bogată asupra cerului gurii și, precum fratele mai mare Cabernet Sauvignon, poate fi ușor mentolat [2].

Vinificația reprezintă un proces complex și extrem de interesant prin transformarea energiei solare și componentilor nutritivi selecționați din sol în struguri și mai departe într-un produs impecabil al fermentației naturale – în vin [1]. Acesta fiind și scopul cercetării noastre în utilizarea levurilor sălbatice păstrând autenticitatea soiului, ceea ce reprezintă o tendință de ultimă oră. În speranța de a demonstra valoarea și aportul acestora în formarea caracterului vinului, cu ajutorul unei abordări corecte și sigure din punct de vedere tehnologic, urmărind obținerea unui produs inedit.

Materiale și metode

Drept metode de analiză am folosit:

- Determinarea conținutului de zahăr prin metoda densimetrică și refractometrică
- Determinarea concentrației în masă a acizilor titrabili prin metoda titrării directe;
- Microscopie directă a apei de spălare și analiza vizuală și microscopia culturilor obținute;
- Inocularea microorganismelor prin metoda zigzag (strierii);


Metodele de analiză au fost efectuate conform îndrumarelor și instrucțiunilor de laborator:

- Controlul microbiologic al produselor alimentare;
- Microbiologia vinului. Ghid metodic pentru lucrările de laborator;
- Bazele Științifice și Practice ale Utilizării Levurilor în Oenologie;
- Operațiuni tehnologice de condiționare și stabilizare a vinurilor.

Caracteristica materiei prime

Tabelul 1.

Indicii fizico-chimici ai strugurilor experimentali

Nr.	Denumirea indicelui studiat	Valoarea indicelui studiat
1.	pH	3,65
2.	Concentrația în masă a acizilor titrabili, g/dm ³ acid tartric	8,85
3.	Concentrația în masă a zaharurilor, g/dm ³	176
4.	Densitatea relativă a mustului, g/cm ³	1075
5.	Temperatura inițială a mustului, °C	18,5
6.	Caracteristica ampelografică 	Soi de struguri cameleon cu proprietăți de adaptare în funcție de climat, preluând în timp caracterul locației. Merlot-ul este un soi de struguri cu o productivitate mijlocie sau mare, producție de la un butuc variază de la 3,5 ÷ 5kg.

Determinarea zaharității. Densitatea zahărului din struguri este măsurată folosind un ariometru sau un refractometru. Ambele dispozitive permit de determinat conținutul de zahăr din suc de struguri, care este un parametru important în determinarea gradului de pregătire a strugurilor pentru recoltare și producția de vin.

Ariometrul este un instrument de sticlă cu biluțe mici din plumb ce sunt sigilate în partea de jos și o scară gradată în partea de sus. Ariometrele utilizate în vinificație au adesea o scară de grade Brix (°Brix), care măsoară zaharurile dizolvate ca procent din greutate.

Refractometru măsoară modificarea unghiului de refracție a luminii care trece prin suc de struguri. Zaharurile din suc afectează refracția luminii, iar un refractometru măsoară acest efect. Rezultatele sunt de obicei prezentate în grade Brix. Refractometrele sunt în general mai portabile și mai rapid de utilizat decât ariometrele.

Un pH-metru este un instrument științific cu ajutorul căruia se măsoară activitatea ionilor de hidrogen în soluțiile pe bază de apă, care indică aciditatea sau alcalinitatea exprimată ca și pH.



Figura 1. a) ariometru b) refractometru c) pH-metrul de masă

Analiza microbiologică a materiei prime. Aprecierea microbiotei strugurilor Merlot (numită ulterior proba 1). Ca metode de analiză am utilizat microscoparea probei analizate. Pentru aceasta proba de struguri (se ia o cantitate provizorie, proba trebuie să conțină atât bobite cât și

porțiuni de ciorchine) sunt spălate timp de 3 minute într-o cantitate de apă distilată astfel microorganismele de pe elementele strugurelui vor trece în apă. După aceasta din apa de spălare se face microscoparea directă și însămânțarea pe medii. Inocularea se efectuează pe suprafața mediilor sterilizate, topite și răcite prin scarificare sau strii, după care mediile se plasează în termostat la temperatura de 30 °C. Probele se termostatează timp de 7 zile, însă periodic se efectuează analiza vizuală a mediilor pentru a monitoriza dezvoltarea și creșterea microorganismelor pe medii.

Rezultate experimentale

După efectuarea microscopiei a apei de spălare s-a depistat prezența drojdiilor din genul *Saccharomyces*, a bacteriilor acetice sub formă de bastonașe, în ambele probe. Iar în decursul a două zile după o microscopare ulterioară s-a observat înmugurirea drojdiilor (fig. 2).

După cum s-a menționat însămânțarea a fost efectuată pe mai multe tipuri de medii, iar după analiza vizuală a mediilor s-a observat creșterea diferitor tipuri de culturi.

Pe mediul MRS – nu s-a dezvoltat nimic, Posibil ca mediul dat să nu fi fost prielnic pentru dezvoltarea acestora.

Pe mediul Sabro(SDA) – s-au evidențiat colonii de culoare albă, rotundă, de mărime medie, puțin bombate, lucioase.

Pe mediul *Bretanomices* – din proba dată s-au dezvoltat colonii de culoare albă- cenușie, de mărime mică, bombate cu luciu.

Pe mediul Broth – s-a dezvoltat o mulțime de colonii de culoare alb-cenușie, de mărime medie, rotunde, lucioase, puțin bombate.

În urma microscopării culturilor apărute am depistat prezența următoarelor microorganisme:

Pe mediul *Bretanomices* agar – în urma microscopării am depistat prezența drojdiilor din genul *Bretanomices*.

Pe mediul Broth – am depistat prezența drojdiilor din genul *Saccharomyces* și *Brettanomyces*.

Pe mediul Sabro – în urma microscopării celor trei colonii, s-a depistat prezența drojdiilor din genul *Saccharomyces cerevisiae* și *Torulopsis*.

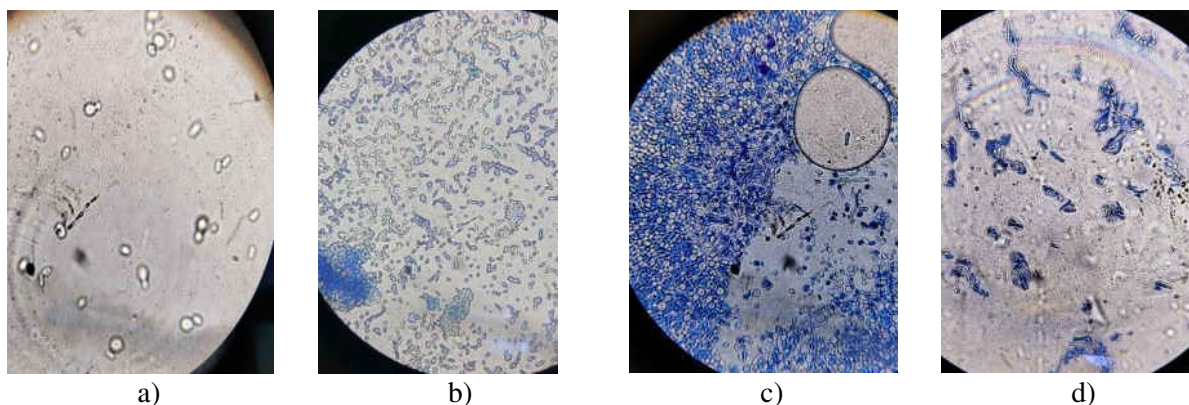


Figura 2. Rezultatele microscopării mediilor. a) apa de spălare, prezența levurilor *Saccharomyces*, înmugurirea acestora; b) mediul-sabro, prezența drojdiilor din genul *Saccharomyces* și *Torulopsis*; c) mediul-*Brettanomyces*, prezența drojdiilor *Saccharomyces*; d). mediul- Broth, prezența drojdiilor *brettanomyces*

Reprezentarea grafică a curbei de fermentare, în funcție de parametrii densității și temperaturii.

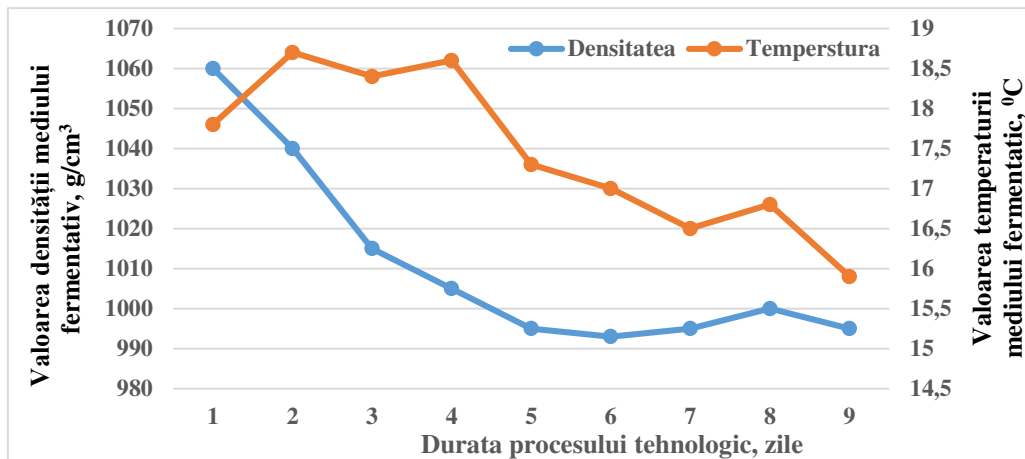



Figura 3. Curba de fermentație alcoolică a mustuală

În urma analizării rezultatelor, putem determina cele trei faze ale fermentației și anume: faza prefermentativă, faza tumultoasă și faza post fermentativă. Putem observa acest lucru după schimbarea temperaturii pe parcursul procesului, în faza tumultoasă aceasta este mult mai ridicată, iar densitatea începe o scădere considerabilă ce denotă faptul că fermentația decurge rapid începând chiar cu a 2-a, zi și durează în jur de 5 zile. Ulterior în faza post fermentativă schimbările sunt deja neesențiale, indicând etapa de degradare a levurilor și sistarea treptată a fermentației.

Tabelul 2.

Indicii fizico chimici ai probei de vin experimentale

Nr.	Denumirea indicelui studiat	Valoarea indicelui studiat
1.	pH	3,37
2.	Concentrația în masă a acizilor titrabili, g/dm ³ acid tartric	7,6
3.	Concentrația în masă a zaharului rezidual, g/dm ³	3,7
4.	Densitatea relativă a mustului, cm ³	995
5.	Temperatura finală a mustului, °C	15,9
6.	Analiza senzorială 	<p><i>Culoare</i>- roșu vișiniu, asemănător cu sucul de vișină sau sfeclă roșie <i>Aromă</i>- nuanțe de piper, arome ușoare de pomușoare, vișine și fructe negre <i>Gustativ</i>- taninos, ușor astringent caracteristic soiului, extractiv, fără gusturi străine <i>Postgust</i>- de durată medie <i>Punctajul</i> - un vin materie primă ce poate fi notat cu 8 puncte.</p>

Analizând rezultatele primite putem cu certitudine spune că în final am obținut un vin materie primă cu indicii necesari și caracteristici specifice soiului, ce poate fi supus vinificării în continuare și care poate obține rezultate, iar în cazul unei maturări baricul de stejar ar putea săi confere și mai mult caracter și desigur după cum am menționat anterior Merlotul este un partener de cupaj excelent ce poate favoriza obținerea unor vinuri inedite. Desigur ca soi solitar acesta poate prezenta caracteristici remarcabile cu specificitate autentică regiunii.

Concluzii și recomandări tehnologice

În lucrarea de cercetare s-au studiat strugurii din regiunea Javgur (Cimișlia). În perioada de fermentație a vinului s-au prelevat zilnic probe, pentru a analiza obiectiv fermentația mustului, determinarea perioadei de fermentație tumultoasă și scindarea acesteia.

În proba analizată s-a depistat prezența mai multor tipuri de microorganisme, atât benefice cât și dăunătoare. Astfel s-ar putea spune că strugurii din această regiune dețin drojii din genul *Saccharomyces* ceia ce ar permite efectuarea fermentației pe levuri sălbatice și ar asigura o

reducere considerabilă a cheltuielilor, dar și o economisire de timp, însă pe lângă drojdiile de fermentație în proba de struguri au fost depistate și alte tipuri de levuri și chiar bacterii ce prezintă pericol pentru procesul de fermentare. Astfel dacă se optează pentru fermentație pe drojzii sălbatice, este necesar de a se efectua monitorizarea sistematică a procesului de fermentație, pentru a nu admite declanșarea proceselor nedorite. Cu toate acestea, fermentația pe levuri sălbatice poate produce o serie de neplăceri, cum ar fi apariția diferitor boli și chiar stoparea fermentației, etc., iar vinul obținut va fi foarte instabil. Ca o soluție ar fi separarea drojdiei din genul respectiv și înmulțirea ei ulterioară pentru a fi folosită la fermentație, astfel nu vor apărea probleme privind infectarea vinului cu alte tipuri de microorganisme ce se conțin în struguri, nu se necesită procurarea levurilor selecționate și plus la toate prin această metodă se păstrează autenticitatea vinului.

Conform efectuării analizei organoleptice a vinului obținut putem constata că în urma procesării soiului Merlot vom obține un vin extractiv, de corpolență medie, arome caracteristice soiului și un post gust plăcut de durată medie.

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UTILIZAREA CĂRBUNILOR ACTIVI PENTRU TRATAREA VINURILOR ROȘII ȘI ALBE

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Rezumat. *Utilizarea cărbunilor activi în vinificație este larg răspândită, oferind oenologilor un instrument important pentru corectarea compoziției chimice și microbiologice a vinurilor, eliminarea defectelor de gust și miros din musturi, reducerea conținutului de precursori ai substanțelor oxidate, produselor din ciuperci, mucegai în cazul strugurilor avariați și corecția culorii vinurilor albe, rose și roșii, diminuarea concentrației pigmentilor oxidați. Originea și modul de activare a cărbunilor influențează relevant structura, dimensiunea și geometria porilor, grupele funcționale la suprafață, proprietățile absorbante. Deși nu sunt adsorbanți selectivi, cărbunii activi, în funcție de parametrii menționați, pot manifesta anumită selectivitate față de unele grupe de substanțe din vinuri. Acest fapt este foarte important pentru oenologi, deoarece permite de a reduce impactul negativ al acestora asupra structurii și profilului organoleptic al vinurilor. Obiectul cercetării au fost cărbuni activi experimentali de origine vegetală, obținuți de savanții de la Institutul de Chimie al USM din deșeuri ale industriei alimentare (sâmburi de piersici, caise, coji de nucă), lemn de măr, cu diverse fracții ale particulelor, un procedeele de tratare a vinurilor experimentale de la Departamentul Oenologie și Chimie al UTM. Scopul cercetării a constat în evaluarea impactului cărbunilor activi experimentali asupra calității vinurilor studiate, corelarea cu caracteristicile lor, compararea efectelor cu cele provocate de cărbuni activi oenologici industriali.*

Cuvinte cheie: *cărbune activ, deșeuri, vinuri, polifenoli, ameliorare*

Introducere

Cărbunele activat este un sorbent micro- sau mezoporos cu o suprafață foarte mare de absorbție, utilizarea acestuia în vinificație este cunoscută și larg răspândită, oferind oenologilor un instrument important pentru corectarea compoziției chimice și microbiologice a vinurilor în cazul materiei prime deteriorate, abaterilor tehnologice în producerea, maturarea și depozitarea vinurilor. Industria oferă o gamă largă de cărbuni activi derivați din plante cu diverse aplicații în domeniul oenologic. Scopul cercetării a fost evaluarea calității cărbunelui activ experimental (AC-C+, AC-2, AC+MRF, Granucol GE, Granucol BI, Granucol FA), obținute pentru diverse contaminări și defecte ale vinurilor [2].

Tratamentul vinurilor cu cărbune activ este însoțit de îndepărtarea parțială a anumitor grupe de substanțe, care, pe lângă faptul că au un impact negativ asupra calității sau riscul transformării în factori nedorțiți, pot determina proprietăți antioxidante importante [1].

Cărbunii activi, exclusiv de origine vegetală, sunt recomandați în oenologie pentru:

- eliminarea defectelor de gust și de miros din musturi la fermentare;
- eliminarea produselor din ciuperci, mucegai în cazul strugurilor avariați;
- reducerea conținutului de precursori ai substanțelor oxidate (diferite grupe de polifenoli-flavonoizi, ciamati);
- eliminarea biopolimerilor bruni, oxidați;
- corecția culorii vinurilor albe, rose și roșii, diminuarea concentrației pigmentilor oxidați;

- înlăturarea reziduurilor unor pesticide și a metaboliților din strugurii afectați de mucegaiuri, inclusiv a toxinelor [1].

Complexitatea problemei utilizării cărbunilor activi în vinificație rezidă în următoarele aspecte [2]:

- compoziția chimică extrem de bogată a vinurilor (peste 8000), cu substanțe chimice în limite extinse de concentrații ($m \cdot n \cdot 10^{-9}$ g) și impact fizico-chimic și organoleptic foarte divers, instabilitatea aceste compoziții în funcție de varietate, podgorie, condiții pedoclimatice, tehnologii de cultivare și procesare etc;
- proprietățile fizico-chimice diverse ale cărbunilor activi în funcție de materia primă, tehnologiile de producere, adsorbția neselectivă în raport cu diferite clase de substanțe;
- unele efecte colaterale, nedorite [3].

Ca adjuvanți cărbunii activi de origine vegetală, au premisele nu doar de a fi utilizați în producerea vinurilor, dar și de a satisface exigențele riguroase pentru vinurile din cea mai prestigioasă nișă-cea a produselor ecologice, biologice, organice [1].

Tabelul 1

Avantajele și dezavantajele cărbunelui activ

Avantaje	Dezavantaje
Permis de OIV și OMS	Pierderea de Arome și Substanțe Benefice
Lipsa proprietăților alergene	Adsorbție neselectivă
Poate fi granulat inclusiv cu alți adjuvanți	Influența negativă asupra stării antioxidante ale vinului
Accesibil	Sub formă de praf este dificil de utilizat

Cărbunii industriali și cărbunii experimentali

Fiind prezența numeroaselor echilibre tangibile în vinuri, care determină calitatea lor fizico-chimică, microbiologică, organoleptică, cât și stabilitatea, a fost monitorizată evoluția comparativă a vinurilor după tratamentul cu cărbuni activi industriali de tip Granucol [4].

Tipurile individuale Granucol sunt de 3 tipuri diferite:

Granucol BI este folosit pentru a decolora mustul/vinul sau a reduce taninurile și polifenolii din vinurile cu culoare accentuată, este un cărbune activ de origine vegetală, granulat, cu adaos de bentonite. Este special pentru decolorarea alimentelor lichide și a aditivilor alimentari. Pe lângă proprietățile excelente de decolorare, realizează o adsorbție la fel de eficientă a polifenolilor în tratarea băuturilor [4].

Granucol FA este un cărbune activ special pentru corecțiile necesare de culoare în produsele alimentare lichide și aditivii alimentari. Granucol FA poate fi aplicat fie pentru tratarea loturilor, fie pentru adăugarea continuă în timpul filtrării și este folosit pentru a elimina rumenirea din vinuri [4].

Granucol GE este folosit pentru a absorbi mirosurile și gusturile nedorite a vinului sau sucului [4].

Tabelul 2

Materia prima a cărbunilor experimentali

AC-2	Coji de nucă
AC-C+	miezuri
MRF	Lemn de măr

Materiale și metode de studiu

S-au utilizat vinurile experimentale produse în condiții de micro vinificație la DOC vinul roșu **Malbec** (2021), vinul alb s-a folosit din soiul experimental rizogen **Malena** (2023), elaborat la Institutul de Genetică, Fiziologie și Protecție a Plantelor, balanța Radwag (Polonia), centrifuga universală 320 R (Germania) (4500 rpm), dozatoare automate.

Veselă din sticlă (Izolab), containere Eppendorf, eprubete din PE de 15 și 50 ml cu capac, cuve, ca metodă de studiu sa utilizat spectrofotometria în UV și VIS.

Rezultate experimentale

Tabelul 3

Legenda

Proba	Tratamentul
MB-0	netratat
MB-1	AC-2 fr. 45÷125 μ
MB-2	AC-2 fr. 90÷125 μ
MB-3	AC-2 fr. 125÷630 μ
MB-4	AC-2 fr. 630÷800 μ
MB-5	AC-2 fr. 800÷22.0 μ
MB-6	GRANUCOL GE
MB-7	GRANUCOL B
MB-8	GRANUCOL FA
MB-9	AC-C+ fr. 45÷125 μ
MB-10	AC+MRF- fr. 45÷125 μ

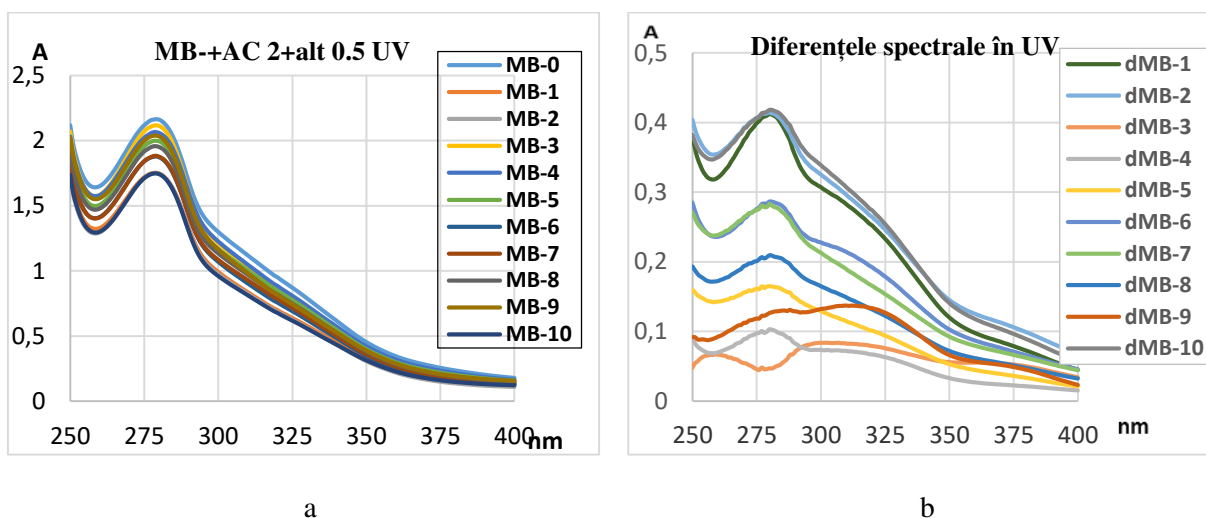


Figura 1. Spectrele de absorbție în ultraviolet a vinului Malbec, tratat cu diverși cărbuni activați (a) și spectrele substanțelor eliminate de aceștia (b)

Figura 1 reprezintă spectrele electronice de absorbție în domeniul ultraviolet ale vinului Malbec, netratat și tratat cu diferiți cărbuni activați (a) și a diferențelor dintre vinul netratat (Mb 0) și cele tratate (b). În acest domeniu (ultraviolet apropiat) anume substanțele fenolice sunt cele care posedă absorbție optică, deși pot fi și interferențe ușoare cu absorbția altor substanțe, minoritate (proteine, aldehide, acizi nesaturați).

Figura 2 reprezintă spectrele de absorbție ale vinului Malbec, netratat și tratat cu diferiți cărbuni activați de tipul Granucol (a) și a diferențelor dintre vinul netratat (Mb 0) și cele tratate (b). După cum se vede în figură, orice adaos provoacă o diminuare a absorbției în acest interval, cauzată de eliminarea diferitor grupe de substanțe fenolice de către sorbenți.

Figura 3 prezintă spectrele electronice de absorbție în domeniul ultraviolet al vinului Malbec atât netratat, cât și tratat cu diverse fracții a cărbunelui activ AC-2. Observăm un efect diferit în dependență de fracție ce aduce la o scădere a absorbției, indicând eliminarea diferitor grupe de substanțe fenolice de către acești sorbenți.

Figura 3b evidențiază diferențele dintre vinul netratat (Mb 0) și cele tratate, arătând că eficiența cărbunilor activi de fracții diferite în eliminarea substanțelor fenolice variază. În eliminarea substanțelor fenolice.

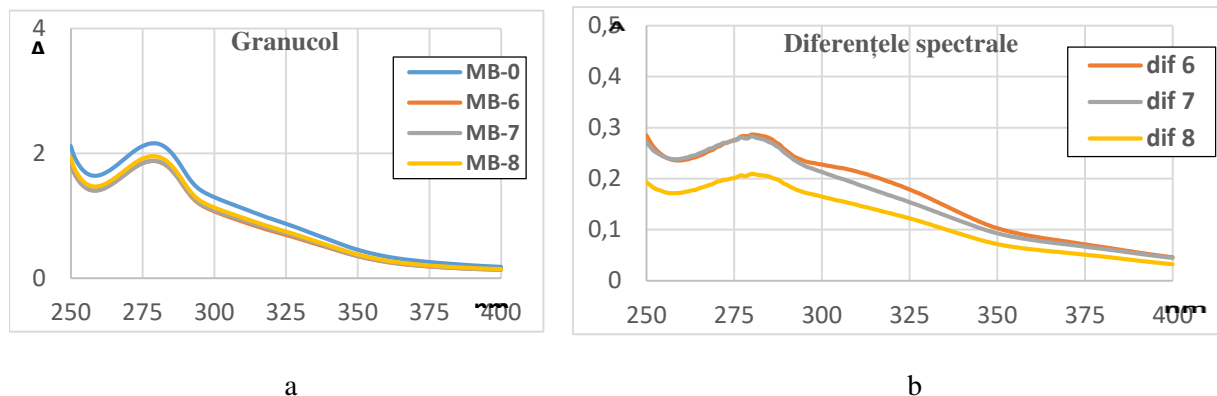


Figura 2. Spectrele de absorbție a vinului Malbec, tratat cu diverși cărbuni activați de tip Granuacol (a) și spectrele substanțelor eliminate de aceștia (b)

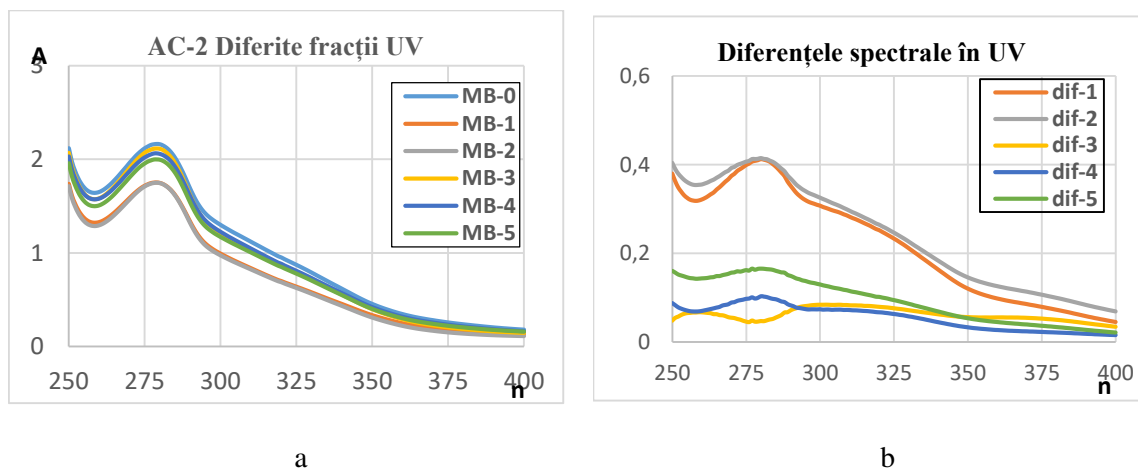


Figura 3. Spectrele de absorbție în ultraviolet a vinului Malbec, tratat cu cărbunele activat AC-2 de diferite fracții (a) și spectrele substanțelor eliminate de aceștia (b)

Evaluarea impactului AC-2 asupra fenomenului pinking, observat în vinul produs din soiul Malena.

Tabelul 4

Legenda	
Proba	Tratamentul
ML-0	netratată
ML-1	AC-2, fr. 90÷125 μ, cantitatea 0.2g/l
ML-2	AC-2 fr. 90÷125 μ, 0.4g/l
ML-3	AC-2 fr. 90÷125 μ, 0.6g/l
ML-4	AC-2 fr. 90÷125 μ, 1g/l

Figura 4 ilustrează spectrele electronice de absorbție în domeniul ultraviolet al vinului Malena, comparând vinul netratat ce suferă de fenomenul Pinking (Mb 0) cu cel tratat cu fracția fr. 90÷125 μ ale cărbunelui activ AC-2 în cantități diferite, observăm că există un efect diferit în absorbție în funcție de cantitatea utilizată de cărbune, indicând eliminarea diferitelor grupe de substanțe fenolice de către sorbentul utilizat.

În Figura 4b, se evidențiază diferențele între absorbanta cărbunelui. Se remarcă eficiența cărbunelui în raport cu cantitatea utilizată pentru îndepărtarea substanțelor fenolice, utilizarea cărbunelui activ impact direct asupra eliminării fenomenului Pinking.

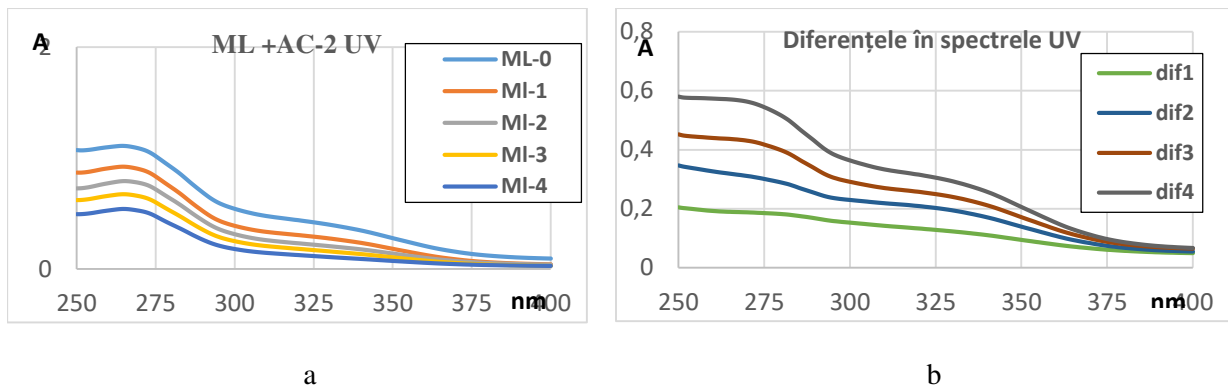


Figura 4. Spectrele de absorbție în ultraviolet a vinului Malena, tratat cu cărbunele activat AC-2 (a) și spectrele substanțelor eliminate de acesta (b)

Figura 5 prezintă spectrele electronice de absorbție în domeniul vizibil al vinului Malena, oferind o comparație între vinul netratat (Mb 0) și vinul tratat cu fracția fr. 90÷125 μ a cărbunelui activ AC-2, utilizat în cantități variate. Se remarcă diferențe semnificative în absorbție în funcție de cantitatea de cărbune utilizată, indicând o influență distinctă asupra eliminării diferitelor grupe de substanțe fenolice.

În Figura 5b, se remarcă disparitățile în absorbția cărbunelui, evidențiind eficiența fracției alese a cărbunilor activi în raport cu cantitatea utilizată pentru eliminarea substanțelor fenolice, ca urmare proba ML-4 demonstrează o înlăturare completă și excesivă a fenomenului Pinking.

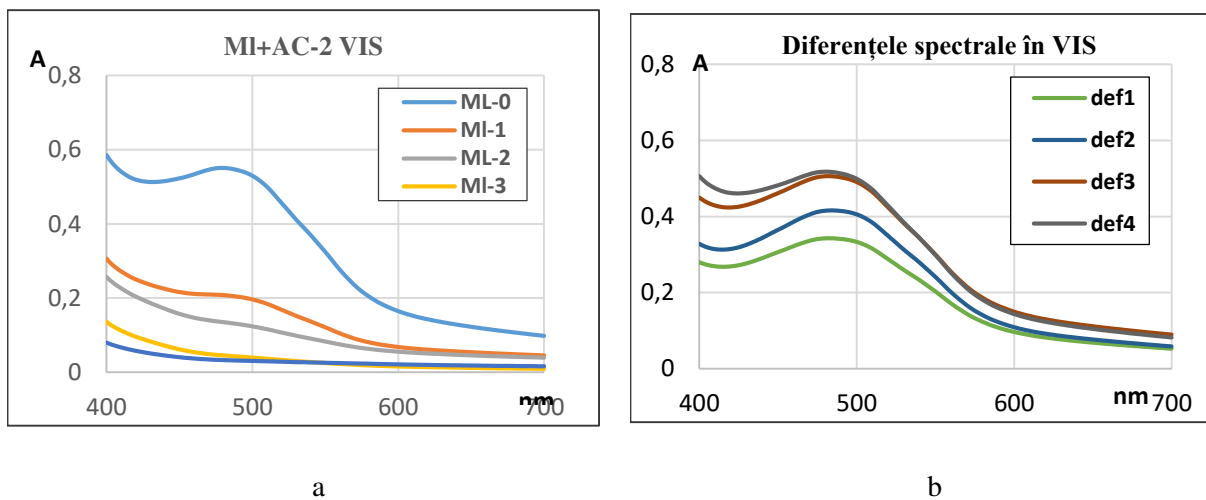


Figura 5 Spectrele de absorbție în Vizibil a vinului Malena, tratat cu cărbunele activat AC-2 (a) și spectrele substanțelor eliminate de acesta (b)

Concluzii generale și recomandări practice

Efectul cărbunilor activi asupra vinului Malbec variază în funcție de tipul de cărbune și de fracțiile utilizate. Diversele probe de cărbuni activați, cum ar fi Granucol și AC-2, manifestă eficiențe diferite în eliminarea substanțelor fenolice din vin, evidențiată și prin diferențele în spectrele de absorbție. Nu toți cărbunii activi au aceeași eficiență față de una și aceeași grupă de substanțe.

Unul și același cărbune activ, dar de diferite fracții are impact divers atât calitativ, cât și cantitativ asupra eliminării diferitor grupe de substanțe din vinuri (*Fig.4 și Fig.5*). Acest fapt poate fi aplicat pentru o tratare atentă, mai selectivă, a vinurilor, cu păstrarea componentilor beneficiu.

Cărbunii activi experimentali au demonstrat eficiență în eliminarea efectului Pinking din vinurile albe din soiuri rizogene, ecologice.

Cărbunii activi experimentali, de natură vegetală, obținute din deșeuri ale industriei alimentare autohtone (AC-2, AC-C+, AC-MRF), pot fi recomandați pentru tratările vinurilor.

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ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ НЕТРАДИЦИОННОГО РАСТИТЕЛЬНОГО СЫРЬЯ В ХЛЕБОПЕЧЕНИИ И ПИЩЕКОНЦЕНТРАТНОЙ ИНДУСТРИИ

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Аннотация. Современный химический состав хлебобулочных изделий представлен минимальным содержанием функциональных ингредиентов и пищевых волокон, которые играют первостепенную роль в создании продуктов питания с высокой биологической ценностью и повышенными органолептическими показателями. Это обеспечивается целенаправленной коррекцией химического состава пищевых продуктов за счет применения нетрадиционного растительного сырья, содержащего комплекс микронутриентов. Практический интерес также могут представлять отходы масложировой отрасли – шроты. В работе показан потенциал использования вторичного растительного сырья в качестве активных добавок для производства хлебобулочных изделий и пищевых концентратов с высокой пищевой и биологической ценностью. Представлен аналитический обзор литературных данных по данному вопросу, определено влияние шротов на текстуру и пищевую ценность продукта. Выявлено, что исследования, направленные на совершенствование технологий переработки вторичных сырьевых ресурсов и расширение области их применения в промышленном производстве пищевых продуктов, в том числе хлебобулочных изделий и пищевых концентратов являются актуальными и необходимыми. Использование добавок из растительных сырьевых отходов в хлебопекарной отрасли позволяет интенсифицировать технологический процесс, сформировать оптимальные текстурные характеристики полуфабрикатов, расширить ассортимент хлебобулочных изделий и пищевых концентратов функционального назначения.

Ключевые слова: шрот, биологическая и пищевая ценность, хлебобулочные изделия, пищевые концентраты, текстура, физико-химические показатели

Введение

Шрот – это побочный продукт производства растительных масел, получаемый после экстракции масел из семян масличных культур. Жмых же является продуктом механической обработки масличных семян, фруктов и ягод, к примеру, облепихи или шиповника.

Основным использованием данного сырья является изготовление комбинированных кормов для сельскохозяйственных животных, благодаря высокому содержанию белка и клетчатки, которые увеличивают продуктивность и качество производимого продукта [1].

У представленного растительного сырья нет четко установленной классификации, всё зависит от материала использовавшегося для выжимки масла: льняной, рапсовый, тыквенный, т.д., при этом по окончании экстракции в шроте содержится около 7% масла.

Если рассматривать состав шрота с точки зрения его питательности и энергетической составляющей, то он довольно близок по своим компонентам к жмыху, но содержание жира в нем гораздо ниже и не превышает 2% [1, 2].

Функциональный состав шротов

Нетрадиционное растительное сырье	Функциональные ингредиенты, %		
	Пищевые волокна	Белки	Жиры
Шроты масличных культур:			
лен	25-35	20-30	30-36
тыква	15-20	25-30	15-20
рапс	25-30	30-36	1-2
Растительные жмыхи:			
облепиха	20-25	8-10	3-12
шиповник	30-35	3-5	7-14
амарант	50-60	15-18	3-9

Польза

Для улучшения качественных и реологических показателей в состав хлебобулочных изделий могут включаться различные функциональные ингредиенты с высокой биологической ценностью. Перспективным источником белковых веществ является вторичное растительное сырье, значительное количество которого встречается в виде шротов и жмыхов. Содержание аминокислот и большого количества сырого белка, жиров и пищевых волокон (Таб.1) очерчивает широкий спектр использования как в хлебопекарной отрасли, так и в пищевых концентратной индустрии [3].

Состав шротов также богат аминокислотами такими как: лизин, метионин, цистин и триптофан совместно с присутствием ненасыщенных жирных кислот таких как: линолевая и линоленовая кислоты в совокупности дают легкоусвояемую функциональную составляющую. Помимо этого, нужно учесть низкую себестоимость и разнообразие данного сырья, которое возможно производить непрерывно [3-5].

Риски/вред

Не смотря на выгоду анализируемого сырья, не нужно забывать об остатках производственной обработки при его получении. Особенно это касается шротов, содержащих остатки органических растворителей, которые в последствии могут повлиять не только на качество готового продукта, но и на здоровье потребителей.

Также в некоторых видах шротов могут присутствовать ингибиторы трипсина. Трипсин – это фермент, производимый поджелудочной железой, способствующий расщеплению белков, ингибиторы которого снижают его активность. Проведены исследования, указывающие на отрицательное соотношение между присутствием ингибиторов трипсина и свёртываемостью крови [7]. Также, присутствие данных ингибиторов способствует развитию заболеваний поджелудочной железы как панкреатит [6, 7].

Альтернативы использования

Несмотря на популярность сбалансированного питания потребителям сложно отказаться от уже устоявшегося вкуса определённых продуктов, особенно если это касается хлеба или пекарских изделий. При этом, качество обогащённого продукта не только не должно уступать уже существующему, но, и в идеале, его превосходить как по вкусовым, так и по производственным показателям. Добавление шротов в такие изделия как куличи или паски которые содержат большое количество сахара и масла поможет минимизировать потребление дрожжей, снизив осмотическое давление, из-за которого происходит обезвоживание и последующая их низкая активность. Также данный критерий применим к продуктам с высоким содержанием соли, таким как гриссини и крекеры [3, 8-10].

Жмыхи же, являющиеся в основном вторичным сырьем при переработке фруктов и ягод, имеют специфический цвет и аромат, из-за чего готовое изделие может приобрести фруктовое послевкусие или запах, в некоторых случаях даже цвет. Добавление данного растительного сырья способствует снижению вязкости и кислотности теста, что в последствии повышает стабильность при хранении продукта, при этом не изменяя его качественные характеристики [3, 11-13].

Выводы

Таким образом, применение нетрадиционного растительного сырья типа жмыхов и шротов в пищевой промышленности представляет собой ряд качественных и экономических преимуществ. Шроты и жмыхи богаты белком, содержат клетчатку, витамины и минералы, которые повышают питательную ценность хлеба и других продуктов хлебобулочной отрасли. Клетчатка в шроте увеличивает объем хлеба и делает его более сытным, при добавлении жмыхов же она способствует замедлению старения хлеба и продлевает срок его хранения. Использование шрота помогает снизить производственные затраты на жировые составляющие, такие как маргарин и различного вида масла из-за остаточных жиров, содержащихся в их составе. Также шроты и жмыхи могут использоваться в качестве основы для пищевых концентратов, таких как супы, соусы и энергетические батончики. Изучение данного направления позволит не только обогатить существующие на рынке продукты, но и открыть его для людей со специфическими вкусовыми и диетологическими нуждами.

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MONITORIZAREA FERMENTAȚIEI ALCOOLICE A MUSTURILOR OBTINUTE DIN SOIURI DE STRUGURI RIZOGENE

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Rezumat. În contextul actual al industriei viticole este crucială elaborarea soiurilor de viță-de-vie, care să producă struguri de calitate superioară, cu randament înalt, rezistente la boli și dăunători, șocuri termice, secetă, și care să întrunească parametrii fizico-chimici necesari pentru producerea vinurilor de calitate. Acest studiu vizează parametrii de maturitate a strugurilor de soiuri rizogene (Alexandrina, Augustina, Malena, Nistreana, elaborate la Institutul de Genetică, Fiziologie și Protecție a Plantelor al USM), parametrii mustului în procesul de fermentație alcoolică, evoluția complexului polifenolic pe durata fermentației alcoolice, fenomenul nedorit de oxidare spontană pinking, întâlnit la vinurile albe, metodele practice de eliminare a pigmentilor responsabili de acest fenomen. Scopul acestui studiu constă în evaluarea potențialului vinicol al soiurilor rizogene autohtone, monitorizarea fermentării alcoolice a musturilor obținute din ele, extracției compușilor polifenolici din părțile solide a boștinei pe parcursul procesului de macerare-fermentare, susceptibilității vinurilor obținute la oxidarea spontană, manifestată prin rozovirea vinurilor, eficienții diferitor metode în eliminarea fenomenului de pinking din vinurile studiate. În studiu au fost testate fermentările alcoolice în condiții de microvinificație și în bioreactor, care permite menținerea temperaturii constante și agitării mustuielii, la care s-au administrat levurile selecționate.

Cuvinte cheie: soiuri rizogene, fermentație alcoolică, compuși fenolici, pinking

Introducere

Agricultura se confruntă cu o vulnerabilitate crescută la variabilitatea factorilor și fenomenelor climatice extreme, care devin tot mai accentuate. Impactul schimbărilor climatice afectează productivitatea culturilor agricole, conducând la o reducere a acesteia. Pentru a remedia situația, este esențială utilizarea eficientă a resurselor și încurajarea adoptării genotipurilor de plante care prezintă performanțe în condițiile schimbărilor continue ale mediului de dezvoltare a organismelor vii.

Prin urmare, este crucial să abordăm crearea genotipurilor de viță-de-vie rizogene, care să îmbine caracteristici precum struguri de calitate superioară, productivitate înaltă, rezistență îmbunătățită la boli și dăunători (cu accent special pe filoxera, Oidium, putregaiul cenușiu) precum și rezistență la temperaturi scăzute și ridicate.

Combinăția dintre rezistența la boli și dăunători, alături de o productivitate înaltă și calitate superioară într-un organism, reprezintă o provocare continuă în selecția viței-de-vie.

E. Alexandrov se dedică cercetării genotipurilor interspecifice de viță-de-vie în cadrul Institutului de Genetică, Fiziologie și Protecție a Plantelor, axându-se pe dezvoltarea variantelor rezistente la factorii biotici și abiotici. Genotipurile rezultate au fost supuse studiilor extinse privind particularitățile agrobiologice și tehnologice, conducând la selecția genotipurilor rizogene de perspectivă. Ca rezultat, au fost create noi soiuri rizogene, printre care se numără Ametist, Augustina, Alexandrina, Malena, Nistreană, Sarmis și Tethys.

Parametri de maturitate a strugurilor și declanșarea fermentației alcoolice

Cunoașterea parametrilor de maturitate a strugurilor este importantă pentru a determina momentul optim de recoltare. Acești parametri includ nivelul de zahăr, pH-ul, conductivitatea electrică și densitatea. Recoltarea trebuie efectuată când strugurii ajung la maturitate tehnologică pentru a asigura o calitate superioară a vinului.

Tabelul 1

Principalii indici fizico-chimici a strugurilor (anul recoltei 2023)

Nr. d/o	Denumirea	°Brix	Conductivitatea electrica $\mu\text{S/cm}$	Densitatea, kg/m^3	pH
1	Alexandrina	22.33	1953	1090	3,35
2	Augustina	23.44	1796	1095	3,53
3	Malena	22.31	1743	1103	3,48
4	Nistreana	22.84	1820	1095	3,53

După analiza tabelului nr. 1, constatăm că conținutul de zahăr se situează în intervalul de 23,44°Brix (Alexandrina) și 22,31°Brix (Malena). Alexandrina prezintă cea mai înaltă conductivitate electrică, indicând cel mai înalt grad de extracție a substanțelor disociabile în ioni (a substanțelor minerale). Nivelul pH este cuprins între 3,35 (Alexandrina) și 3,53 (Augustina, Nistreana).

Fermentația alcoolică a fost inițiată folosind levuri selecționate (Zymaflore X5) viabilitatea celulelor 100% în cantitate 30 g/hl la musturile provenite de la soiuri de struguri rizogene, cum ar fi Alexandrina (Ax), Augustina (Ag), Malena (MI) și Nistreana (Ns). Administrarea preparatului are loc sub formă de maia, pentru protejarea mustului în procesul fermentației alcoolice este necesar de folosit anhidrida sulfuroasă (SO_2), cantitatea totală a SO_2 administrată este 90 mg/l.

Declanșarea fermentației cu utilizarea levurilor selecționate reflectă un șir de avantaje: fermentația mustului începe rapid, în special datorită levurilor ale căror proprietăți le cunoaștem, în urma fermentației, se formează cu 0,5-1 vol % mai mult alcool decât în cazul fermentației spontane, vinurile conțin niveluri mai scăzute de acizi și eteri volatili. vinurile au gust și arome curate și sunt mai puțin susceptibile la boli, durata fermentației alcoolice este redusă, vinul se limpezește mai ușor.

Partea experimentală

De menționat faptul că fermentația alcoolică are loc în 2 condiții diferite: în bioreactor Lambda Minifor Laboratory fermentor la $T=20^\circ\text{C}$ și frecvența agitării=2Hz și în condiții standard unde $T=12-14^\circ\text{C}$.

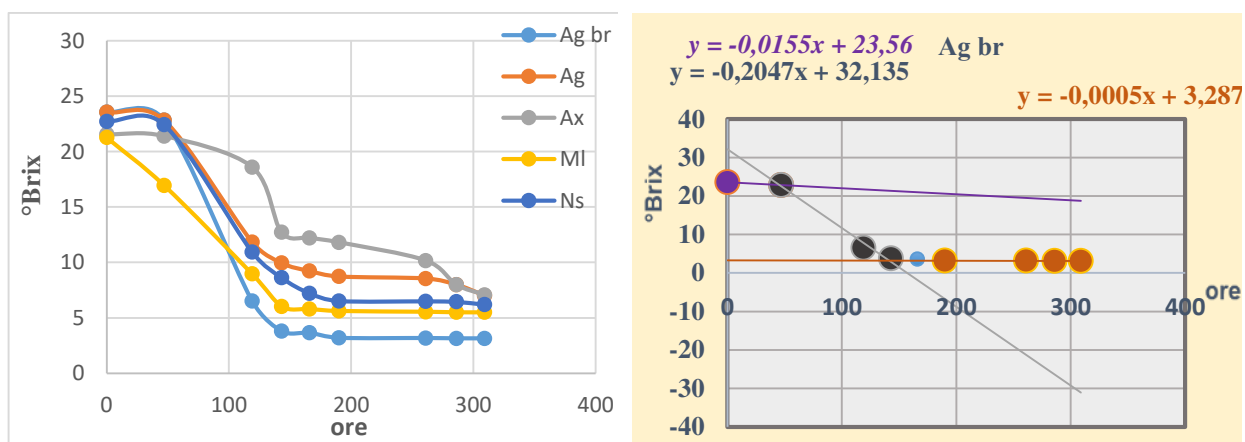


Figura 1. Grafice de fermentare

După analiza Fig.1, se poate concluziona că fermentația alcoolică tumultuoasă a avut loc în cel mai rapid și uniform în bioreactor. Absența fazei de inhibiție la Malena indică adaptarea eficientă a levurilor la mediul respectiv. Viteza fermentației tumultuoase este diferită 0,2 °Brix/ora (Ag br) și 0,07°Brix/ora (Ax).

Prin monitorizarea indicatorilor fizico-chimici, cum ar fi conținutul de zahăr(°Brix), densitatea, conductivitatea electrică, pH, extractul sec total și TAV putem evalua calitatea vinului și progresul procesului de fermentare alcoolică.

Tabelul 2

Principalii indici fizico-chimici a vinurilor (anul 2023)

Nr. d/o	Denumirea	°Brix	Conductivitatea electrica, $\mu\text{S}/\text{cm}$	Densitatea, kg/m^3	TAV, %	pH	Extractul sec total, g/l
1	Alexandrina	7,07	1788	988	9,46	3,2	46,3
2	Augustina	7,02	1645	985	11,55	3,32	23,6
3	Malena	5,5	1504	983	12,54	3,56	17,3
4	Nistreana	6,2	1528	984	13,02	3,63	25,2
5	Augustina Bioreactor	3,15	1708	993		3,24	29,6

După examinarea Tab. 2, observăm că procentajul cel mai ridicat al alcoolului total volumetric (TAV) este înregistrat la vinul Nistreana, cu 13,02%, și extractul sec total de 25,2 g/l, în timp ce cel mai scăzut procentaj este la vinul Alexandrina, cu 9,46%, având un extract sec total de 46,3 g/l. Extractul sec total reprezintă ansamblul tuturor substanțelor din must sau vin care în anumite condiții fizice nu se volatilizează și rămân în reziduu. Vinul de tip Alexandrina este caracterizat de cea mai înaltă aciditate, având un pH de 3,2, în timp ce vinul Nistreana se distinge prin cea mai scăzută aciditate, având un pH de 3,63. Dinamica fermentației alcoolice joacă un rol primordial în calitatea vinului, vine cu o varietate enormă a metaboliților secundari care influențează gustul, aroma și culoarea vinului.

Substanțele fenolice reprezintă valoroase caracteristici pentru calitatea vinurilor. Prin urmare au proprietăți antioxidante (cinamiții), contribuie la formarea culorii vinurilor albe (acidul galic,substanțele fenolice flavonoide si substanțele fenolice totale), gustului, structurii și stabilității.

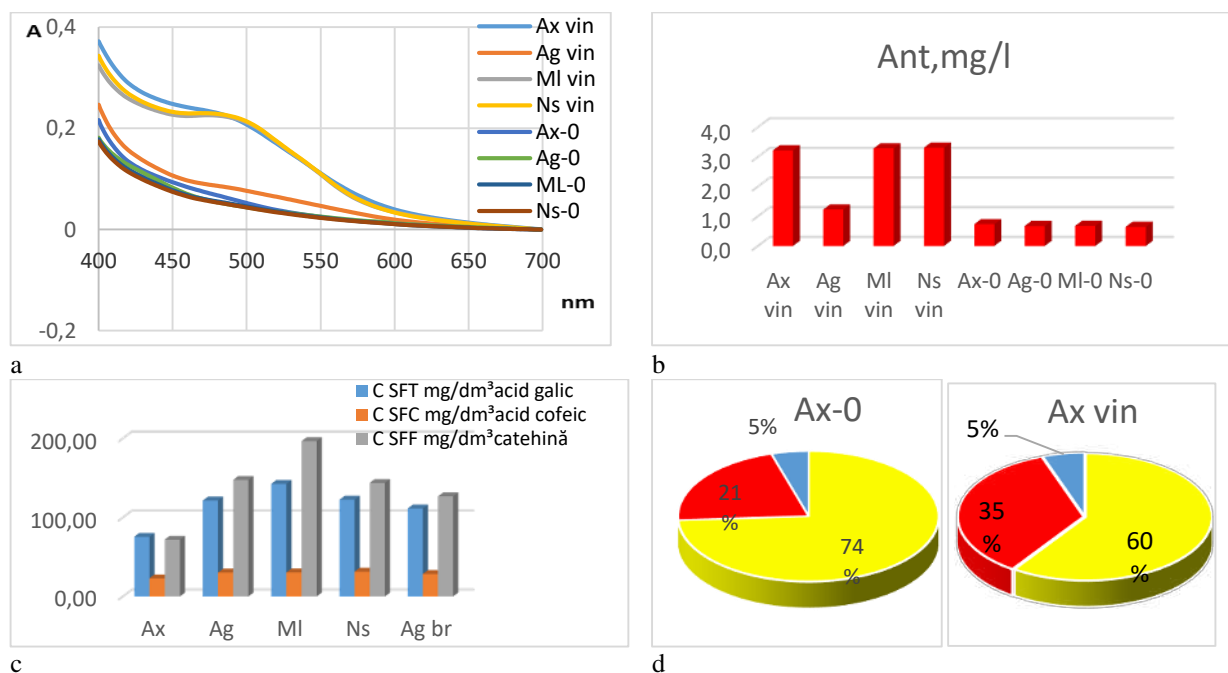


Figura 2. a) Spectrele de adsorbție și concentrația substanțelor fenolice, b) Concentrația antocianilor, c) Substanțele fenolice, d) procentul fiecării culori. Ax vin,Ag vin,MI vin,Ns vin-vinuri fermentate cu levuri salbatice.Ax-0,Ag-0,MI-0,Ns-0-musturi la 150 ore de declanșarea FA cu levuri selecționate.

Analizând Fig.2 observăm că spectrele de adsorbție în domeniul VIS sunt semnificative între vinurile fermentate cu drojzii sălbatice și musturile cu drojzii selectate și sulfitate cu SO₂. Concentrația de antociani este de trei ori mai mare în cazul vinurilor deja oxidate. La fel se prezintă o diferență a componentei roșie a vinului care în vinurile fermentate cu levuri sălbatice este cu 14-16% mai mare. În urma analizei spectrelor de adsorbție în UV mustul fermentat din soiul MI evidențiază cele mai ridicate concentrații de substanțe fenolice totale, cinamice și flavonoide, în timp ce mustul fermentat din soiul Alexandrina înregistrează cele mai scăzute concentrații de astfel de substanțe. La fel în cadrul tuturor probelor limitele concentrațiilor substanțelor fenolice cinamice este în limitele 15-30 mg/l protejând vinurile albe de oxidări și îmbruniri oxidative. Cele mai ridicate concentrații sunt SFF ce determina culoarea vinurilor albe în cea mai mare parte.

Fenomenul Pinking adesea apare la vinurile albe care au fost obținute în condiții extrem de reducătoare afectând culoarea (apare culoarea roz) la expunerea bruscă la aer. Aroma rămâne adesea neschimbată, culoarea roz dă adesea impresia de oxidare, cu toate acestea, oxidarea este un fenomen separat. Cauza probabilă este transformarea oxidativă a anumitor proantocianidine incolore în cianidine roșii, pot contribui și alte substanțe din vinuri, (ioni de metale, acizi organici și biopolimeri).

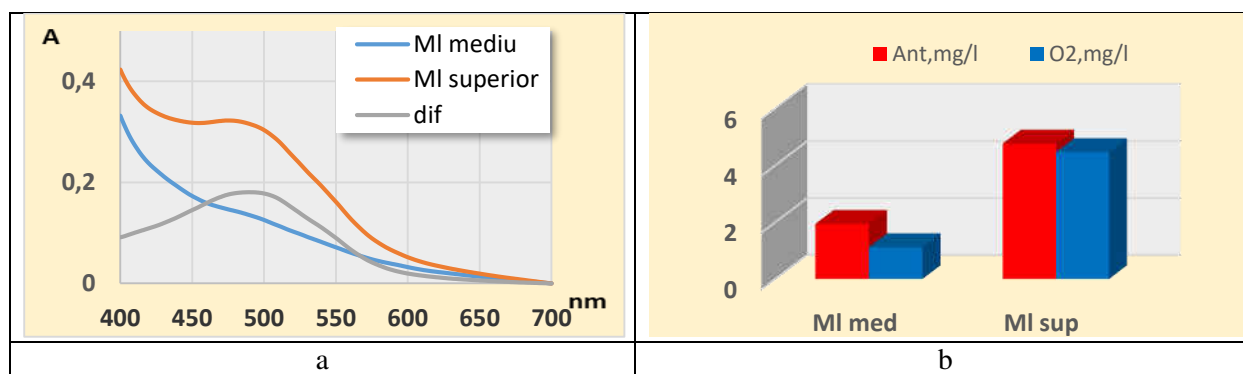


Figura 3. a) Spectrele de adsorbție în VIS a vinului MI, b) Conținutul antocianilor și O₂ în vin.

În urma diferitor analize sa demonstrat că vinurile fermentate cu levuri sălbatice, fără adaos de SO₂ dezvoltă fenomenul Pinking cel mai afectat fiind vinul din soiul Malena.

În urma analizei Fig. 3 se observă cum influențează conținutul de oxigen dizolvat, în stratul superior conținutul oxigenului este de 3 ori mai mare la fel crește și conținutul de antociani.

Pigmenții din vin pot fi eliminați folosind cărbune activ, PVPP și SO₂. În cadrul cercetării s-a folosit adjuvanții SO₂ (0,02;0,04;0,1g/l) și PVPP (0,2; 0,4; 1 g/l).

Figura 4 prezintă vinul tratat cu PVPP, se remarcă o reducere a absorbției în funcție de concentrație, asociată cu diminuarea concentrației de antociani (cantitatea minima de antociani necesară pentru vizualizarea culorii roz în vin este 0,3 mg/l), o ușoară diminuare a pigmentilor roșii, dar și o reducere a SFT, SFC și SFF. Concentrația maximă admisibilă de PVPP (1g/l) nu a dovedit eficiență în eliminarea totală a fenomenului.

În Fig.5 este prezentat efectul altui adjuvant SO₂, sub formă de metabisulfid de potasiu. De asemenea are loc o scădere a absorbției în funcție de concentrație, diminuare a pigmentilor roșii în VIS, precum și o descreștere a SFT, SFC, SFF. Spre deosebire de PVPP, metabisulfitul de potasiu în concentrație de 100 mg/l prezintă o eficacitate mai înaltă în diminuarea fenomenului Pinking cu 0,1 mg/l mai mult antociani și cu 6% mai mult din culoarea roșie.

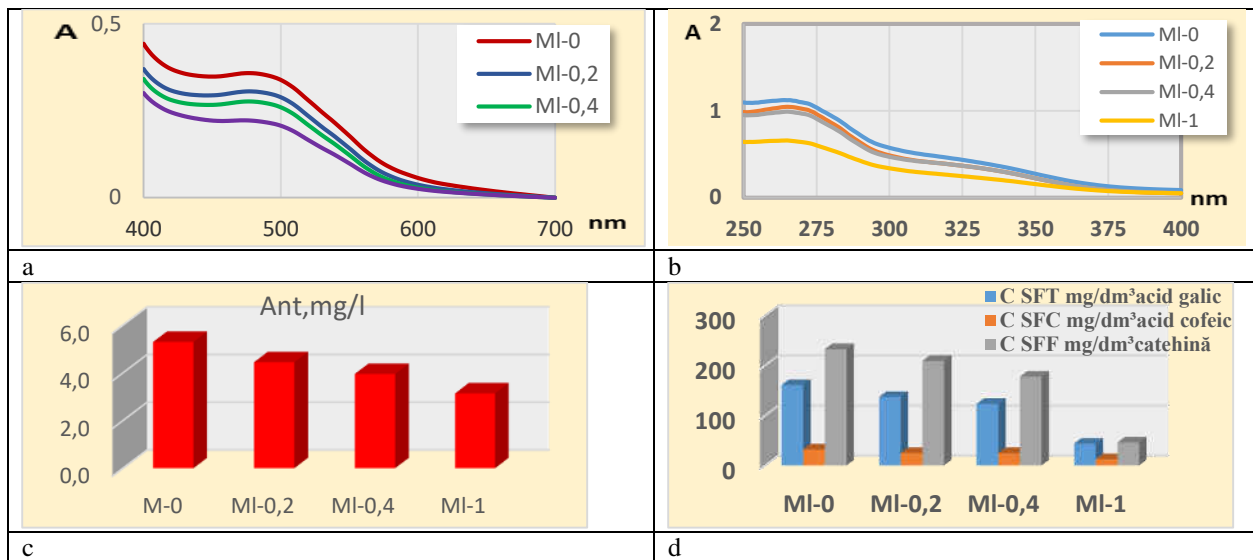


Figura 4. Spectrele de absorbție în VIS: a) vinului MI, b) Spectrele de absorbție în UV a vinului MI, c) Concentrația antoncianelor, d) Substanțele fenolice

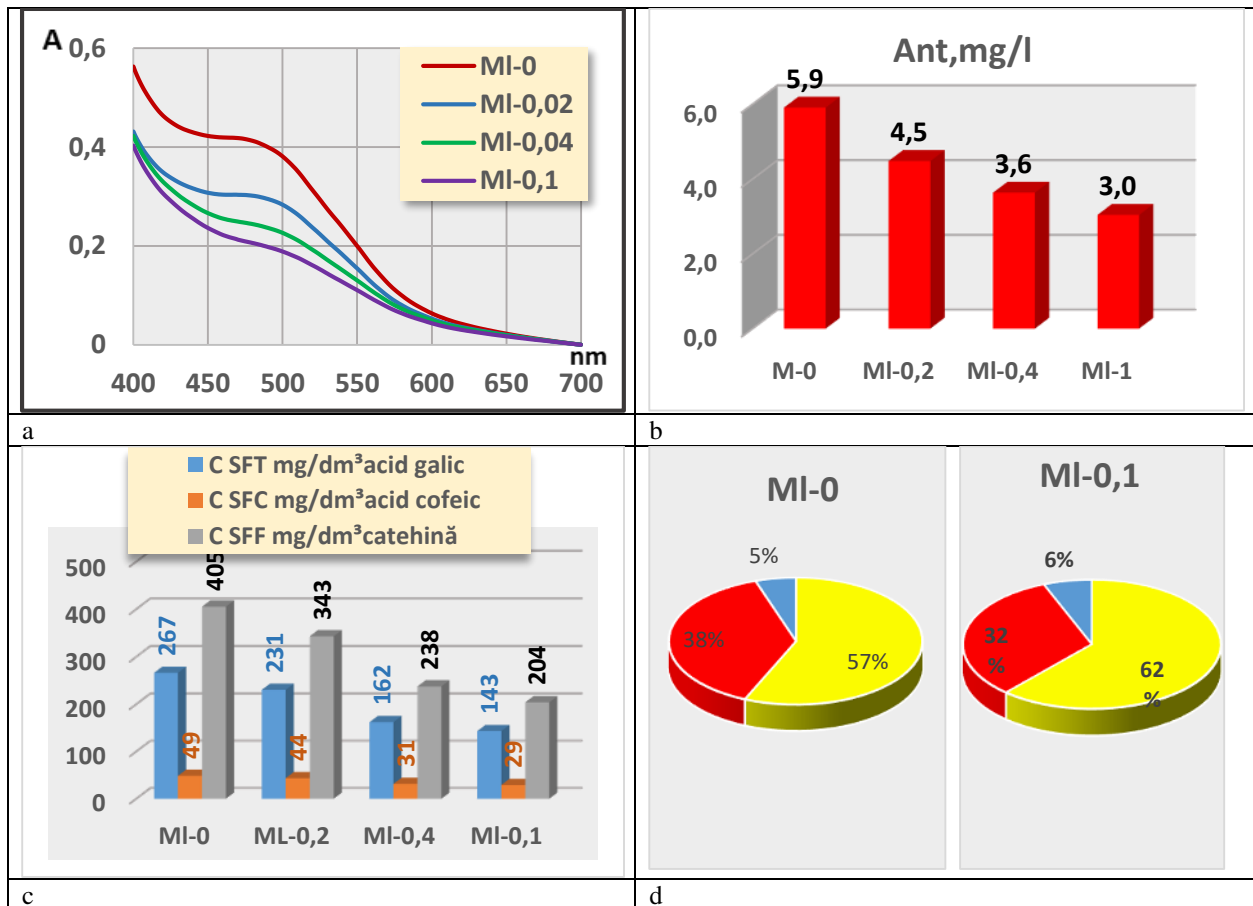


Figura 5. a) Spectrele de absorbție în VIS a vinului MI, b) Concentrația antoncianelor, c) Substanțele fenolice, d) Procentul fiecărei culori

Concluzii

S-a urmărit procesul de fermentație alcoolică a musturilor albe provenite din soiurile experimentale rizogene Alexandrina, Augustina, Malena și Nistreana, S-a constatat că fermentația alcoolică a avut cel mai bun randament în bioreactor la temperatura de 20°C și cu o frecvență de agitare de 2 Hz.

S-a demonstrat că vinurile tinere, neprotejate împotriva oxidărilor la etapele inițiale, în scurt timp pot dezvolta fenomenul Pinking. Tratamentul vinului Malena cu adjuvanții PVPP și SO₂ în concentrații maxime de 1 g/l și respectiv 0,1 g/l s-au dovedit a fi insuficiente în eliminarea totală a fenomenului de pinking. La etapele inițiale de formare a pigmentilor roșii în vinurile studiate dozele respective ar fi suficiente. Studiile realizate au pus în evidență complexitatea majoră a transformărilor chimice, rezultate cu Pinking, motiv pentru care fenomenul urmează să fie investigat în profunzime în continuare.

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НЕТРАДИЦИОННЫЙ ИСТОЧНИК ПИТАНИЯ

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Аннотация. Желудь — плод дуба и родственных ему видов в пределах родов *Quercus* и *Lithocarpus* семейства буковых (*Fagaceae*). В большинстве случаев он содержит одно семя, редко два, окруженное твердой кожурой и заключенное в чашевидную оболочку, называемую плюской.

Следы использования желудей в жизни первобытного человека были обнаружены в разных местах на территории современной Европы. Упоминание о желудях как о пище для человека можно встретить в нескольких смыслах: как о пище для отшельников, ушедших в лес, как о символе преодоления невзгод и во время голода, как об использовании кукурузной муки в паре с мукой из проса и других злаков для приготовления хлеба.

Пищевые свойства желудей очень высоки. Они лишь немного уступают ячменю. Мука из желудей дуба отлично подходит для организма и является хорошей, возможно, даже более здоровой альтернативой другим видам муки. В сочетании с зерновой мукой она намного богаче калием, кальцием и магнием, которые являются необходимыми питательными веществами и минералами для нашего здоровья. Дубовый желудь считается богатым питательными веществами источником энергии (источником углеводов, белков и жиров, витаминов группы B, клетчатки), что оправдывает его использование в качестве пищи или ингредиента. Желудевая мука ценна для правильного функционирования пищеварительной системы, лечения диареи, ларингофарингита, меноррагии, ожирения и язвы желудка. Эта мука считается безглютеновой. Желудевую муку можно использовать в рационе человека, например, при производстве хлеба, лапши, печенья, сладкой выпечки или в качестве ингредиента при заваривании кофе.

Ключевые слова: безглютеновый, желудь, желудевая мука, пищевая ценность

Введение

Современная агропромышленность в процессе своей эволюции отобрала культуры, которые проще всего выращивать. Это помогло снабдить население достаточным количеством пищи, но при этом сократило разнообразие потребляемых продуктов. Желудь может стать одной из возможных альтернативных пищевых культур.

Исторические следы употребления желудей в пищу

Следы применения желудей в быту первобытного человека были найдены в разных местах: на территории современной Бельгии [1], в Европе [2], Леванте [3]. Одним из первых упоминаний желудей как кормовой культуры принадлежит Древней Греции в "Одиссее" Гомера, когда Цирцея кормила превращенных в свиней спутников Одиссея [4]. Но при этом желуди употребляли в пищу и люди, хотя и бедное население [5]. На территории Японии при раскопках периода Дзёмон (охватывает период с 14 000 года до н. э. до 300 года н. э.) также были обнаружены желуди, и находки указывают на то, что они составляли значимую роль в рационе и повлияли на выживание популяции [6].

В период средневековья письменных упоминаний о желудях в пищевом смысле стало больше, правда, в основном это упоминания о них как о кормовой культуре для свиней. Упоминание желудей как еды для человека встречается в нескольких контекстах. Во-первых, как еда для отшельников, ушедших в лес. В этом конкретном случае дубовые орехи могли стать пищей покаяния для тех, кто решил отказаться от мира и усмирять свою плоть [7].

Во-вторых, как символ преодоления трудностей. Так, в любовном романе, где влюбленные собираются убежать, чтобы жить в лесу и питаться своей любовью, но также и дикими фруктами, ягодами, желудями и лесными орехами [8]. В-третьих, во времена голода, которые в средние века были не редким явлением, люди искали все возможные варианты насыщения в своем рационе, в том числе и желуди, корни и дикие растения [9]. Есть источники, упоминающие использование желудевой муки в сочетании с мукой из проса для приготовления хлеба [10].

По мнению Готфрида Малатерры, монаха-доминиканца и летописца, описывающего голод в Южной Италии в 1058 году, поедание желудей не превращало людей в свиней, но, напротив, типичная пища свиней была приспособлена к культурному акту изготовления хлеба: акт контролируемого отчаяния, цивилизованной паники [11].

На сколько обычной едой были желуди в неэкстремальных условиях, сложно сказать. Питание разных сословий сильно отличалось, а письменные источники на рецептуру того периода существуют только для высших сословий: дворянства и духовенства. Тем не менее, в 16 веке появилась тенденция готовить для высшего сословия блюда крестьянства, обогащая их специями и добавками, недоступными для бедных, но характерными для богатого сословия. В своем кулинарном труде "Opera" 1570 года повар высшего духовенства Бартоломео Скаппи предложил блюдо "связующее звено" между дворцовой кулинарией и "народной" культурой – пирог из желудей с сыром, глазированный сахаром, корицей и розовой водой [12]. Этот факт все еще не дает точного ответа на вопрос, насколько сильно было распространено употребление желудей среди крестьян. Но желуди как продукт в течение времени не раз были ключевым продуктом, спасавшим при голоде [13, 14], в том числе во времена второй мировой войны [15].

В некоторых культурах в национальных кухнях сохранились следы употребления желудей. Как пример, 2 вида так называемого "бедного хлеба" в Сардинии - lande fitta и lande cottu [16]. Либо доторикуксу (лапша из желудей) и дотори-мук (желе из желудей) в корейской кухне, сохранившиеся в ней после военного голода [17].

Желуди в современном питании

Желуди используются в питании и в наши дни. Желудевый кофе производится в Литве, Польше и России. Исследования показывают, что кофе из желудей содержит полезные минералы и имеет более низкий уровень опасных тяжелых металлов [18].

В азиатских странах существуют различные блюда из желудевой муки: желе и различные виды лапши. Исследование, сравнивающее питательные качества корейских видов лапши (в том числе из желудевой муки) с западными, показало, что они не сильно отличаются от западных видов, но обладают более низкой калорийной плотностью и выигрывают по содержанию некоторых микронутриентов [19].

Существует ряд исследований, указывающих на то, что хлеб из желудевой муки имеет потенциал как безглютеновый продукт [20-22]. Также есть исследования возможности применения желудевой муки в сладкой выпечке: желудево-рисовые кексы [23], печенье с пряностями и тыквенные маффины [24], национальная иракская сладкая выпечка "kulicha" [25]. Потенциал применения желудевой муки в кулинарии достаточно высок – от всевозможной выпечки и безглютеновых продуктов до супов и соусов [26].

Химический состав желудей

Желуди в сыром виде содержат на 100 грамм веса: углеводов - 40.75 г., белков – 6.15 г., воды – 27,9 г. Витамины: А, В1, В2, В3, В5, В6, В9, С. Минералы: кальций, медь, железо, магний, марганец, фосфор, калий, натрий, цинк. Благодаря своему богатому фитохимическому составу и связанной с этим биоактивности, желуди обладают потенциалом предоставлять такие преимущества для здоровья, как защита от окислительного стресса, предотвращение раковых заболеваний и поддержка работы сердечно-сосудистой системы. Применение их в терапии специфических заболеваний, таких как атеросклероз, сахарный диабет или болезнь Альцгеймера, подчеркивает их важность для включения в рацион [27]. В зависимости от сорта и периода сбора химический состав может колебаться [28].

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Заключение

На территории Республики Молдова произрастают разные сорта дубов: дуб красный (*Q. rubra L.*) [29], дуб черешчатый (*Q. robur*), дуб скальный (*Q. petraea*) и дуб пушистый (*Q. pubescens*) [30]. Разнообразие сортов дубов предоставляет уникальную возможность для экспериментов с использованием желудей в пищу, открывая широкий спектр вариаций как в плане вкуса, так и в отношении их химического состава.

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УСИЛИТЕЛИ ВКУСА НОВОГО ПОКОЛЕНИЯ. ПЕРСПЕКТИВЫ И ПРЕИМУЩЕСТВА

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Аннотация. Статья рассматривает тенденцию использования пищевых добавок, с целью улучшения качества пищевого продукта. В настоящее время производитель всё чаще применяет синтетические аналоги, что заставляет задуматься о их воздействии на организм человека. Особое внимание уделено сравнению двух основных типов усилителей вкуса: синтетического - глутамата натрия (Е621) и натурального - дрожжевые экстракты. Глутамат натрия, известный как итати, придаёт дополнительную интенсивность и насыщенность продукту, ключевой компонент в супах, соусах и фаст-фуде. В свою очередь, дрожжевые экстракты – это безопасная альтернатива, формирующая богатый вкус продукта и способная маскировать нежелательные привкусы. Полученные выводы могут быть применены при разработке новых рецептов, улучшении органолептических характеристик и создании пищевого продукта с натуральным составом.

Ключевые слова: пищевые добавки, глутамат натрия, дрожжевые экстракты, влияние на здоровье, сравнение

Введение

Пищевые добавки — это вещества, применяемые в обработанных продуктах питания или других типах пищевой продукции, производимых на промышленном уровне. Они используются с целью достижения различных технических целей, таких как повышение безопасности продуктов, увеличение срока их хранения или изменение органолептических свойств. Добавление натуральных компонентов в качестве пищевых добавок является основополагающим процессом в производстве пищевых продуктов, однако развитие химической индустрии способствовало популяризации синтетических аналогов, в отношении которых до сих пор ведутся многочисленные дискуссии. Основным привлекательным фактором для потребителей является эстетичный внешний вид продукции, содержащей пищевые добавки. Возникает вопрос о потенциальной опасности вкусовых добавок и о целесообразности ограничения их потребления. На примере глутамата натрия и других усилителей вкуса наблюдается неоднозначное воздействие этого типа добавок на организм человека.

Синтетические усилители вкуса: механизмы и применение в пищевой промышленности

Пищевые добавки классифицируются по различным функциям в продуктах питания. Красители (Е100—Е182) используются для усиления или восстановления цвета продукта. Консерванты (Е200—Е299) увеличивают срок хранения, а антиоксиданты (Е300—Е399) защищают от окисления. Особое внимание следует уделить усилителям вкуса и аромата (Е600—Е699), которые способны придавать свежести и интенсивность вкусу пресной еды, раскрывая её ароматы и усиливая восприятие вкусов. Наиболее распространенными

усилителями вкуса являются поваренная соль, глутаминовая кислота и другие рибонуклеиновые кислоты, и их соли, которые придают продуктам соленый, мясной, рыбный и другие характерные вкусы.

Глутамат натрия (Е621) — это пищевая добавка, которая химически является солью глутаминовой кислоты. Глутаминовая кислота, в свою очередь, является одной из заменимых аминокислот, встречающихся в большинстве белков растительного и животного происхождения. Она присутствует в плазме крови и тканях человеческого организма и животных. Специальные клетки-рецепторы, находящиеся в большом количестве на языке, отвечают за интерпретацию вкуса. В течение долгого времени считалось, что эти рецепторы могут распознать только четыре основных вкуса. Однако в 1907 году японский химик Кикунэ Икэда обратил внимание на необычный вкус бурой водоросли комбу, не вписывающийся в традиционное деление на соленый, сладкий, кислый и горький. Он назвал этот новый пятый вкус "umami" и выяснил, что он обусловлен присутствием в водоросли глутаминовой кислоты [1]. В 1908 году Икэда извлек глутамат натрия из водорослей и впоследствии получил патент на производство глутамата натрия, который стал выпускаться в Японии под названием "Ajinomoto" (корень вкуса).

Вплоть до 1960-х годов пищевая добавка Е621, глутамат натрия, производилась из клейковины пшеницы в условиях промышленного производства. На данный момент основным методом производства глутамата натрия в промышленном производстве является бактериальное брожение. В этом процессе участвуют бактерии различных видов, такие как *Brevibacterium*, *Arthrobacter*, *Microbacterium* и *Corynebacterium*. Глутамат натрия (Е621) является природным компонентом, который содержится в различных продуктах, таких как помидоры, сыр, мясо, молоко, рыба, капуста и другие. Во многих продуктах присутствует свободная глутаминовая кислота (таблица 1), которая придает им характерный вкус. Именно поэтому определённые процессы приготовления пищи предполагают частичный гидролиз белка, что означает превращение связанной глутаминовой кислоты в свободную, поэтому варёное или жареное мясо, курица и другие продукты изменяют свой вкус. Соевый соус, пармезан, грибы, помидоры и водоросли содержат значительное количество глутамата, поэтому при их добавлении блюдо становится более насыщенным.

Таблица 1

Содержание глутамата натрия в пищевых продуктах [3]

Продукт	Связанный глутамат	Свободный глутамат	Продукт	Связанный глутамат	Свободный глутамат
	(мг/100 г)	(мг/100 г)		(мг/100 г)	(мг/100 г)
Сыр пармезан	9847	1200	Лосось	2216	20
Мясо курицы	3309	44	Зелёный горошек	5583	200
Мясо утки	3636	69	Кукуруза	1765	130
Говядина	2846	33	Томаты	238	140
Свинина	2325	23	Картофель	280	180

Способностью усиливать вкус обладает только L-глутаминовая кислота в полностью диссоциированной форме при pH 6,0–6,5. При обычных условиях приготовления пищи ($t \leq 100$ °C) эта способность сохраняется, но при высоких температурах и $\text{pH} \geq 8,0$ или $\text{pH} \leq 4,0$ в среде L-изомер глутамата натрия превращается в рацемат — смесь L- и D- изомеров, а D-изомер не обладает свойством усиливать вкус [2].

Однако глутамат натрия также может быть произведен химическим путем. Это белый порошок, легко растворимый в воде. Синтетический глутамат натрия производится из сахарного тростника, свеклы или кукурузного крахмала в процессе ферментации. Химически не существует различий между глутаматом натрия, полученным из природных и синтетических источников (рисунок 1). Человеческому организму нет необходимости различать, был ли глутамат в рационе природного или искусственного происхождения [3].

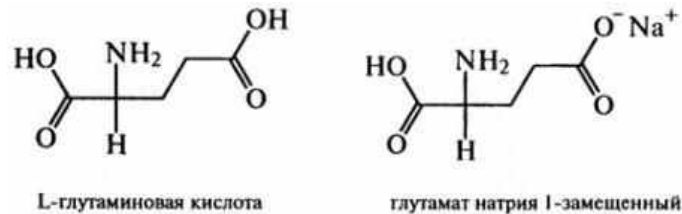


Рисунок 1. Структурная формула

Глутамат натрия был оценен экспертами из организации ВОЗ - ФАО по пищевым добавкам. С 1970 года проводились исследования, направленные на безопасность использования глутамата натрия. Согласно данным, представленным в 1973 году, допустимая суточная доза (ДСД) для человека составляла 120 мг на 1 кг массы тела. Это означало, что ежедневное потребление человеком (примерно 60 кг) 7,2 г глутаминовой кислоты не несет угрозы для здоровья. В 1987 году, после проведения дополнительных исследований, было принято решение о пересмотре норматива суточной дозы ДСД. В соответствии с отчетами экспертов ФАО/ВОЗ, в итоговом протоколе был установлен новый норматив - "допустимая суточная доза - не устанавливается" [4]. Данный норматив применяется для веществ, которые имеют низкую токсичность и их потребление с пищей значительно выше, чем использование в качестве пищевой добавки. Согласно информации ФАО/ВОЗ, пищевая добавка глутамат натрия разрешена в течение более чем 40 лет.

Тем не менее, глутамат натрия проявляет токсичные свойства только в очень больших дозах (больше, чем 120 мг на 1 кг веса человека). Избыток глутаминовой кислоты в пище может привести к ее накоплению в организме при длительном употреблении. Сразу после приема продуктов, содержащих глутамат, рецепторы питания реагируют на увеличение его концентрации в крови. Большая часть глутамата усваивается клетками слизистой оболочки желудочно-кишечного тракта, а избытки поступают в кровеносную систему и накапливаются в печени. Кроме того, глутамат натрия обычно добавляют в сильно процессированные продукты: чипсы, быстрозамороженные лапшу, приправы. Более серьезная опасность от Е621 — это риск переизбытка, что может привести к набору лишнего веса и ожирению. Однако нет точной информации о связи между потреблением глутамата натрия и развитием ожирения.

Новое поколение усилителей вкуса: альтернативные подходы и перспективы

На сегодняшний момент в мире наблюдается тенденция к росту спроса на продукты с «чистой этикеткой», которые содержат только натуральные ингредиенты. Именно поэтому как альтернатива, в мировой практике используются натуральные усилители вкуса на основе дрожжей.

Дрожжевые экстракты — это водорастворимая фракция свободных аминокислот и пептидов, которая получается при переработке различных видов дрожжей (хлебопекарных, пивоваренных или молочных), в основном *Saccharomyces cerevisiae* [5]. Высокое содержание аминокислот, пептидов и полипептидов в этих экстрактах позволяет не только обогащать их вкус, но и увеличивать их интенсивность.

Дрожжевой экстракт применяется в качестве пищевых добавок или ароматизаторов и обладает свойствами, сходными с глутаматом натрия. Глутамат натрия и аминокислоты отвечают за ощущение "umami" и присутствуют в пищевых добавках Е600 — Е699. Однако

в дрожжевых экстрактах также содержится глутаминовая кислота (свободный глутамат) естественного происхождения, но в меньших количествах, чем в глутамате натрия. Одни дрожжевые экстракты придают более глубокий вкус, в то время как другие добавляют интенсивные нотки "umami", например, оттенки говядины, курицы, тостов, жареного и других. Интерес к дрожжам в качестве добавки для улучшения вкуса продуктов питания начал проявляться в начале 20-го века и приобрел заметное значение на рынке в 1950-х годах. Дрожжевые экстракты изготавливаются путем использования процесса автолиза на первично выращенных пекарских дрожжах.

Процесс автолиза клеток дрожжей, таких как пекарские дрожжи (*Saccharomyces cerevisiae*), начинается после истощения внутриклеточных запасов углерода. Активация ферментов происходит при уменьшении энергетических ресурсов внутри клетки, что приводит к её разрушению. В результате клеточного разложения освобождаются пищеварительные ферменты (рисунок 2). Оптимальные условия для проведения автолиза дрожжей включают рН около 5,5 и температуру около 45–55 °С. При снижении осмотического давления в цитоплазме клетки многие ферменты высвобождаются в окружающую среду [6].

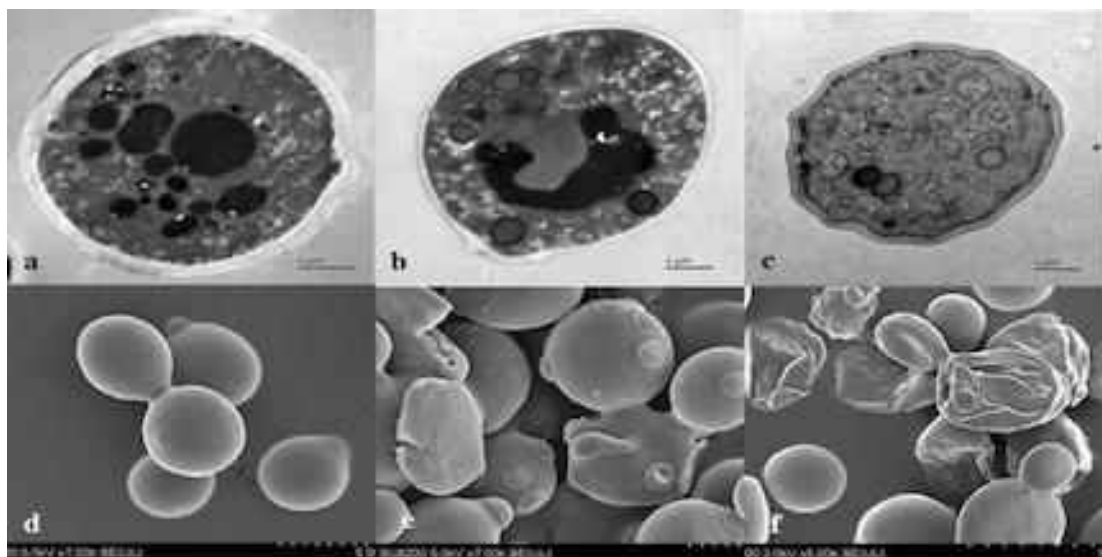


Рисунок 2. Автолиз дрожжевой клетки

Существует два основных типа дрожжевого экстракта: автолизированный и гидролизированный. В обоих случаях клеточные стенки дрожжей удаляются, а содержимое клеток объединяется. В автолизированных дрожжах ферменты, находящиеся в клетках дрожжей, применяются для разложения белков. В гидролизированных дрожжах эти ферменты добавляются к дрожжам. Иногда к ним также могут добавляться кислые или внешние ферментные препараты. Дрожжевой экстракт доступен в двух формах: в виде плотного геля или влажного порошка.

Дрожжевые экстракты содержат основные питательные компоненты, включая частично гидролизированный белок с содержанием свободных аминокислот около 35-40%, а также витамины группы В и определенные микроэлементы. Благодаря этому их аминокислотный состав сопоставим с такими продуктами, как грибы, сыр, мясо и овощи.

Однако, потребление дрожжей в качестве источника белка может быть ограничено из-за высокого содержания нуклеиновых кислот. Дрожжи содержат от 6% до 15% нуклеиновых кислот, что существенно выше, чем в мясных продуктах, где их содержание составляет около 2%. Известно, что чрезмерное употребление нуклеиновых кислот в пищу может привести к повышению уровня мочевой кислоты в крови, что может спровоцировать

развитие определенных заболеваний, таких как подагра и образование камней в почках, а также может ухудшить функционирование нервной системы.

Тем не менее, следует отметить еще одно преимущество использования дрожжевых экстрактов - возможность уменьшения содержания поваренной соли в рецептурах. При этом сохраняется текстура продукта, а срок его хранения не уменьшается. Дрожжевые экстракты полностью растворяются в воде, образуя прозрачные растворы, и могут быть добавлены в продукт в любом виде (сухом, пастообразном или растворенном) на той же стадии производства, что и глутамат натрия. Дрожжевые экстракты широко используются в производстве колбасных изделий, полуфабрикатов, паштетов, а также диетических продуктов с низким содержанием соли и детского питания. На рынке наиболее часто предлагаются экстракты, придающие продуктам насыщенный мясной вкус.

Производители стремятся заменить синтетические усилители вкуса на дрожжевые экстракты, поскольку они являются натуральным ингредиентом, в отличие от однокомпонентных добавок, таких как глутамат натрия, которые обозначаются номерами E (E 620 - E 640) в списке ингредиентов продуктов. Основное различие между дрожжевым экстрактом и глутаматом натрия в продуктах питания заключается в их вкусовых характеристиках. Глутамат натрия (E621) не обладает собственным вкусом, а действует как усилитель вкуса, аналогично соли. В то время как дрожжевой экстракт добавляет пище аромат, напоминающий пряность. Он практически формирует вкус продукта, придавая ему насыщенность, маскируя нежелательные привкусы и создавая ощущение присутствия мясных компонентов в рецептуре без излишнего жирного привкуса.

Выводы

Растущая популярность синтетических добавок, вызывает сомнения потребителей в связи с их возможными негативными последствиями для здоровья человека. Эта проблема становится актуальной, например, в случае усилителей вкуса, таких как глутамат натрия. Стоит обратить внимание, что глутамата натрия (E621) это усилитель вкуса, формирующий насыщенный вкус продукта, а также натуральный компонент, входящий в состав овощей, мяса, сыров. Вопреки допустимости его употребления, необходимо продолжать исследования глутамата натрия в пищевых продуктах, чтобы установить более четкие нормативы для производителей.

Изучение дрожжевых экстрактов как пищевых добавок выделяет их важное свойство, благодаря высокому содержанию свободных аминокислот и пептидов они создают новый более глубокий и интенсивный вкус в продуктах. Их применение может способствовать разнообразию вкусовых ощущений и снижению содержания поваренной соли, а также замене синтетических усилителей вкуса на натуральные ингредиенты. Использование дрожжевых экстрактов является перспективным направлением в пищевой промышленности, позволяя производителям создавать продукты с насыщенным вкусом и безопасными для здоровья характеристиками.

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Если еще 25-30 лет назад индустрия anti-ageing, эксплуатируя человеческое стремление к вечной молодости, предлагала широкий спектр beauty-услуг омоложения, охватывающий различные аспекты - от ухода за собой до сложных медицинских процедур, то сегодня он включает в себя комплексный подход к оздоровлению, охватывающий все уровни организма, от клеток до личности. В этом процессе задействованы специалисты различных областей – врачи разных специализаций, и генетики, и психологи. Особая роль в функциональном подходе к anti-age процессам принадлежит нутрициологам - специалистам помогающей профессии, работающих со стратегиями, связанными с анти-эйджингом, направленными на предупреждение и замедление возрастных изменений, которые происходят в организме.

Anti-age идеология: новый взгляд на старение

Anti-ageing, или *борьба со старением*, уже давно стал не просто модным трендом, а научно-обоснованным подходом, позволяющим улучшить качество жизни и замедлить старение.

Наряду с определением *anti-age* все чаще стало использоваться новое направление *ageing well* – хорошее взросление (не старение). Это понятие подчеркивает не просто борьбу со старением, а гармоничное проживание каждого возрастного этапа, сохранение здоровья и продление физической и социальной активности.

Все больше людей стали вести правильный образ жизни, для которых возраст 70+ не является каким-то критическим.

И лучше начинать подготовку к эйджингу в 35-40 лет, на пике своей физической формы - чем раньше человек будет замотивирован заниматься этой проблемой, тем успешней будут складываться антивозрастные стратегии, нутриентные, диагностические и профилактические схемы для коррекции его здоровья.

Опять-таки возвращаясь к возрасту, когда нужно сосредоточиться на проблеме анти-эйджинга, хочу заметить, что многие мультицентровые клинические исследования называют возраст 40+ критическим, когда у человека начинаются возрастные метаболические изменения, регистрируются пока еще незаметные оксидативные нарушения, гормональные изменения не только у женщин, но и у мужчин, которые приводят к нарушению нейроиммуноэндокринной регуляции.

В конечном итоге в возрасте 40+ начинают проявляться и мультифакторные заболевания (например, у аллергии 1 типа, у сахарного диабета есть мультифакторный характер наследования). А в совокупности с эпигенетическими факторами вредного влияния (окружающей среды, стресса и вредных привычек), начинается быстрый процесс старения [2].

Нутриенты

Главное в антивозрастных стратегиях – это удержать постоянство внутреннего состояния организма и поддержать энергетический баланс.

Микронутриенты, также известные как витамины, минералы и другие биологически активные вещества, – это незаменимые элементы, необходимые для правильного функционирования организма. Это пищевые вещества с суточной потребностью порядка всего 2 грамм. Сюда входят 11 водорастворимых витаминов и витаминоподобных веществ, 4 жирорастворимых витамина (А, Е, К, D), 30 макро- и микроэлементов, так называемых минералов и 20 классов других биологически активных веществ (биофлавоноиды, каротиноиды, изотиоцианаты, полисульфиды, терпеноиды, фитостеролы, полисахариды (крахмалы, клетчатка, инулин, гликаны, альгинаты), о которых медицина практически ничего не говорит, и даже система питания не очень акцентирует на них внимание, но они являются очень важными в концепте здоровья человека.

Приведенный выше неполный перечень дает представление о том, что помимо жиров, белков, углеводов, есть широчайший класс продуктов, без которых организм и вся его система жизнеобеспечения человека существовать и работать не может.

Роль нутрициолога заключается в том, чтобы помочь людям разобраться в сложном мире микронутриентов, подобрать индивидуальную схему питания, обеспечивающую организм всеми необходимыми веществами.

Углеводы, жиры, белки являются базовыми нутриентами, однако микронутриентное обеспечение их метаболизма, к сожалению, обычно не обсуждается.

Возьмем из базовых продуктов питания метаболизм глюкозы – в питании используют сахарозу в избытке, но сахароза состоит из глюкозы и фруктозы. Для метаболизма необходимы витамины В1, В2, В3, липоевая кислота из витаминоподобных веществ, витамины В5 и Н. Обязательно наличие минеральных компонентов - магния, кальция, калия, марганца, цинка, хрома, ванадия.

Подавляющее большинство населения даже не представляет себе, что просто для того, чтобы нормально усваивался обычный сахар или всё сладкое, а его в избыточном количестве в нашем питании, сколько компонентов дополнительных нужно, о них вообще никто не говорит.

Для метаболизма жиров требуются витамины В2, В3, В5, Н, L-карнитин, Омега-3 жирные кислоты, минеральные компоненты - магний, кальций, хром.

Для ключевого метаболизма - белков и аминокислот необходимы витамины В6, В2, В3, С, В5, В6+В9+В12, минералы – магний, кальций, калий, медь, железо.

Начиная с базовых продуктов, которые называются макронутриенты, количество, в котором мы нуждаемся: белки – в среднем 60-80 граммов в сутки. Углеводов (медленно и трудно расщепляющихся крахмалах и клетчатке прежде всего) - 450-500 граммов в сутки. Жиры примерно 60-70 граммов, причем жиры должны быть разнообразными - животные жиры (твёрдые) и растительные масла (жидкие).

Поэтому базовый обмен должен быть полностью обеспечен витаминами, минералами, потому что они входят в состав ферментов - специфических белков, которые участвуют абсолютно во всех биохимических процессах, начиная с переваривания жиров, белков, углеводов, всасывания и их обмена.

Режим питания

Здоровое питание долгожителя должно быть разнообразным и сбалансированным.

Нутрициологи в работе с anti-age стратегиями обычно используют базовые протоколы с их корректировкой под предпочтения клиента во избежание резких срывов и ограничений.

Средиземноморский протокол питания ассоциируется с 30%-ным снижением рисков развития депрессии и кардиометаболических нарушений. В рацион входят цельнозерновые продукты, овощи, фрукты, орехи, рыба, низкое потребление красного мяса, базой является оливковое масло [3, 4].

Диета DASH (Dietary Approaches to Stop Hypertension) также соответствует базовым принципам anti-age и состоит из набора рекомендаций, включающих повышенное потребление цельнозерновых, фруктов и овощей, нежирных молочных продуктов и орехов, снижение потребления сладостей, натрия, красного и переработанного мяса. Применяется в основном при сердечно-сосудистых и онкологических заболеваниях [5].

Диета MIND (Mediterranean-DASH Intervention for Neurodegenerative Delay diet) сочетает принципы средиземноморской диеты и диеты DASH. По протоколу необходимо съедать в день три порции зерновых, порцию листового салата с еще одним каким-нибудь овощем. В течении дня для перекусов выбираются орехи. Бобовые употребляются через день, белое куриное мясо и ягоды (лучше, чернику и клубнику) — два раза в неделю, рыба хотя бы 1 раз в неделю. Объем потребления сливочного масла не более 1 столовой ложки в

день, жаренная пища и фастфуд ограничивается до 1 раза в неделю, лучше исключить). Становится все более популярной благодаря своей эффективности в профилактике нейродегенеративных заболеваний - строгое соблюдение MIND диеты более чем на 53% снизило риск развития болезни Альцгеймера [6].

Мито протокол питания - низкоуглеводная диета с повышенным потреблением жиров и белков и умеренным потреблением углеводов Основная цель Мито диеты – anti-age, коррекция митохондриальной дисфункции, оксидативного стресса. Примерная пропорция БЖУ - 20/65/15% от дневного рациона. Основа рациона - белок. В качестве белка использовать только цельные продукты.

Независимо от выбранного протокола питания, питаться нужно регулярно, желательно в одно и то же время, по возможности скорректировав режим рабочих и выходных дней – это касается в первую очередь биоритмов органов пищеварения [7].

В отношении кратности приемов пищи – имеется достаточно научных данных, чтобы рекомендовать 3-разовое питание в качестве здорового и эффективного режима питания, без перекусов, с соблюдением 4-часового промежутка между приемами пищи [8-10].

Исключение составляют те, кому по состоянию здоровья положено дробное 4-5 разовое питание [11, 12].

Последние годы появилась тенденция к двухразовому (интервальному) питанию. Однако такое питание может подойти не каждому – это может привести к хронической усталости и нарушению метаболизма.

Необходимо соблюдать ограничение калорийности рациона и объема порций. С возрастом метаболизм человека замедляется, энергозатраты снижаются – рестрикция калорий может помочь поддержать здоровый вес, снизить риск развития сердечно-сосудистых заболеваний, диабета и других хронических возраст зависимых заболеваний [13, 14].

Желательно снизить поступление метионина. После 45-50 лет в организме человека происходят естественные изменения, в том числе и на клеточном уровне – из аминокислоты метионин синтезируется гомоцистеин (аминокислоту, связанную с развитием сердечно-сосудистых заболеваний и других возрастных проблем). Снижение потребления метионина может стимулировать митофагию – процесс саморазрушения поврежденных митохондрий, что способствует обновлению клеток и замедлению старения. Метионин содержится в продуктах животного происхождения (мясо, рыба, яйца, молочные продукты) и брокколи.

И обязательно исключение аллергенов – кроме традиционных, так и менее очевидных, которые могут вызывать аутоиммунную воспалительную реакцию или скрытую пищевую непереносимость.

Нутрицевтики

Основной принцип применения саплиментов - чем меньше синтетических препаратов применяется, тем здоровее организм, поскольку все синтетические препараты, которые не повторяют природные, являются чужеродными веществами для нашего организма.

Общая anti-age стратегия работы нутрициолога с клиентом.

В мире, где царит культ быстрого питания, стресса и малоподвижного образа жизни, очень важно соблюдать рекомендации по изменению образа жизни:

- Коррекция питания;
- Регулярный медикаментозный скрининг здоровья;
- Профилактика и своевременное лечение возрастных заболеваний;
- Устранение гормональных сбоев и дефицитов;
- Баланс витаминов и минералов с помощью приема парафармацевтиков;
- Устранение проблем ЖКТ;

- Налаживание режима дня с соблюдением циркадных ритмов, достаточное количество сна;
- Отказ от вредных привычек (курение, алкоголь, переедание, малоподвижный образ жизни);
- Физическая активность для максимального улучшения метаболического здоровья.
- Нормализация веса;
- Отказ или минимизирование использования «химии» в быту.

Выводы

Анти-эйджинг – это не просто мода, а необходимость в современном мире.

Всего за 100 лет природа подарила человеку еще 30 лет жизни - средняя продолжительность жизни в развитых странах увеличилась на 30 лет [15].

И хотя статистика свидетельствует о росте хронических заболеваний, эпидемий неинфекционных болезней, а эксперты ВОЗ говорят об эффекте накопления, когда **новое поколение уже сейчас имеет более хрупкое здоровье, чем предыдущее** - это огромный срок, который кардинально изменил наш подход к жизни и своему здоровью.

Поэтому на много десятилетий увеличение продолжительности жизни **станет комплексной задачей, требующей системного подхода.**

Здоровье и долголетие зависят не только от питания, но и от многих других факторов, таких как физическая активность, качество сна и эмоциональное состояние. **Необходимо не только** развивать медицину, **но и** повышать качество жизни, формировать культуру здорового образа жизни **и** создавать условия для активного долголетия.

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ИСПОЛЬЗОВАНИЕ ФУНКЦИОНАЛЬНЫХ ИНГРЕДИЕНТОВ ДЛЯ ПРОИЗВОДСТВА КОНДИТЕРСКИХ ИЗДЕЛИЙ

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Резюме. В Республике Молдова вырабатываемый ассортимент функциональных пищевых продуктов крайне ограничен. В настоящее время кондитерская отрасль решает множество задач, направленных на повышение пищевой и биологической ценности готовой продукции, снижение содержания сахара и, как следствие, энергетической ценности, разработку новых рецептур кондитерских изделий с использованием функциональных пищевых ингредиентов. Настоящая статья представляет исследование о важности и эффективности использования функциональных ингредиентов в кондитерской промышленности. Функциональные ингредиенты играют ключевую роль в улучшении качества кондитерских изделий, таких как шоколад, конфеты, печенье и торты. Авторы рассматривают различные категории функциональных ингредиентов, включая стабилизаторы, эмульгаторы, подсластители, антиоксиданты, улучшители вкуса и другие. Проанализировано влияние каждой категории на вкус, текстуру, пищевую ценность и срок годности кондитерских изделий. Статья обсуждает также преимущества использования функциональных ингредиентов, включая повышение конкурентоспособности продукции, улучшение технологических процессов производства и удовлетворение потребительских запросов, таких как требования к здоровому питанию и снижение содержания сахара. В заключение, авторы подчеркивают важность дальнейших исследований и разработки новых функциональных ингредиентов для улучшения качества кондитерских изделий и удовлетворения растущих потребностей рынка.

Ключевые слова: стабилизаторы, эмульгаторы, подсластители, антиоксиданты, пищевая ценность, здоровое питание

Введение

Функциональное сырье является неотъемлемой частью кондитерского производства, но в настоящее время в нашей стране ассортимент кондитерских изделий специального назначения крайне ограничен. Кондитерские изделия пользуются высоким спросом у населения, но так как кондитерские изделия не самый полезный продукт, необходимо использовать функциональные ингредиенты.

Функциональное сырье обладает рядом полезных свойств, которые улучшают биологическую ценность продукта и здоровье человека. Именно поэтому большая часть населения уделяет внимание аспектам здоровья.

В пищевой промышленности вопросы использования различных пищевых добавок специального назначения малоизучены, но являются актуальными для разработки продукции улучшенного состава для людей с различными заболеваниями и патологиями.

Классификация функциональных ингредиентов

Функциональные ингредиенты включают в себя растворимые и нерастворимые пищевые волокна (пектины и др.), витамины (витамин Е, токотриенолы, фолиевая кислота и др.), минеральные вещества (кальций, магний, железо, селен и др.), жиры и вещества,

сопутствующие жирам (полиненасыщенные жирные кислоты, структурированные липиды и др.), полисахариды, вторичные растительные соединения (флавоноиды/полифенолы, каротиноиды и др.), пробиотики, пребиотики и синбиотики, антиоксиданты, стабилизаторы, подсластители, эмульгаторы.

Функциональные ингредиенты классифицируются по происхождению на природные и искусственные.

Среди природных различают пребиотики, пробиотики и традиционные.

Пребиотики – вещества, которые стимулируют рост полезных бифидо- и лактобактерий, обычно не перевариваются в кишечнике, например, они содержатся в бананах, яблоках, злаковых и бобовых.

Пробиотики – препараты, которые содержат полезные бактерии в высушенном или растворенном виде. Чаще всего – это микроорганизмы из рода *Lactobacillus* и *Bifidobacterium*, которые содержатся в йогуртах, батончиках со злаками и в творожных сырах.

Традиционные – стандартные продукты растительного или животного происхождения, например, различные разновидности муки, злаки.

Нутрицевтики – биологически активные добавки с микро- и макроэлементами, включая витамины.

К наиболее распространённым пищевым добавкам функционального назначения относятся стабилизаторы, эмульгаторы, антиоксиданты и подсластители.

Характеристика пищевых добавок функционального назначения

Пищевые стабилизаторы – это специальные добавки, которые применяются для сохранения консистенции и поддержания однородности готового продукта. Их существует более тысяч, но самые распространенные это:

- агар-агар является природным полимером, который получают, как правило, из красных морских водорослей. По своей химической природе он представляет собой высокомолекулярное соединение, макромолекулы которого образованы из многих молекул полисахаридов, связанных между собой гликозидной связью. Помимо полисахаридов, которые составляют 70-80% его массы, природный агар содержит 10-20% воды, а также от 1,5 до 4% минеральных веществ. Характерной особенностью данного полимера, делающего его более предпочтительным по сравнению с другими природными полимерами, является образование им прочных (в механическом отношении) студней или пластичных гелей [1]. В пищевой промышленности (пищевая добавка E406) агар-агар применяют как загуститель при производстве супов, соусов, мороженого, мармелада, зефира, жевательных конфет, пастилы, начинок разного рода, суфле, диетических продуктов, шариков для жемчужного чая, джема, конфитюра и так далее; в авангардной кулинарии из него производят также лапшу;
- гуаровая камедь – пищевая добавка (E400-E499), используется в пищевой промышленности в качестве загустителя, способствующего повышению вязкости. Растворимость гуаровой камеди и плодов рожкового дерева значительно зависит от массовой доли галактозы в их химическом составе. Гуаровая камедь, имеющая более высокое содержание галактозы, почти полностью растворима как в холодной, так и в горячей воде [2]. Она хорошо растворяется в воде, эластичная и жесткая, выдерживает заморозку и разморозку. Используется для производства мороженого и десертов, которые подаются охлажденными;
- ксантановая камедь (E415) – внеклеточный полисахарид, продукт особого типа брожения [3]. Используют в выпечке – обеспечивает мягкость, внедрение и удержание воздуха, увеличивает выход мучных изделий;
- каррагинаны – сульфатированные гетерополисахариды красных водорослей, которые используются в пищевой промышленности в качестве загустителей и

эмульгаторов (E407) [4]. Их используют при производстве взбитых сливок, муссов, паст, жележных десертов. В качестве стабилизатора E407 применяется в изделиях из сдобного теста, мороженом, йогуртах;

- эмульгаторы – вещества, обеспечивающие создание эмульсий из несмешивающихся жидкостей. Их также большое количество, но самые часто используемые это соевый лецитин, яичный белок и желток, пектин и моноглицериды;
- соевый лецитин – натуральный эмульгатор, жидкость янтарного цвета, получают из соевого масла, эмульгатор в масловодяных смесях, используют в производстве шоколада и десертов с шоколадом, кондитерского жира;
- яичный белок и желток – компоненты, в основном, используемые для стабилизации структуры мучных кондитерских изделий;
- пектин (E440) – нерастворим в воде и очень хорошо образует гели, входит в состав структурных элементов клеточной ткани высших растений, по химической структуре представляют собой полисахарид гетерогенной природы, основным элементом которой является Д-галактуроновая кислота. Качественный и количественный состав пектина зависит от источника его получения, таких как, различные фрукты, овощи, корнеплоды, лекарственные растения [5]. Используется в желе, начинках, мармеладах, соусах и подобном;
- моноглицериды (E471) – состоят из одной жирной кислоты - масляной, каприловой, каприновой или лауриновой, связанной с одной молекулой глицерина, используются в жирных глазурах, кремах [7];
- антиоксиданты – вещества, которые обладают способностью вступать во взаимодействие с различными реактогенными окислителями, активными формами кислорода и приводить их к частичной или полной инактивации. Наиболее частыми в кондитерском производстве являются аскорбиновая кислота, лимонная кислота, яблочная кислота и цитрат натрия;
- аскорбиновая кислота – мощный антиоксидант и кофактор для нескольких важных реакций, препятствует окислению и изменению цвета изделий. Используется при изготовлении тортов, рулетов и бисквитов, фруктовых десертов и кремовых полуфабрикатов, конфет и шоколада с начинками;
- лимонная кислота – важное соединение, как в метаболизме живых организмов, так и в пищевой промышленности. Она является натуральной пищевой кислотой и активно используется как регулятор кислотности во всевозможных напитках и разнообразной продукции. Используют при производстве мучных кондитерских изделий, тортов, пирожных;
- яблочная кислота – усилитель кислинки, регулятор кислотности. Яблочная кислота служит, помимо прочего, консервантом и регулятором кислотности – популярная E296, добавляемая в консервы, джемы, мармелад, конфеты;
- цитрат натрия (E331) – это химическое соединение, которое выполняет несколько разных функций, но в кондитерских изделиях его используют в качестве буферной соли при производстве жележных конфет, мармелада, десертов на пектине [7].

Классификация подсластителей

Подсластители – вещества, используемые для придания сладкого вкуса. Подразделяются на интенсивные и сахарозаменители. Интенсивные подсластители – вещества несахарной природы, которые в десятки и сотни раз слаще сахара [6]. По природе различают натуральные и искусственные.

Среди натуральных наиболее известны солодка голая, стевия медовая, монеллин, тауматин, сладкие вещества из цитрусовых и осладин.

Среди синтетических сахарозаменителей наиболее известны сорбит, ксилит, маннит, мальтитол, сахарин, аспартам, сукралоза, фруктоза и глюкоза (Рис. 1).

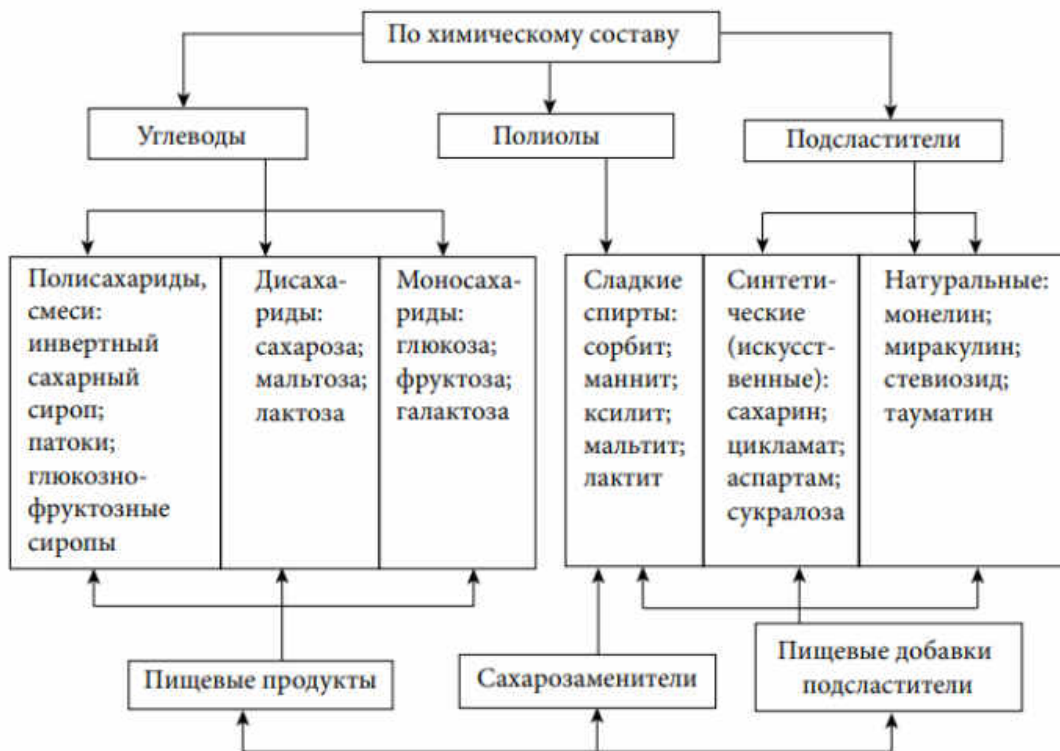


Рисунок 1. Классификация подсластителей

Характеристика сахарозаменителей

Солодка голая – это многолетнее травянистое растение семейства бобовых имеет народное название лакричник сладкий, или солодовый корень. Его использование насчитывает несколько тысяч лет. Лечебные свойства препаратов солодки определяются химическими веществами, входящими в ее состав, главное из которых — глицирризин (калиевая или натриевая соль глицирризиновой кислоты). За счет глицирризина солодка голая превосходит сахарозу в 50-100 раз. Экстракты и сиропы из солодки добавляют в шоколад, карамель и пастилу. Наиболее выгодно на практике использовать аммонийную и другие соли глицирризиновой кислоты, которые применяются в качестве подсластителей и ароматизаторов для усиления вкусоароматических характеристик халвы, мучных кондитерских изделий, мороженого.

Стевия медовая (*Stevia rebaudiana*) – растение семейства сложноцветных. Комплекс сладких веществ стевии состоит из восьми компонентов, различающихся между собой как по степени сладости, так и по количественному содержанию в листьях. Листья стевии содержат и другие сладкие гликозиды – ребаудиозиды (А, В, С, D и Е), дулиобиозид и стевииобиозид с различной степенью сладости (от 50 до 450) по отношению к сахарозе. Наиболее широкое распространение в качестве сахарозаменителя получил стевииозид, так как его содержание в растении более высокое.

Монеллин – молекула монеллина состоит из двух белковых субъединиц, каждая из которых в отдельности сладким вкусом не обладает. Это вещество не токсично и не устойчиво к термической обработке. Он в 2 тысячи раз слаще сахара.

Тауматин – белок со сладким вкусом. Сладость тауматинов в 1600 раз превышает сладкий вкус сахарозы. Отрицательным свойством тауматинов является их термолабильность. Применяется в йогуртах, жевательных резинках.

Аспартам – пептид наиболее распространен как метиловый эфир L-аспартил фенилаланина. По степени сладости аспартам превосходит сахарозу в 200 раз и не имеет

послевкусия. Аспартам усиливает сладкий вкус сахарозы, глюкозы, цикламатов и сахараина, снижая их дозу и подавляя неприятный привкус. В настоящее время аспартам является одним из наиболее часто употребляемых сахарозаменителей с приятным вкусом, который рекомендуется больным сахарным диабетом, беременным и кормящим женщинам, а также детям.

Сукралоза – в промышленных масштабах этот сахарозаменитель выпускается под названием «спленда». Он хорошо растворяется в воде, стабилен к температуре при изготовлении пищи и напитков. Он полностью безопасен и безвреден.

Сахарин - является наистарейшим синтетическим сахарозаменителем. Его сладость превышает таковую сахарозы в 300 раз, а сладкий вкус может ощущаться в разведении 1 части на 100 000. Сахарин может применяться только в диетическом питании.

Натуральные функциональные ингредиенты

Пивная дробина – отличается высоким содержанием клетчатки, минеральных веществ, витамина Е и витаминов группы В.

Порошок ягод – используется как источник биологически активных веществ, общеукрепляющее и способствующее нормализации обменных процессов.

Амарантовая мука – отличительная особенность амаранта – это отсутствие в его белке глютена. Обладает высокой питательной ценностью.

Использование функционального сырья в кондитерском производстве

- Для увеличения или снижения калорийности продуктов питания.
- Для улучшения органолептических качеств, придания дополнительных ноток вкусов, увеличения сладости.
- Для обогащения изделий витаминами, белками, жирами, углеводами и другими необходимыми микро- и макро- нутриентами.
- Для стабилизации структуры изделий, как пример придания пористости или плотной структуры.

Выводы

Функциональное сырьё является неотъемлемой частью кондитерского производства, но в настоящее время в нашей стране ассортимент кондитерских изделий специального назначения крайне ограничен.

Кондитерские изделия, как правило, не отвечают нормам здорового питания, поэтому необходимо разрабатывать новые технологии, находить новые источники биологически активных веществ для обогащения продуктов дополнительными микро- и макроэлементами, разрабатывать новые рецептуры, направленные на улучшение качества изделий.

Функциональные ингредиенты необходимо использовать, так как именно они позволяют добиться улучшения характеристик конечных кондитерских изделий таких как: структурная стабильность, текстура, срок годности, внешний вид, вкус и аромат. Помимо этого, они играют ключевую роль при создании изделий для диабетиков и людей с прочими генетическими заболеваниями.

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ИССЛЕДОВАНИЕ ПОПУЛЯРНЫХ СУПЕРФУДОВ: АНАЛИЗ ПИТАТЕЛЬНЫХ СВОЙСТВ И ИХ ВЛИЯНИЕ НА ЗДОРОВЬЕ

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Краткое содержание. Мир человека и здорового образа жизни постоянно меняется и развивается. Появляются новые тенденции гарантирующие более здоровый и сбалансированный образ жизни. В последние годы нутрициологи и диетологи отмечают широкую популярность в области здорового питания продуктов, богатых витаминами, минералами и антиоксидантами, которые были названы суперфудами. Были доказаны свойства этих продуктов оказывать глубокое влияние на физиологию человека, способность поддержания здоровья и профилактики заболеваний. Суперфуды -ценный ресурс для поддержания здоровья и благополучия, и их включение в рацион может способствовать достижению оптимального здоровья. Они оказывают положительное влияние на метаболизм человека, обладают способностью ускорять обмен веществ, снижать уровень воспалений и поддерживать оптимальный вес. Популярные суперфуды включают гранат, шпинат, ягоды годжи, голубику, морские водоросли, корень имбиря, брокколи, авокадо, чиа-семена и грецкие орехи. Их включение в рацион питания может помочь обеспечить организм необходимыми питательными веществами для поддержания здорового образа жизни. Многие суперфуды связаны с улучшением иммунной системы, снижением уровня холестерина, снижением риска сердечно-сосудистых заболеваний и даже предотвращением рака.

Ключевые слова: суперфуды, здоровое питание, антиоксиданты, витамины, минералы

Введение

Суперфуды представляют собой объект интереса как для научного мира, так и для широкой общественности. Эти продукты питания обладают выдающимися нутритивными свойствами, способными оказывать положительный эффект на здоровье человека. Наиболее важными биоактивными компонентами суперфудов для человека являются полиненасыщенные жирные кислоты (ω -3, ω -6), витамины, минералы, пробиотики, антиоксиданты, незаменимые аминокислоты, полисахариды и ферменты [1].

Эпидемическая вспышка множества дегенеративных заболеваний усилила необходимость поиска решений в естественной среде: все больше людей теперь обращаются к продуктам питания с высокой питательной ценностью, чтобы улучшить качество своей жизни и укрепить здоровье.

Список суперфудов непрерывно растет из года в год, а отслеживание ценных питательных веществ и понимание механизмов действия в человеческом организме активизировали научный интерес, способствуя все большему количеству научных исследований. В частности, наиболее важными суперфудами, согласно данным, полученным в результате ряда исследований, являются следующие:

- Фрукты, ягоды: гранат, ягоды, черника, малина,
- Клубника, ягоды годжи, виноград, ягоды асаи
- Орехи: грецкие орехи, миндаль
- Бобовые: красная фасоль, какао
- Овощи: брокколи, шпинат, батат.

- Водоросли: спирулина, хлорелла.
- Травы: имбирь, гинкго билоба, чай.
- Продукты пчеловодства: мед, воск [1].

В данной статье будут рассмотрены не только биологические характеристики суперфудов, но и их потенциальные медицинские применения и влияние на организм человека в контексте современных научных исследований.

Голубика (*Vaccinium Myrtillus*)

Все больше исследований подчеркивают ценный вклад голубики в укрепление здоровья, главным образом из-за содержания полифенолов и антоцианов. Было доказано, что употребление 150 г голубики в неделю может способствовать снижению уровня артериального давления [1, 2]. Ряд других исследований показал потенциальное влияние голубики на профилактику различных видов рака, таких как рак толстой кишки, благодаря наличию фенольных соединений, дубильных веществ, флавонов [2].

Голубику можно включать в сбалансированный рацион из-за ее низкого гликемического индекса, который может регулировать уровень сахара в крови, особенно у людей, страдающих диабетом II типа, снижать резистентность к инсулину и положительно действовать на людей с ожирением и метаболическим синдромом [1, 2].

Краткое изложение некоторых преимуществ голубики для здоровья представлено в Таблице 1.

Таблица 1

Преимущества голубики для здоровья

Польза для здоровья	Соединения, ответственные за пользу
перебражная функция и снижение нейродегенеративных заболеваний и артериального давления	полифенолы и особенно антоцианы
профилактика различных видов рака	фенольные соединения, дубильные вещества, флавоны, флавоноиды кемпферол и лютеолин
запор и диарея	Пищевые волокна
защита от вируса гепатита С и профилактика инфекций мочевыводящих путей	проантоцианидины

Ягоды Годжи (*Lycium barbarum*)

Ягоды Годжи являются одним из самых богатых природных источников таких питательных веществ как β -каротин, витамины С, Е, В1 и В2, минералы, антиоксиданты и аминокислоты [1, 3].

Наиболее важным действием является сильная антиоксидантная защита от свободных радикалов, присутствующих в организме человека. Это приводит к предотвращению таких заболеваний, как сердечно-сосудистые заболевания и диабет и укреплению иммунной системы [3].

Годжи способствуют улучшению зрения благодаря высокому содержанию антиоксидантов, включая такие соединения, как зеаксантин, лютеин, полисахариды и полифенольные соединения [4]. Краткое описание пользы для здоровья ягод Годжи представлено в Таблице 2.

Таблица 2

Преимущества ягод Годжи для здоровья

Польза для здоровья	Соединения, ответственные за пользу
Профилактика сердечно-сосудистых заболеваний и диабета	Полисахариды в виде гликозидов, германия и различных антиоксидантных веществ.
Уменьшение воспаления и закупорки кровеносных сосудов.	Антиоксиданты, такие как фенольные соединения
Профилактика рака желудка	Бета-ситостерин
Улучшить зрение	Зеаксантин, лютеин, полисахариды и полифенольные соединения.

Корень имбиря (*Zingiber officinale*)

Имбирь родом из Южной Азии, и сейчас его выращивание распространилось почти во все тропические страны. В основном он состоит из воды (80%), при этом содержит в достаточном количестве калий, цинк и полифенолы. Пищевая ценность имбиря на 100 г составляет: 0,4 г жиров, 18 г углеводов, 2 г клетчатки, 2 г белка, 43 мг магния, 2 мг меди, 415 мг калия, 34 мг фосфора, 16 мг кальция, 13 мг натрия, витамин С 5 мг, фолат 11 мкг [1].

Экстракт имбиря, являясь сильным антиоксидантом, может устранить расстройства, вызванные окислительным стрессом [5]. Исследования показали, что существующие фенольные соединения и антоцианы обладают нейрозащитными эффектами, такими как обезболивающее действие, улучшение памяти и способность к обучению, вызванные процессом старения [1, 5]. Основная биологическая активность и польза для здоровья от употребления корня имбиря представлена ниже в Таблице 3.

Таблица 3

Преимущества корня имбиря для здоровья

Польза для здоровья	Соединения, ответственные за пользу
Профилактика сердечно-сосудистых заболеваний	полифенолы
Пищеварение	Неорганические соединения
Антимикробная и противовоспалительная активность	Витамин С, калий, цинк и полифенолы

Брокколи (*Brassica oleracea*)

Брокколи обладает ярко выраженным антиканцерогенным эффектом. Продукты распада глюкозинолатов, таких как сульфорафан, могут влиять на инициацию и прогрессирование рака [6]. Брокколи на сегодняшний день является лучшим источником сульфорафана. Одна порция может содержать, в зависимости от сезона, сорта и свежести, до 60 мг этого вещества.

Однако, недавние исследования предполагают, что потеря глюкозинолатов составляет более 50% после 10 минутного кипячения капусты [6]. В связи с этим можно сделать вывод, что максимальную пользу в борьбе с раковыми клетками брокколи имеет в своем сыром виде.

Влияние суперфудов на пищеварение

Высокое содержание растворимых и нерастворимых волокон способствует нормализации кишечной микрофлоры, улучшает перистальтику и предотвращает запоры. Ферменты в суперфудах, такие как папаин в папайе или бромелайн в ананасе, могут улучшать расщепление пищи, облегчая процесс пищеварения. Антиинфламаторные свойства некоторых суперфудов также могут снижать воспаление в ЖКТ, создавая более благоприятное окружение для пищеварения [1, 7].

Влияние суперфудов на мозг и нервную систему

Интеграция суперфудов в рацион может быть полезным шагом для поддержания когнитивного здоровья на протяжении всей жизни. Полифенолы улучшают кровообращения в мозге, защищают нейроны от воспалений, что способствует сохранению когнитивных функций. Омега-3 кислоты улучшают когнитивные функции, поддерживает здоровья мозга, особенно в области памяти и концентрации. Витамины группы В участвуют в синтезе нейротрансмиттеров, повышение энергии и поддержание нервной системы. Антиоксиданты защищают мозга от окислительного стресса, что связано с снижением риска нейродегенеративных заболеваний [7].

Выводы

В данной статье были проанализированы такие суперфуды, как голубика, ягоды Годжи, корень имбиря и брокколи. А также был проведен анализ влияния суперфудов на различные системы организма: пищеварительная система, нервная система и уровень холестерина.

Включение суперфудов в ежедневный рацион может способствовать снижению риска различных дегенеративных заболеваний, таких как сердечно-сосудистые заболевания, диабет, метаболический синдром, ожирение, неврологические заболевания и рак.

Однако, независимо от каких-либо признанных и научно подтвержденных преимуществ суперфудов для здоровья, следует отметить, что программа питания не должна основываться исключительно на присутствии суперфудов, но они должны быть частью здорового и сбалансированного рациона.

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НУТРИЦЕВТИКИ ДЛЯ СПОРТСМЕНОВ, КОТОРЫЕ ЗАНИМАЮТСЯ ОПРЕДЕЛЁННЫМ ВИДОМ СПОРТА

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Краткое содержание. Питание спортсменов отличается от питания других людей. Ни для кого не секрет, что спортсмены расходуют намного больше энергии. В результате проделанных исследований и анализов было установлено, что их рацион должен состоять из оптимально подобранного соотношения белков, жиров и углеводов. В его основе лежат элементы здорового питания, к которым добавляется профицит калорий, определенное соблюдение ритма подачи блюд в зависимости от их состава, времени, ритма тренировок или же спортивных соревнований. Также было отмечено, что спортсменам требуются нутрицевтики и различные добавки для поддержания баланса организма. В работе представлены правила питания до и после тренировок, до, после и вовремя соревнований, чтобы спортсмен всегда был в форме и имел необходимое количество калорий. Было подчеркнуто что активные виды спорта такие как: волейбол, теннис требуют быстрого движения и быстрого рывка в течение длительного времени. Спортсменам, занимающимся такими видами спорта, требуется определенное количество витаминов и минералов, а также других полезных питательных веществ, из которых организм получает энергию для жизнедеятельности.

Ключевые слова: спорт, нутрицевтики, спортивное питание, теннис, волейбол

Введение

В наше время люди стали пересматривать свое отношение к жизни, к своему здоровью. Ищут множество вариантов и решений, чтобы сделать свою жизнь здоровой, отгородить себя от недугов и различных заболеваний. Один из самых актуальных способов в наше время, на которое люди стали обращать внимание – спорт. Когда как ни сейчас, он стал наиболее актуальным и популярным, что люди вносят в свой распорядок дня спорт как основной аспект своей рутины, не забывая при этом о питании конечно же.

Существует очень много направлений спорта, которые в наше время набирают популярность и у людей появляется заинтересованность узнать что это такое и попробовать. В наше время все больше и больше набирает популярность такие виды как: йога, пилатес, фитнес, теннис, баскетбол, волейбол и другие.

В наше время профессиональные спортсмены уделяют очень много времени тренировкам. Они тратят много усилий для достижения результатов, для того чтобы каждый день, каждую тренировку усовершенствовать свои навыки, свои силы и уметь составлять конкуренцию остальным спортсменам. Каждый тренер заинтересован в том, чтобы его спортсмены были лучшие, поэтому каждая тренировка разнообразна, нет повторяющихся элементов и все силы идут на то, чтобы сделать спортсмена сильнее, быстрее, выносливее, координальнее. Упор идет не только на тренировки, но также тренер обязан уделять огромное внимание тому как спортсмен питается, соблюдает ли он режим и получает ли организм энергию из нужных источников пищи [1, 2].

Питание играет важную роль в состоянии организма каждого человека и спортсмена в том числе. Именно поэтому наряду с составлением плана и режима питания спортсмена, тренер прописывает определённые добавки в виде различных нутрицевтиков. Нутрицевтики – вид биологически активных добавок, помогающих скорректировать химический состав пищи и обеспечить нас необходимым количеством макро- и микроэлементов каждый день. Некоторые питательные вещества наш организм не может самостоятельно восполнять даже благодаря правильному и сбалансированному питанию. Даже стараться следить за качеством продуктов, очень часто наш пищеварительный тракт страдает от того, что еда содержит переизбыток сахара и жиров. Это утомляет и перегружает пищеварительную систему. Также еще одной причиной неправильного питания является чрезмерная термическая и химическая обработка продуктов, которая лишает их важных витаминов и микроэлементов [3].

Перечень веществ необходимых для здоровья нашего организма давно известен – аминокислоты, минералы, витамины, и жирные кислоты, именно они получили общее наименование – нутрицевтики, которые играют важную роль в поддержании и укреплении здоровья человека. К нутрицевтикам относят витамины и витаминopodobные средства — предшественники витаминов, аминокислот, макро и микроэлементов, полиненасыщенных жирных кислот, углеводов (моносахаридов и дисахаридов), клетчатки, некоторые ферментов.

Нутрицевтики разделяют на два вида происхождения: растительного (витамины С (или же аскорбиновая кислота) – необходим человеку для поддержания жизнедеятельности; витамин Р (бифлавоноид) – важен для укрепления капилляров и поддержания эластичности сосудов, предотвращая кровотечения + для поддержания нормального давления крови; каротиноиды) и животного (жирорастворимые витамины А – для нормального зрения, роста костей, функционирования иммунной и репродуктивной системы; Е – разрушает свободные радикалы и защищает клетки от окислительного стресса; D – снижает риск возникновения различных заболеваний и другие). Они выполняют множество функций такие как: покрывают быстро и легко недостаток жизненно необходимых пищевых веществ; обладают иммуномодулирующими свойствами, усиливают выведение из организма токсичных и чужеродных веществ (радионуклидов, различных тяжелых металлов); направленно изменяют обмен веществ в организме, чтобы максимально удовлетворить потребности в пищевых веществах у человека с наличием заболеваний и другие.

Ни для кого не секрет, что тренировки - физический стресс для организма. Они стимулируют мышцы, сердечно-сосудистую и другие системы организма, чтобы адаптироваться и стать сильнее. В ответ на физическую нагрузку организм нуждается в дополнительных ресурсах, чтобы поддерживать тренировочный процесс и восстановление. Недостаток необходимых питательных веществ может повлиять на результаты тренировок и общее самочувствие. Поэтому тренер в определённый период времени назначает некоторые нутрицевтики, которые благоприятно влияют на организм спортсмена. Например, глюкозамин – способствует поддержанию хрящевой ткани, делая суставы упругими и гибкими; хондроитин – поддерживает эластичность и мобильность связок, что является важной частью здоровой физической активности; метилсульфонилметан – помогает улучшить общее состояние суставов, поддерживая их подвижность; L-Лизин – играет важную роль в росте мышц и поддержании иммунитета, обеспечивая защиту организма в период тренировок и многие другие.

Полноценное, сбалансированное питание - это ключ к спортивному росту и новым достижениям, кроме того, от питания зависит качество восстановления спортсмена, а также сбалансированный рацион предотвращает развитие многих заболеваний связанных с истощением организма во время чрезмерных нагрузок. Основные требования к питанию спортсмена:

1. *Качественный и количественный состав пищи*
2. *Коэффициент усвоения пищи*
3. *Режим приёма пищи*

Качественный прием пищи – подбирается индивидуально для в зависимости от физических характеристик спортсмена, вида спорта и уровня физических нагрузок. Пища должна содержать все необходимые макро- (белки, жиры, углеводы) и микронутриенты (витамины и минеральные вещества). «общий» рацион спортсменов должен приближаться к такой формуле: белки - 25-30%: жиры - 10-15%: углеводы 55-60%. Рацион спортсменов должен содержать не менее 60% белков животного происхождения и 40% растительных белков, при этом во время тренировок направленных на увеличение силы и скорости спортсмена, количество животных белков можно увеличить до 80%.

Растительные жиры содержат большее количество ненасыщенных жирных кислот, чем животные и потому усваиваются намного легче. Кроме того, животные жиры богаты витамином А, тогда как растительные жиры содержат преимущественно витамин Е.

Углеводы - являются основой энергетического метаболизма организма человека. Углеводы расходуются во время быстрых интенсивных движений или при недостатке кислорода в мышцах.

Рекомендуемая норма белка в рационе: 0.8 – 1 г – взрослый человек для поддержания жизнедеятельности; **2-3 г** на 1 кг массы тела – дети дошкольного возраста; **1,5 – 2 г** – подростки; **1,3 – 1,8 г** – виды спорта на выносливость; 2 г белка при интенсивных тренировках; **3 г** для силовых тренировок

Рекомендуемая норма углеводов в рационе: 3-5 г на 1 кг массы тела – для взрослого человека; **5-8 г** на 1 кг массы тела – для спортсменов; **7 г** – для скоростно-силовых видов; **10 г** при развитии общей выносливости

Рекомендуемая норма жиров в рационе: 1,5 г на 1 кг массы тела

Углеводы - являются основой энергетического метаболизма организма человека. Углеводы расходуются во время быстрых интенсивных движений или при недостатке кислорода в мышцах. Основы рациона: Необходимо употреблять не менее 1,5 л в день. На втором месте овощи и фрукты - они богаты витаминами, минералами и клетчаткой. На третьем месте цельнозерновой хлеб, крупы, картофель, макаронные изделия твердых сортов. На четвертом мясо, птица, рыба - богаты белком, железом, цинком и витаминами группы В. А также на этой ступени молочные продукты, они содержат кальций, белок и витамины. На заключительной ступени находятся сладости и жиры - при умеренном употреблении могут стать частью здоровой и сбалансированной диеты.

В качестве примера мы хотим привести два вида спорта, которые в наше время набирают популярность и люди все чаще и чаще приходят смотреть, поболеть за любимых игроков. Первый вид спорта, про который хочется рассказать и описать все принципы питания – теннис. Теннис – быстро развивающийся вид спорта, в котором чередуются периоды высокой и низкой интенсивности, и для которого характерны повторяющиеся спринты. Каждая игра может длиться более часа, а иногда и более 5 часов. Теннис требует разнообразных навыков, большой силы и энергозатрат. Энергия, необходимая теннисисту, может значительно варьироваться в зависимости от множества факторов, таких как тип корта, стиль игры, продолжительность розыгрыша, температура и влажность окружающей среды.

Диета теннисиста – баланс углеводов, жиров, белков, гидратации, витаминов и минералов. Теннис полагается на гликоген, энергетическую форму, которая легко доступна для мышечных клеток. Однако гликоген может закончиться довольно быстро, поэтому необходимо пополнять запасы углеводов во время игры, особенно если матч длится долго. Исследования показывают, что теннисист должен получать около 30% своих ежедневных калорий из жиров, что составляет примерно **1-1,5 г/кг веса тела в день**. Углеводы являются пополнением запасов в организме. Наука предполагает, что когда запасы гликогена истощаются во время теннисного матча, уровень глюкозы в крови падает и ограничивает результативность на корте. Это может быть одной из самых распространённых причин снижения спортивных результатов. Если спортсмен тренируется интенсивно около 4-6 часов в день, то ему нужно получать около **6-10 г/кг углеводов в день**. Тоже самое касается и соревнований, если тренировка в обычном режиме, то можно снизить потребление до **5-7 г/кг в день**.

Протеин – наращивание мышц: для достижения наилучших результатов нужно уделять особое внимание качеству и типу получаемого белка и стараться по возможности сочетать его с другими питательными веществами.

Ключевые витамины и минералы:

- Мультивитамины;
- Железо - является ключевым минералом, поскольку оно используется для переноса кислорода в красных кровяных тельцах;
- Кальций - играет множество ролей в организме, от поддержания здоровья костей до помощи мышцам в сокращении;
- Калий - помогает регулировать водный баланс, пищеварение и нервную систему.

Среди **нутрицевтиков**, которые принимают теннисисты можно отметить:

Кофеин, стимулятор, помогает чувствовать себя менее уставшим во время игры и поддерживать постоянную скорость подачи. Рекомендованная доза: не больше 9 мг/день

Креатин – используется для наращивания мышц и улучшения спортивных результатов

Цитруллин – влияет на аэробную выносливость, что означает, что вы лучше и дольше тренируетесь на выносливость (бег, плавание и т.д) за счёт улучшения кровотока, который доставляет кислород к работающим мышцам

В качестве второго примера, мы хотим рассказать про волейбол. В последнее время волейбол набирает все больше и больше популярность, люди приходят посмотреть на захватывающий матч и поболеть за любимых игроков. Волейбол - это вид спорта, требующий быстрой реакции, концентрации, занимающий второе место в мире по популярности, после футбола. Этот спорт очень полезен для физического и умственного развития ребенка и замечательно занимает его свободное время после школы. Каждый спортсмен в начале своей карьеры безусловно задумывался о том какие продукты нужно кушать, чтобы всегда восполнять энергию после интенсивных тренировок и длительных, тяжёлых игр. Во время игры волейболисты должны делать взрывные движения, прыгать вверх, блокировать и наносить удары.

Поэтому в диету волейболистов должны входить продукты, которые их насыщают. Продукты, богатые углеводами, жирами и белками, должны составлять часть диеты волейболиста. Каждый тренер всегда думает о том, чтобы его спортсмены всегда были в строю, не было травм и каждая игра была результативной. Именно поэтому тренер на определённый период времени даёт своим спортсменам некоторые виды нутрицевтиков:

Хондропротекторы — позволяют укрепить хрящи и соединительные ткани

Креатин — даёт прибавку в силе и скорости

Аминокислоты — ускоряют процесс восстановления

L-карнитин — будьте осторожны с жиросжигателями и помните, что они работают только при аэробных нагрузках. Важно знать процент жира в организме.

Кардиопротекторы — самые простые: рибоксин, магнерот, аспаркам, панангин, милдронат. Сердцу обязательно нужно питание, магний, калий. Кроме того, избавит спортсмена от мышечных судорог.

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ВЛИЯНИЕ ПИТАНИЯ НА КАНЦЕРОПРЕВЕНЦИЮ И ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ЛЕЧЕНИЯ ОНКОЗАБОЛЕВАНИЙ

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***Аннотация.** В статье проводится комплексный анализ взаимосвязи между питанием и онкологическими заболеваниями, подчеркивая, что в процессах профилактики, развития и лечения рака сбалансированный рацион может сыграть решающую роль. Отмечается, что рак возникает из-за сочетания множества факторов на геном и метаболические процессы, и разбалансированное питание может стать одной из предпосылок развития хронических воспалений и образования опухолей. В последние годы накоплено значительное количество исследований, подтверждающих влияние алиментарных факторов не только на канцерогенез, но и профилактику и лечение рака, помогая улучшить качество жизни онкопациентов. В статье систематизированы современные знания о витаминах, минералах, макро- и микронутриентах, оценен их потенциал в онкопрофилактике и терапии онкологических заболеваний. Обосновано тесное взаимодействие нутрициологов и врачей в рамках комплексной реабилитации онкобольных. Отмечены основные цели работы нутрициолога с онкоклиентом – это полноценное обеспечение организма пластическим материалом (белками, жирами и углеводами), энергией и необходимыми веществами, которые обладают биологической (витамины, микроэлементы, антиоксиданты) и фармакологической активностью (биофлавоноиды, природные антибиотики). Особое внимание уделено оценке нутрицевтического статуса клиента, поэтому нутрициолог должен в первую очередь учитывать такие факторы, как индивидуальные особенности клиента, сложность изменения его пищевых привычек, а также недостаток информации о биохимических аспектах питания и его влиянии на организм. Рекомендации, данные в статье, могут быть использованы нутрициологами для разработки индивидуальных профилактических и поддерживающих программ для своих клиентов.*

***Ключевые слова:** онкопрофилактика, канцеропревенция, питание и рак, витамины и рак, качество жизни, диетотерапия при онкологии*

Введение

Слово «онкология» у любого вызывает страх гораздо больший, чем инсульты, инфаркты, потому что в понимании людей это НЕЧТО поселяется в человеческом теле, являясь в общем-то его частью, и начинает его разрушать.

Онкологические заболевания – это группа многофакторных заболеваний, вызванных комплексом генетических и эпигенетических изменений, характеризующихся неконтролируемым ростом и размножением раковых клеток [1].

К сожалению, онкологические заболевания продолжают оставаться одной из ведущих причин смертности во всем мире в составе триады болезней цивилизации.

Роль нутрициолога в работе с онкобольными и клиентами с онконастороженностью

В медицине, к сожалению, профилактические подходы к онкологическим заболеваниям не всегда оказываются приемлемыми для практикующих врачей. Ситуация осложняется тем, что онкологические проблемы часто носят актуальный характер, требуя немедленного реагирования [2].

И задача нутрициолога в том, что занимаясь превенцией, не допустить самого по себе любого заболевания с помощью питания, изменения образа жизни клиента.

Здоровое питание может снизить риск развития рака, а также улучшить прогноз у пациентов, уже страдающих этим заболеванием.

Еще 30-40 лет назад средний возраст первого диагностирования онкологического заболевания был 60-70 лет, то с каждым годом заболевание молодеет, часто унося жизни в том числе из-за неправильного выхаживания онкобольных, неразумного и бездумного питания, из-за угнетенного психоэмоционального состояния, из-за состояния гиподинамии.

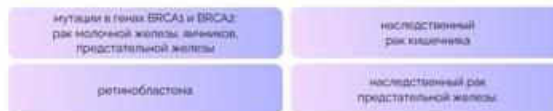
Раковые клетки, которые возникают в результате мутаций ДНК, вызванных вирусами, химическими веществами, канцерогенами в пище и воздухе, ультрафиолетовым излучением, употреблением лекарственных препаратов, особенно в высоких дозах или при длительном приеме и которые не удается вовремя вывести, чрезмерного уровня свободных радикалов (побочных продуктов метаболизма), приводят к повреждению генетического материала клетки [3].

ФАКТОРЫ РИСКА ЗЛОКАЧЕСТВЕННЫХ ЗАБОЛЕВАНИЙ И МЕХАНИЗМЫ ИХ РЕАЛИЗАЦИИ

1. Загрязнение окружающей среды



2. Наследственность



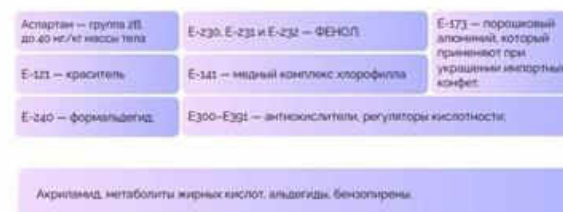
3. Инфекции



4. Возраст

5. Стресс

7. Е-шки



6. Питание и образ жизни

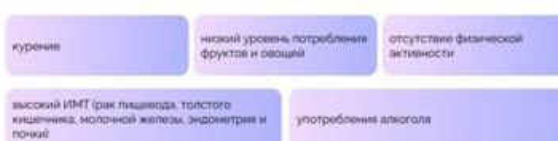


Рисунок 1. Факторы риска возникновения злокачественных заболеваний

То, что касается иммуносупрессии, как и канцерогены - все факторы окружающей среды, воздействие которых на организм человека будет вызывать образование злокачественных опухолей. Они могут быть химические, физические и биологические [3].

Самыми определяющими из основных факторов развития рака — это хроническое воспаление, это нарушение гормонального статуса и это питание. И самое главное – это то, что мы на них можем влиять, изменяя их с позиции превентивного подхода, особенно при первичной профилактике.

Изменяя эти факторы, мы начинаем с позиции превентивного подхода к профилактике, и самое главное - к первичной профилактике любого заболевания. Изначально первичная профилактика (здоровый сон, правильное питание, физические

нагрузки) – как раз компетенция нутрициологов. Нутрициологи обрабатывают то, что не успевают врачи. И по всем клиническим исследованиям с позиции онкологии первичная профилактика показывает самый большой процент улучшения результатов.

ПОКАЗАНИЯ К НУТРИТИВНОЙ ПОДДЕРЖКЕ

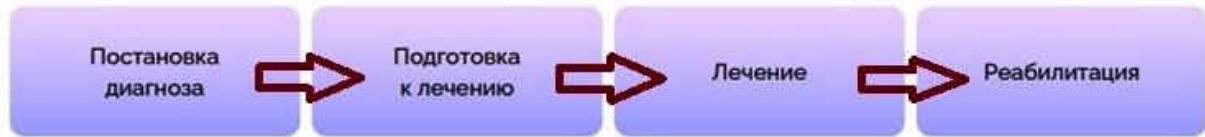


Рисунок 2. Показания к работе нутрициолога в нутритивной поддержке онкоклиента

Влияние питания на канцерогенез

Глюкоза и жирные кислоты – это основные источники энергии для клеток организма. При сжигании глюкозы и жирных кислот в клетках образуются свободные радикалы – мутагены, нестабильные молекулы, которые приводят к накоплению мутаций в митохондриальной и ядерной ДНК, что приводит к онкологическому перерождению клеток.

В норме клетки используют электронно-транспортную цепь (ЭТЦ) для выработки энергии в виде АТФ. Эта энергия высвобождается при окислении жирных кислот, а электроны по цепочке переходят от молекулы к молекуле, пока не соединятся с кислородом, образуя воду. Однако при избыточном количестве электронов в ЭТЦ (например, при обильном питании, где есть большое количество источников энергии) не все электроны успевают соединиться с кислородом. Вместо этого они могут присоединяться к другим молекулам, образуя перекись водорода, которая в присутствии меди, цинка и железа, может катализировать образование свободных радикалов, например, гидроксилрадикалов, высокореактивных молекул, способных атаковать ДНК, вызывая спонтанные мутации и повреждения в генетической информации [4].

И влияние таких факторов как инсулин и инсулиноподобный фактор роста (IGF-1) - гормонов, которые играют важную роль в регуляции роста и метаболизма клеток, и которые вырабатываются в ответ на прием пищи, особенно если человек употребляет пищу в больших количествах, без остановки, без промежутков между приемами – и это тоже способствует развитию онкологических заболеваний. IGF-1 усиливает деление клеток, что может привести к неконтролируемому росту и образованию опухолей, снижает способность клеток к восстановлению повреждений ДНК, блокирует запрограммированную клеточную смерть (апоптоз), что позволяет необратимо мутировавшим клеткам выживать и накапливаться.

Влияние питания на развитие и прогрессирование онкозаболеваний неоспоримо. Например, избыточное потребление глюкозы, особенно в сочетании с насыщенными жирами и белками, может стимулировать рост и метастазирование уже имеющихся онкологических клеток - раковые клетки активно потребляют глюкозу, вырабатывая энергию для быстрого деления и метастазирования.

В свою очередь насыщенные жиры могут стимулировать выработку воспалительных молекул, которые также создают благоприятную среду для роста и метастазирования раковых клеток.

А белки обеспечивают раковые клетки аминокислотами, которые необходимы для построения новых белков и клеточных мембран. И их чрезмерное потребление тоже может ускорить рост и метастазирование раковых клеток.

Некоторые гормоны, такие как инсулин, тестостерон, эстроген, лептин и IGF-1 возвращают цитокины, которые стимулируют пролиферацию (деление) клеток – как здоровых, так и раковых клеток. Хронически высокий уровень этих гормонов может

создавать воспалительную среду в организме и частично подавляет иммунные клетки, которые отвечают за распознавание и уничтожение раковых клеток.

Митохондрии (энергетические станции клетки) играют важную роль в регуляции апоптоза (запрограммированной клеточной смерти). Чрезмерное поступление питательных веществ, особенно глюкозы и аминокислот, приводит к закислению митохондриальной среды, что нарушает работу ферментов, участвующих в выработке энергии и апоптозе, блокируя их способность к обезвреживанию раковых клеток, стимулирует образование активных форм кислорода (ROS), которые повреждают ДНК и белки в митохондриях, что еще больше нарушает их работу [5].

Потребленные с пищей лишние калории депонируются в жировую ткань, которая помимо хранения энергии, синтезирует адипокины, (гормоны), стимулирующие системное воспаление, нарушающие чувствительность к инсулину.

И чтобы преодолеть инсулинорезистентность, β -клетки поджелудочной железы начинают синтезировать больше инсулина. Инсулин, регулируя уровень глюкозы, влияет на канцерогенез, стимулируя деление клеток, подавляя репарацию ДНК и снижая активность антиоксидантных систем [5].

Высокий уровень инсулина (гиперинсулинемия) увеличивает биодоступность:

- тестостерона (связывает его с белками, транспортирующими его в крови, стимулируя рост некоторых видов рака - простаты и молочной железы),
- эстрадиола (синтезирует его выработку в жировой ткани, стимулируя рост некоторых видов рака - молочной железы и эндометрия),
- IGF-1 в печени, которые являются факторами роста и способствуют развитию онкологических заболеваний.

Питания при онкозаболеваниях и в условиях онконастороженности

Мы то, что мы едим. Первичная профилактика – это в первую очередь питание. И это вопрос превентивных подходов.

Когда есть рак – его нужно лечить. И все дополнительные профилактические средства рекомендуются нутрициологами не для излечения, а для улучшения результатов течения самого по себе злокачественного процесса, для удлинения периодов выживаемости пациентов, для снижения рисков метастазирования, для улучшения качества жизни.

Одна из основных задач нутрициолога - помочь клиенту в самочувствии, в ощущениях, улучшить его состояние, но вылечить питанием или голоданием, невозможно.

Нет ни одного протокола питания, который бы на 100% излечивал бы от рака или предотвратил бы его рецидивы. Все протоколы питания непосредственно снижают только процентное содержание фактов обнаружения рака [7].

Рекомендуется отказаться от всех форм диет, которые не основаны на клинических данных, не имеют доказанной эффективности и потенциально могут быть вредить здоровью!

Большому проценту клиентов нужен щадящий мягкий средиземноморский режим питания.

Можно под клиента модифицировать LCHF протокол, где в рационе минимум «быстрых» углеводов, больше жиров.

Интервальное питание (IF 16/8 или 14/10) может быть применимо в период реабилитации.

При разработке индивидуальных планов питания с учетом видов рака, этапов лечения и потребностей человека, нутрициолог должен учитывать массу особенностей. Но важным остается принцип не рекомендовать диетические продукты, которые ограничивают энергию - этой категории клиентов это очень важно.

Нужно увеличивать количество приемов пищи, потому что они ослаблены – это может быть и 5, и 6 раз, причем высококалорийным питанием.

Клиентам с прогрессирующим раком или проходящим химиотерапию - а это вообще отдельная категория клиентов, необходимо использовать добавки с омега-3 жирными кислотами не только для восстановления клеточной стенки, но в первую очередь для стабилизации и улучшения аппетита, увеличения мышечной массы. И это тоже нюансы питания этой группы клиентов [8].

Чем здоровее будет питание, чем меньше будет индустриально переработанных продуктов, тем ниже будет риск низкоуровневого воспаления и соответственно риск самого по себе онкологического процесса.

Сейчас демонизируют углеводы, до последнего времени это были жиры и белки. Но исследования говорят, что все клетки тела для своего функционирования используют глюкозу. Отказ от всех углеводных продуктов лишит здоровые клетки энергии, необходимой для восстановления.

И эту энергию организм будет получать их из белков, то есть забирать у мышц, здесь важно смотреть на клиента с позиции мышечной массы, чтобы не допустить кахексию (то есть крайнее истощение организма).

Поэтому онкологическим пациентам белка как это не странно нужно больше, хотя сейчас говорят о том, что белок им вообще не нужен, от него якобы начинают расти раковые клетки.

Принципы составления индивидуальной программы питания онкоклиента

Регулярно оценивать потребление питательных веществ, изменение веса и индекса массы тела (ИМТ), начиная с постановки онкодиагноза.

Общий расход энергии онкологических больных должен быть таким же, как и у здоровых людей, от 25 до 30 ккал/кг/день. Потребление белка должно быть выше - 1 г/кг/день и, по возможности, до 1.5 г/кг/день.

Витамины и минералы должны поступать примерно в рекомендуемой суточной норме. Но рекомендуется использовать высокие дозы микроэлементов при отсутствии специфических недостатков [9].

У худеющих онкологических больных с инсулинорезистентностью рекомендовано увеличить соотношение энергии из жиров и углеводов.

Парафармацевтики и натуропатия

Нутрицевтики, функциональные продукты и пищевые добавки могут снижать рост раковых клеток, ингибировать пролиферацию клеток и вызывать апоптоз раковых клеток.

они позволяют снизить прогрессию заболевания, если у клиента обнаружен онкологический процесс. Или снизить то самое низкоуровневое воспаление в качестве превентивного подхода для того, чтобы не допустить само по себе это онкологическое заболевание [10].

- *Куркума* ингибирует пролиферацию миграции и экспрессии ДНК-репарационных белков.
- *Черный тмин* может способствовать апоптозу (программируемой гибели) раковых клеток, а его антиоксиданты защищают клетки от повреждений свободными радикалами.
- *Ресвератрол* - полифенол, содержащийся в кожуре винограда - способствует уничтожению раковых клеток и предотвращению их размножения.
- *Омега-3 жирные кислоты* – имеют потенциальный эффект в снижении риска некоторых видов рака.
- *Витамин D* – его дефицит связан с повышенным риском развития некоторых видов рака.
- *Берберин* оказывает противоопухолевое действие на рак молочной железы, мочевого пузыря, печени, толстой кишки.

- *Имбирь* обладает противовоспалительными свойствами и может помочь в уменьшении тошноты, вызванной химиотерапией.

Принципы составления индивидуальной программы реабилитации онкоклиента

Рекомендовано поддерживать или повышать уровень физической активности у онкологических больных для поддержания мышечной массы, физической функции и метаболического паттерна [11].

Физическая активность хорошо переносится и безопасна на разных стадиях рака, а также пациенты с поздними стадиями заболевания могут и хотят заниматься физической активностью.

Должна состоять из контролируемых или домашних тренировок умеренной интенсивности (50-75% от исходной максимальной частоты сердечных сокращений или аэробной мощности), трех тренировок в неделю по 10-60 минут за тренировку.

Выводы

Если говорить о превентивных подходах в работе нутрициолога, чтобы не допустить онкозаболевание, необходимо работать в двух направлениях: со скоплением клеток с мутациями и с клетками в дисплазии.

Как только возникла раковая клетка, превентивные подходы для излечения от рака уже не подходят; здесь превентивные подходы применяются для улучшения самочувствия пациента, но обратного развития, когда раковая клетка уже сформировалась в опухоль, уже невозможно.

Но если есть дисплазия или есть изменения генетической информации, но при этом не возникла ещё сама по себе опухоль, то есть на самых начальных этапах, то задача коллаборации врача и нутрициолога в том, чтобы отработать изменение микроокружения, восстановить дефициты, восстановить нормальный уровень гормонов, снизить хроническое воспаление, для того чтобы не допустить раковое заболевание.

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ПОВЫШЕНИЕ МИКРОБИОЛОГИЧЕСКОЙ СТАБИЛЬНОСТИ КОНСЕРВОВ РАСТИТЕЛЬНОГО И ЖИВОТНОГО ПРОИСХОЖДЕНИЯ

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Резюме: Данная работа посвящена изучению методов повышения микробиологической стабильности мясных и рыбных консервов с акцентом на сокращение применения потенциально вредных химических веществ. В последние годы научные исследования в этой области фокусируются на минимизации использования таких веществ, снижая потенциальные риски для здоровья потребителей. Разработка новых методов и технологий консервирования, направленных на сохранение качества и безопасности продуктов питания, является актуальной задачей. Особую важность представляет поиск альтернатив, способных заменить традиционные консерванты и химические вещества, снижая их содержание в конечном продукте. Целью данного исследования является изучение инновационных технологий, новых методов консервирования и применения натуральных антиоксидантов для: повышения безопасности и микробиологической стабильности мясных и рыбных консервов; снижения потенциального негативного воздействия на здоровье потребителей; разработки методов, позволяющих уменьшить количество добавляемых консервантов и химических веществ без ущерба для качества и вкусовых характеристик продукции. В работе будут проанализированы: эффективность применения натуральных антимикробных компонентов, таких как соль и масло; подходы к оптимизации процессов консервирования без ущерба для качества и вкусовых характеристик продукции. Разработка методов повышения микробиологической стабильности мясных и рыбных консервов с минимизацией использования вредных веществ является важной задачей, имеющей значительный потенциал для развития более здорового и безопасного питания.

Ключевые слова: технологии консервирования, антимикробные вещества, безопасность, биоконсерванты.

Введение

Мясные и рыбные консервы, хотя и являются важным сегментом продовольственного рынка благодаря доступности, длительному хранению, безопасности, разнообразию и сохранению питательных веществ, требуют пересмотра традиционных методов консервирования с использованием потенциально вредных химических веществ. В связи с этим, разработка методов, позволяющих повысить безопасность и качество продукции, а также минимизировать риски для здоровья потребителей, является чрезвычайно важной задачей. Целью исследования является изучение инновационных технологий, новых методов консервирования и применения натуральных антиоксидантов для: повышения безопасности и микробиологической стабильности мясных и рыбных консервов; снижения потенциального негативного воздействия на здоровье потребителей; разработки методов, позволяющих уменьшить количество добавляемых консервантов и химических веществ без ущерба для качества и вкусовых характеристик продукции. В

работе проанализированы: эффективность применения натуральных антимикробных компонентов, антиоксидантов, таких как молочная и аскорбиновая кислота; подходы к оптимизации процессов консервирования без ущерба для качества и вкусовых характеристик продукции.

Особенности технологии производства мясных и рыбных консервов

Мясные консервы – это мясные продукты, герметично укупоренные и подвергнутые воздействию высокой температуры для уничтожения микроорганизмов и придания продукту стойкости к употреблению, обладают высокой питательной ценностью [1,2]. Классификация мясных консервов представлена на Рис. 1.

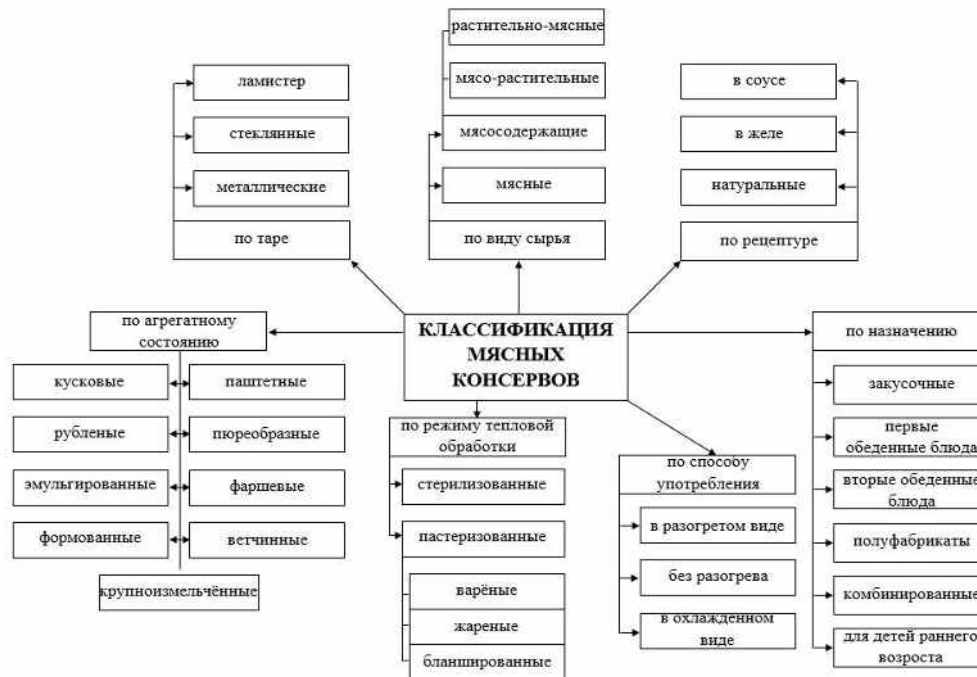


Рисунок 1. Классификация мясных консервов

Технологию производства мясных консервов можно разделить на 4 основных блока представленных на Рис. 2.

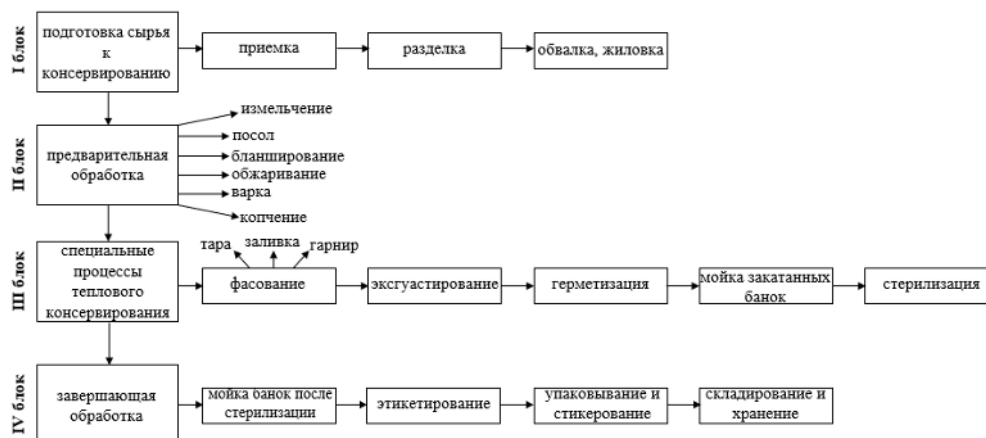


Рисунок 2. Технология производства мясных консервов

Рыбные консервы – это рыбные продукты, после предварительной обработки герметично укупоренные в тару и подвергнутые стерилизации в течение определенного времени. В зависимости от способов приготовления и назначения консервы, принято подразделять на следующие группы: натуральные, в томатном соусе, в масле, паштеты и

пасты, рыбо-овощные, диетические. Более подробная классификация и технология производства рыбных консервов представлена на Рис. 3 и Рис. 4.

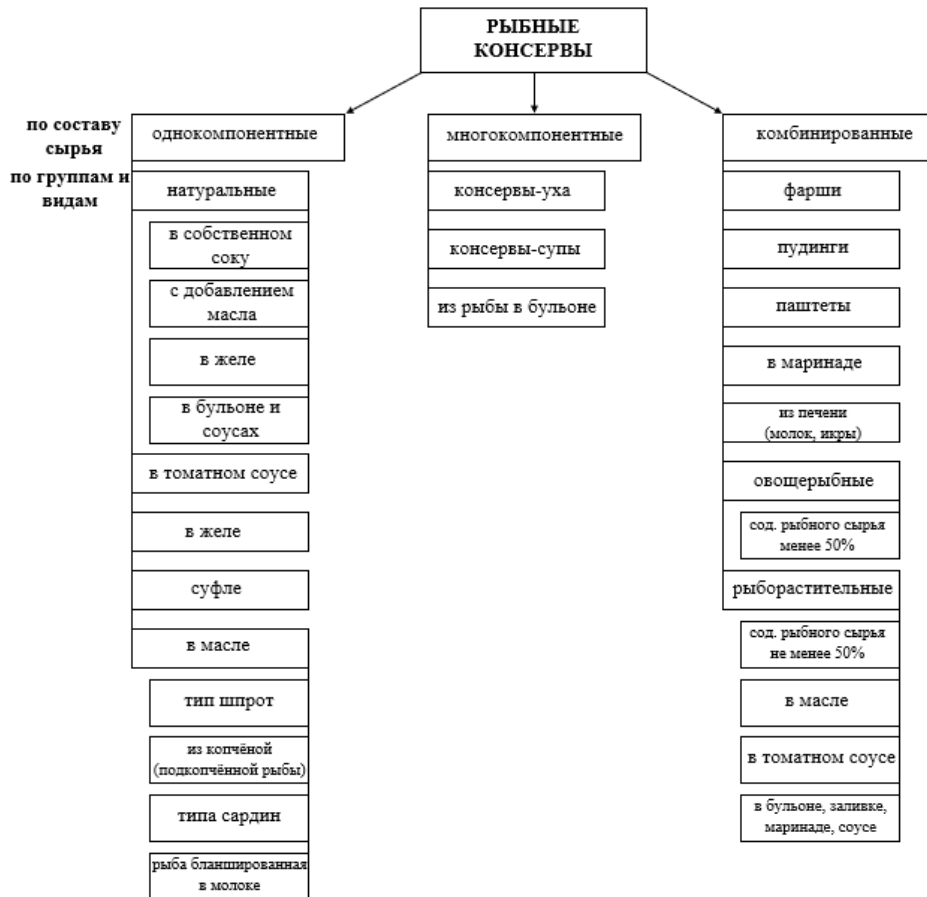


Рисунок 3. Классификация рыбных консервов

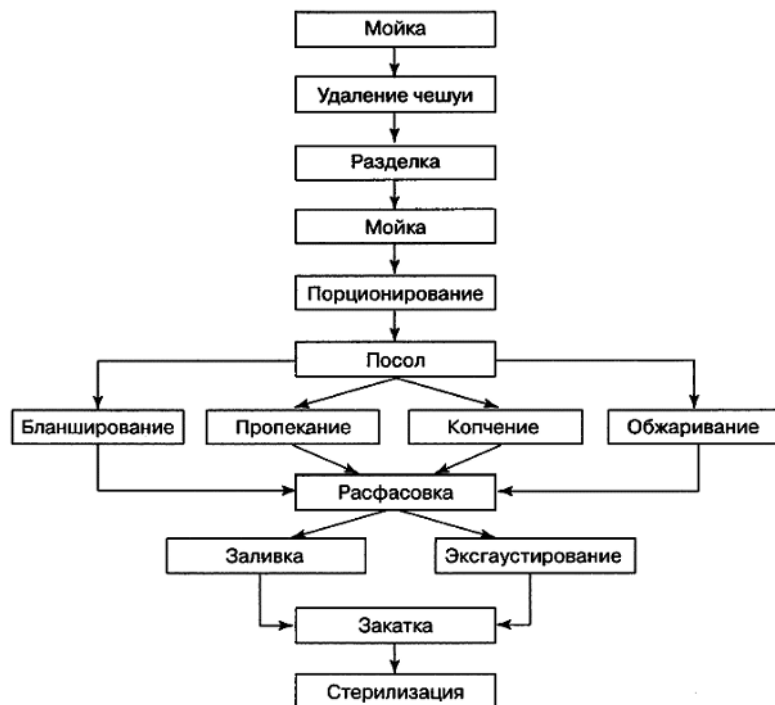


Рисунок 4. Технология производства рыбных консервов

Натуральные консервы производят из ценных пород рыб, ракообразных, морепродуктов, печени тресковых, причем закладывают в банки сырье без добавления

других компонентов, герметично укупоривают и стерилизуют. Иногда добавляют специи или другие продукты (лавровый лист, перец, рыбный бульон, желеобразующие заливки).

Консервы в томатном соусе производят из всех видов рыб, но рыбу предварительно подвергают термической обработке (обжариванию в масле, бланшированию паром или маслом, подсушке). В банку укладывают полуфабрикат, заливают томатным соусом, укупоривают и стерилизуют. Печень тресковых и лососевых рыб укладывают в банки без предварительной термической обработки и заливают томатным соусом.

Консервы в масле также вырабатывают из различных видов рыбы, предварительно обработанной (обжаривание, бланширование, подсушка, копчение) из-за чего они подразделяются на консервы из копченой (шпроты), подсушенной (сардины) и обжаренной рыбы. Консервы из обжаренной рыбы готовят по технологической схеме, аналогичной схеме производства консервов в томатном соусе, только вместо соуса для заливки используют растительное масло.

Паштеты и пасты производят из мяса различных рыб, ракообразных и печени тресковых или отходов, образующихся при производстве консервов. Сырье или полуфабрикат тщательно измельчают до однородной массы с добавлением растительного или животного масла, томата, лука, пряностей и закладывают в банку.

Консервы рыбо-овощные готовят из различных, главным образом мелких пород рыб, с добавлением овощей (капуста, морковь, баклажаны, сладкий перец и др.). Это позволяет улучшить качество, повысить пищевую ценность за счет углеводов и витаминов, содержащихся в овощах. Рыбу предварительно термически обрабатывают, а овощи закладывают в свежем или сухом виде и заливают соусом.

Диетические консервы вырабатывают без острых и пряных веществ, но с добавлением комплексов витаминов, сливочного масла и других веществ, повышающих питательную ценность и усиливающих профилактические и лечебные свойства консервов.

Кроме того, рыбная промышленность вырабатывает консервы из нерыбных морепродуктов, которые выделяют в особую группу по виду основного сырья (морская капуста, мидии, кальмары, трепанги, осьминоги, устрицы и др.). Производят эти консервы, используя все способы предварительной обработки сырья. Такие консервы имеют высокую питательную ценность из-за наличия значительного количества биологически активных веществ [3, 4].

Факторы, повышающие микробиологическую стабильность консервов

Несмотря на то, что консервы – это стерильный продукт, герметично укупоренный и прошедший термическую обработку, проблема остаточной и вторичной микрофлоры (повторного обсеменения) остаётся актуальной. Среди микроорганизмов, особую опасность представляют грамположительные спорообразующие палочки (*Clostridium botulinum*, *Bacillus spp.*), а также *Staphylococcus aureus*, *Salmonella*, *Escherichia coli*, *Lactobacillus spp.*, *Micrococcus spp.*, источниками загрязнения которых служат почва, вода, кожа и слизистые человека и животных. В отличие от рыбных консервов, в мясных реже обнаруживаются такие м/мы, как *Escherichia coli* и *Salmonella spp.*, т.к. мясо подвергается более высоким температурам обработки, которые уничтожают эти микроорганизмы. Также, в мясных консервах реже встречаются *Lactobacillus spp.*, это связано с тем, что в мясе содержится меньше свободных сахаров, которые являются необходимыми для роста этих бактерий.

К факторам, повышающим микробиологическую стабильность консервов, относятся:

- свежесть и качество сырья: использование свежего, высококачественного сырья с низким уровнем микробиологической обсемененности и соответствующими нормативными документами;
- предварительная обработка сырья: мойка, сортировка, очистка и др.;

- рН: кислая реакция ускоряет тепловую денатурацию белков и вызывает снижение термоустойчивости бактерий, ингибирует рост и развитие м/ов, помимо этого в кислой среде стерилизация достигается быстрее;
- температура обработки: консервирование при высоких температурах (121°C - 135°C) в течение достаточного времени приводит к уничтожению вегетативных форм микроорганизмов;
- вода: снижение активности воды (a_w) продукта путем сушки;
- жир: при повышенном содержании жира в продукте термоустойчивость бактерий повышается, поэтому эффективность стерилизации снижается, считается, что жир, обволакивая клетку, препятствует увлажнению ее оболочки;
- условия хранения: создание вакуума (удаление кислорода), который необходим для дыхания многих микроорганизмов; герметичная упаковка; хранение при низких температурах (4°C - 10°C) и при низкой влажности (50% - 70%), в защищенном от света месте [5].

Инновационные методы повышения микробиологической стабильности консервов:

- применение антиоксидантов: например, аскорбиновая кислота сохраняет цвет и вкус мясных консервов;
- использование уксусной кислоты: является эффективным консервантом за счёт снижения рН среды, что неблагоприятно для многих микроорганизмов;
- внедрение натуральных консервантов: экстракты специй, эфирные масла могут сохранить вкус и текстуру;
- применение белково-минерального комплекса (БМК), получаемого путём гидротермолиза голов кильки горячего копчения. БМК отличается повышенным содержанием минеральных веществ костной ткани рыб, в частности, кальция и фосфора, что позволяет сбалансировать повышенное содержание минеральных веществ в мясном продукте; в результате продукт приобретает пикантный вкус и аромат копчености [6];
- применение молочной кислоты и лактата натрия для регулирования кислотности, увеличения сроков годности, а также для ускорения технологических процессов (является конкурентноспособным на рынке). Молочная кислота обладает более высокой по сравнению с поваренной солью проникающей способностью, поэтому ее использование обеспечивает быстрое и равномерное распределение соли и других посолочных ингредиентов в мышечных волокнах, благодаря чему ускоряются процессы посола. Лактат натрия, присутствующий в составе пищевой добавки, разрешен для использования в производстве рыбной продукции в качестве антиокислителя. Он не только оказывает тормозящее действие на процессы окисления жиров, но и одновременно предотвращает изменения пигментов ткани, и ингибирует окислительное действие образовавшихся в продукте свободных радикалов на организм человека. Благодаря мягкому солоноватому вкусу лактата натрия можно уменьшить дозировку поваренной соли, оказывающую проокислительное действие [7];
- применение растительных антиоксидантов (ресвератрол, дигидрокверцетин) способных увеличить сроки годности жиросодержащих продуктов прерывая реакции самоокисления пищевых компонентов и подавление роста микроорганизмов в продуктах, уже подверженные процессу окисления. Ресвератрол – самый мощный растительный антиоксидант, синтезируемый некоторыми растениями: сосной, виноградом, арахисом. Дигидрокверцетин – антиоксидант натурального происхождения, который извлекается из экологически чистого растительного сырья – комлевой части древесины лиственницы Сибирской или Даурской. Способен увеличить сроки годности жиросодержащих продуктов от 1,5 до 4 раз. Аскорбиновая кислота (витамин С) -

природный антиоксидант, используемый для предотвращения окислительной порчи жиров, прерывает реакции самоокисления в компонентах пищевых изделий, предотвращает снижение органолептических характеристик продуктов, увеличивает срок хранения в несколько раз [8];

- применение эфирных масел и экстрактов трав – в результате их антиокислительных, антиоксидантных свойств и веществ ингибирующих патогенные бактерии.

Выводы

Проведенный анализ свидетельствует, что консервирование мясных и рыбных продуктов является актуальным и перспективным направлением в пищевой промышленности. Консервирование обеспечивает микробиологическую стабильность продукции, что гарантирует ее безопасность и длительный срок хранения. Применение современных технологий позволяет сохранить или даже усилить вкусовые характеристики продуктов, делая их более привлекательными для потребителей. Важно отметить, что использование натуральных консервантов, в отличие от искусственных добавок, минимизирует негативное влияние на организм человека, делая консервированные мясные и рыбные продукты не только вкусными, но и полезными.

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СЕРДЕЧНО-СОСУДИСТЫЕ ЗАБОЛЕВАНИЯ. МОДИФИКАЦИЯ ОБРАЗА ЖИЗНИ И НУТРИЦИОЛОГИЧЕСКАЯ ПОДДЕРЖКА

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Аннотация. Данная статья поднимает важную тему влияния образа жизни и питания на здоровье сердца и сосудов, указывая на необходимость комплексного подхода к профилактике и лечению сердечно-сосудистых заболеваний (ССЗ), включающего медицинское наблюдение и коррекцию питания. В свете того, что ССЗ остаются лидирующей причиной смертности на глобальном уровне, а основную роль в патогенезе этих заболеваний играют факторы, связанные с образом жизни, включая питание, физическую активность и контроль веса, роль нутрициологии в модификации образа жизни должна стать ключевой стратегией в профилактике и борьбе с этими заболеваниями. Рассмотрены факторы риска развития ССЗ, такие как неправильное питание, гиподинамия, избыточный вес и стресс, предложены эффективные способы их коррекции через изменение образа жизни и диетические подходы. Особое внимание уделено значению сбалансированного питания, богатого растительными волокнами, антиоксидантами, витаминами и микроэлементами в предотвращении атеросклероза и других ССЗ. Среди прочего, выделен средиземноморский диетологический протокол питания как особенно эффективный в снижении рисков ССЗ. Рассмотрена роль нутрицевтиков как дополнительного инструмента в улучшении ферментативных процессов в организме и в поддержании здоровья сердца и сосудов. Подчеркнута значимость интегративной нутрициологии и немедикаментозных подходов в управлении здоровьем сердца и сосудов, в активном изменении образа жизни и пищевых привычек как фундаментальных мер профилактики ССЗ.

Ключевые слова: сердечно-сосудистые заболевания, нутрицевтическая поддержка, алиментарная коррекция, диета

Введение

Сердечно-сосудистые заболевания составляют 61% всех заболеваний, основную роль в патогенезе которых играет фактор питания, и помимо генетической предрасположенности возникают и прогрессируют при неправильном образе жизни, нездоровом несбалансированном питании, гиподинамии, избыточном весе. Снижение заболеваемости и смертности от ССЗ возможно при коррекции образа жизни и питания.

Сердечно-сосудистые заболевания находятся на первом месте по смертности среди заболеваний последние десятилетия. Только в США и Европе (включая Россию) в XX в. от последствий атеросклероза умерло более 360 млн. человек [1].

Атеросклероз сосудов считается главной причиной роста смертности от сердечно-сосудистых заболеваний.

От 10 до 15% инсультов происходят у людей в возрасте от 18 до 50 лет.

Каждый год на инфаркт миокарда приходится более трети смертей, каждая третья из них – молодые люди в возрасте от 25 до 40 лет.

Даже у детей в возрасте 10-15 лет наблюдаются повреждения сосудов (липидные пятна, фиброзные холестериновые бляшки), предпосылки к развитию атеросклероза, последствием которого является инфаркт миокарда.

Сердечно-сосудистые заболевания

Сердечно-сосудистые заболевания - большая группа болезней сердца и сосудов, в которую входят:

- гипертония (повышенное кровяное давление);
- ишемическая болезнь сердца (инфаркт миокарда);
- нарушения мозгового кровообращения (инсульт);
- сердечная недостаточность;
- врождённые пороки сердца;
- ревматические болезни сердца.

Сердечно-сосудистые заболевания вызываются рядом причин, самыми распространёнными из которых являются: образование холестериновых бляшек на внутренней стенке сосудов (атеросклероз), врожденные пороки развития сердца и сосудов, нарушения работы эндокринной системы, инфекции, заболевания других органов и систем, наследственность, ожирение и нарушение липидного обмена, малоподвижный образ жизни, стресс [2].

Алиментарно-зависимые сердечно-сосудистые заболевания

Образ жизни и связанные с ним факторы риска (алкоголь, курение, нездоровое и несбалансированное питание, отсутствие физических нагрузок, избыточный вес, высокое артериальное давление), взаимодействуя с генетическими особенностями, способствуют развитию и прогрессированию сердечно-сосудистых заболеваний.

Нарушение работы сердца и сердечные заболевания начинаются именно с повреждения сосудов [3]. В их основе находятся две ключевые проблемы: нарушение сосудистой стенки, развитие в ней воспаления и как следствие - нарушение кровотока из-за накопления холестерина, образования тромбов и спазма сосудов.

Инсульт

Инсульт - вторая ведущая причина смерти в мире после инфаркта. Инсульт уже давно перестал быть болезнью пожилых людей. 30% перенесших инсульт становятся глубокими инвалидами, только 15-20% людей после инсульта возвращаются к работе.

Инвалидизация после инсульта занимает первое место среди всех других заболеваний.

Смертность после первого инсульта составляет около 30%.

Инфаркт

При повреждении сосуда при инфаркте на место воспаления приходят стволовые клетки, из которых должны вырасти новые клетки эпителия сосудов, но при наличии воспаления нарушается дифференцировка стволовых клеток (эпителиальные или костные). И некоторая часть клеток приобретает черты костной ткани, со способностью накапливать кальций.

Чем больше очаг воспаления, тем больше кальция откладывается в сосудах. На них «налипает» холестерин, сосуды закупориваются, недополучающие питания участки преобразуются в рубцовые ткани (инфаркт миокарда), которые перестают активно участвовать в сердцебиении.

Кальцификация сосудов происходит при избытке кальция в сыворотке крови на фоне нарушения работы паращитовидных желез, высокого уровня сахара крови (инсулинорезистентность, сахарный диабет), нарушения метаболизма мочевой кислоты (избыток фруктозы, нарушение работы печени и почек, хроническое воспаление) и приема

мегадоз витамина Д (повышает всасывание кальция в кишечнике) без поддержки витамином К (перенаправляет кальций в костную ткань) [4].

Варикоз

Варикоз является сосудистым повреждением на уровне вен, связанный с поражением глубоких тканей сосуда – мышечной и соединительной.

Избыточное и длительное давление на вену, особенно на фоне воспаления, дефицитов, малоподвижного образа жизни, ослабляет венозную стенку и вызывает ее выпячивание.

Дополнительными факторами риска является лишний вес, гормональные нарушения и повышенное внутрибрюшное давление (запоры).

Аневризма

Аневризма является сосудистым повреждением на уровне артерии, характеризующимся выпячиванием стенки артерии (реже - вены) вследствие её истончения или растяжения. Кровоизлияние в головном мозге в результате прорыва аневризмы – инсульт.

Факторами риска по развитию аневризмы является женский пол, возраст (после 50 лет риск возникновения аневризмы в 2 раза выше), курение, повышенное артериальное давление, семейный анамнез, дисплазия соединительной ткани и применение гормональной заместительной терапии в период постменопаузы.

Тромбоз

Артериальные тромбозы являются причиной 95% крупноочаговых инфарктов миокарда, 85% ишемических инсультов, гангрены конечностей, а также инфарктов других органов.

Одними из причин образования тромбов является замедление тока крови и изменение ее вязкости, к чему приводят обезвоживание, возраст более 40 лет, сидячий образ жизни, длительные путешествия и авиаперелеты, беременность и послеродовой период, приём КОКов, гормональная терапия, курение, инсулинорезистентность и ожирение (с индексом массы тела больше 30).

Ожирение приводит к развитию системного воспаления — это способствует дисфункции эндотелия. А низкий уровень адипонектина и высокий уровень лептина способствуют повышению агрегации тромбоцитов. Лептин повышает стабильность артериальных тромбов, а образование тромбина усиливает гиперкоагуляцию, что является причиной внутрисосудистого тромбоза и атеросклероза.

Атеросклероз

У людей, не соблюдающих диету и без физической активности, систематически подвергающихся стрессам, стенки артерий покрываются холестерином, разрушающим их и формирующим рубцовую ткань [5]. Возникает заболевание, называемое атеросклерозом.

Обычно появляется у людей старше 35-40 лет при наличии недостатка поступления с пищей растительных волокон, антиоксидантов, калия, магния, хрома, избыток в рационе окисленных жиров, окисленного холестерина, резкие изменения в режиме питания, повышение калорийности рациона, брюшное ожирение, курение.

Холестерин – основная причина сердечно-сосудистых катастроф

Мнение о том, что употребление продуктов с высоким содержанием холестерина значительно влияет на уровень холестерина в крови, в последние годы претерпело серьезные изменения.

Холестерин является основным структурным компонентом мозга, помогая в работе его рецепторов, защищает оболочки клеток от воздействия внешних разрушительных

факторов, транспортируя Q10. Холестерин необходим для производства гормонов, витамина Д и желчных кислот.

Холестерин синтезируется клетками печени больше, чем человек получает из еды, если говорить о сбалансированном питании. При снижении холестерина в питании организм увеличит его производство в соответствии со своими потребностями.

Но повышению холестерина также способствуют и другие факторы, связанные с избытком углеводов (триглицериды), нарушением работы щитовидной железы.

Алиментарный фактор профилактики сердечно-сосудистых заболеваний

Основная задача сбалансированного питания при сердечно-сосудистых рисках - восстановить обмен веществ клиента и скорректировать его состояние. Наряду со средиземноморской диетой по версии ВОЗ [6] и US News & World Report [7] одной из лучших диет 2023 года при заболеваниях сердечно-сосудистой системы стал протокол питания DASH (диетический подход для остановки гипертонии).

Нутрициолог, работая с образом жизни и образом питания клиента, может помочь отстроить стратегию профилактики риска сердечно-сосудистых заболеваний.

Лечить холестерин бессмысленно – это следствие. Если в организме все работает правильно, печень расщепит излишек холестерина, полученный с едой, и с желчью выведет из организма.

Но если в организме есть повышенная потребность в холестерине ввиду повреждений сосудов, инсулинорезистентности, гипотериоза, стресса – печень будет стараться выработать как можно больше необходимого холестерина.

Поэтому в своей работе нутрициологу необходимо уделить внимание причине, а не со следствия.

После выявления причины повышения уровня холестерина, нутрициолог определяет алгоритм работы: восстановить уровень белка, поддержать работу желчного и печени, снизить уровень воспаления, нормализовать работу щитовидной железы, нормализовать углеводный обмен, работать над стрессом.

При работе с клиентами с генетическими мутациями, нутрициолог обязан рекомендовать параллельное и регулярное наблюдение врача.

Нутрицевтическая профилактика сердечно-сосудистых заболеваний

Нутрициолог, помимо составления стратегии питания, дополнительно в виде нутрицевтика может рекомендовать такой компонент как бромелайн – он не только улучшает ферментативные способности организма, помогает переваривать особенный белок, а также влияет на кровь, замедляя образование сгустков, и, соответственно, снижая вероятность риска сердечно-сосудистых катастроф.

Хорошей рекомендацией будет употребление наттокиназы. Она является одним из ферментов, полученных из пищевого продукта Natto - вареных соевых бобов, сброживаемых бактериями *Bacillus subtilis*. Этот фермент прекрасно влияет на метаболизм холестерина, снижая его за счёт влияния на липопротеиды низкой плотности и триглицериды, тем самым снижая вероятность закупорки сосудов холестерином, но и будет влиять на предотвращение тромбообразования, поскольку способен расщеплять фибрин - эффект достаточно сильный, сравнимый с эффектом аспирина [8].

Не менее важны еще два нутрицевтика, которые доказано работают на снижение холестерина:

таурин – аминокислота, которая содержится в любой пище, богатой белком. Имеет большое комплексное действие на здоровье сердечно-сосудистой системы. Также необходим для синтеза желчных кислот, поддерживает работу желчного пузыря, снижает кровяное давление и уровень воспаления, предотвращает накопление жировых бляшек в артериях. Прием таурина курсом в 7 недель приводит к значительному снижению уровня

триглицеридов и индекса атерогенности. Однако лечебная доза таурина может быть назначена только врачом [9].

ниацин - снижает уровень холестерина и оптимизирует его профиль, может повышать уровень хорошего холестерина ЛПВП и снижать уровень триглицеридов, ЛПНП [10].

Даже, несмотря на наличие современных исследований о негативном влиянии статинов на митохондрии и производство CoQ10, который снижает количество свободных радикалов за счёт антиоксидантного действия и участвует в производстве энергии, а также необходим для работы сердца и мозга, медикаментозный протокол до сих пор предусматривает назначение статинов.

Статины действительно снижают уровень холестерина, а именно ЛПНП за счёт блокировки специфических ферментов печени. Статины не влияют на холестерин, который человек получает с пищей, а блокируют выработку собственного холестерина, и это очень важный момент, так как статины влияют на рецепторы, своим действием напоминая поломку в генах и полиморфизмы.

Поэтому, когда нутрициолог начинает работать с клиентом, которому были назначены статины, и клиент не имеет возможности обратиться к интегративному врачу, нутрициолог может предложить клиенту поддержать организм нутрицевтиками:

- CoQ10, который снижает негативные последствия приема статинов [10];
- Токотриенолы, необходимые для митохондрий, а именно для увеличения эндогенного производства CoQ10.

Также, для снижения холестерина интегративный нутрициолог может рекомендовать клиенту:

- лецитин как источник фосфолипидов, поддерживает текучесть желчи, нормализует липидный обмен, снижает уровень холестерина, восстанавливает клетки печени (яичный желток источник лецитина);
- красный дрожжевой рис (растительный аналог статинов) - снижает уровень холестерина, нормализует липидный профиль;
- экстракт чеснока - высокое содержание антиоксидантов, снижает общий холестерин, ЛПНП.
- ликопин - повышает эластичность кровеносных сосудов, снижает уровень холестерина.

Из продуктов, холестерин может быть снижен с помощью вишни, которая содержит полифенолы, которые снижают сосудистый тонус и оптимизируют уровень холестерина. Кроме того, полифенолы качественно влияют на воспаление, имеют противовоспалительный эффект.

Жирная морская рыба, богатая омега-3 тоже обладает сильным противовоспалительным эффектом, поэтому здесь тоже важно добавлять и масло рисовых отрубей.

Кунжутное масло содержит фитостеролы, растительные аналоги холестерина, который организм как бы воспринимает как копии настоящего холестерина и поэтому немного замедляет его собственный синтез.

Чек-ап в работе с профилактикой сердечно-сосудистых заболеваний

Часто, прежде чем приступить к работе, нутрициолог должен клиенту предложить пройти чек-ап для выявления причин высокого холестерина:

липидный обмен

- холестерин;
- липопротеины высокой плотности (ЛПВП);
- липопротеины низкой плотности (ЛПНП);
- липопротеины очень низкой плотности (ЛПОНП);
- триглицериды;

- коэффициент атерогенности (КА);
- липопротеин.

панель щитовидной железы:

- ТТГ;
- Т4 свободный;
- Т3 свободный;
- реверсивный Т3;
- антитела к ТПО и ТГ.

общий белок.

оценка состояния желчного:

- УЗИ на наличие камней и сладжа;
- обмен билирубина (общий, прямой, непрямой)

оценка воспаления:

- гомоцистеин.

Выводы

Сегодня большую роль в превенции многих заболеваний и состояний начинает играть интегративная нутрициология и немедикаментозные методы восстановления здоровья человека. Особенно важно использовать инструменты нутрициологи в проведении превентивных мероприятий по профилактике всех болезней, которые называют болезнями цивилизации.

Снижение заболеваемости и смертности от сердечно-сосудистых заболеваний возможно при коррекции образа жизни и питания.

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IMPACTUL AGENȚILOR DE ÎNGROȘARE ÎN INDUSTRIA ALIMENTARĂ: PERSPECTIVĂ PRACTICĂ ȘI TEORETICĂ ȘI IMPLICAȚII ASUPRA SĂNĂȚII PUBLICE

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Rezumat. *Această lucrare investighează rolul și impactul agenților de îngroșare în cadrul industriei alimentare, servind drept ghid practic în utilizarea acestora. Analiza se concentrează pe procesele de gelifiere cu pectină, agar-agar și gelatină, evaluând consistența obținută pentru fiecare agent și condițiile de păstrare a produsului finit. Substanțele gelifiante sunt caracterizate în funcție de capacitățile lor termice de regenerare, puterea de legare a apei în timpul procesului de gelifiere, precum și temperatura de activare și solidificare, alături de calitățile organoleptice, inclusiv gustul și mirosul. Originea și valoarea nutritivă a fiecărui compus gelifiant sunt discutate în contextul relevanței acestora pentru consumatorii care urmează diete specifice sau restricții alimentare. De asemenea, este subliniat rolul esențial al agenților de îngroșare în asigurarea securității alimentare și a sănătății publice, influențând în mod semnificativ termenul de valabilitate al produselor. Un accent deosebit este acordat aspectelor teoretice, facilitând înțelegerea proceselor fizice și chimice implicate în gelifiere. Această înțelegere permite stabilirea relațiilor cauză-efect în cadrul proceselor tehnologice, contribuind la dezvoltarea de noi produse alimentare, inclusiv cele din gastronomia moleculară, și la introducerea acestora pe piață.*

Cuvinte cheie: *agenți de îngroșare, siguranța alimentelor, gelatină, pectină, agar-agar*

Introducere

Substanțele gelifiante (agenții de îngroșare) sunt compuși care măresc viscozitatea unui lichid, fără a schimba substanțial celelalte proprietăți ale acestuia. Ele se utilizează pe larg la îngroșarea și gelificarea compozițiilor alimentare, precum: supe, sosuri, creme, insertii pentru deserturi, bomboane, marmelade etc.; pentru a oferi textura necesară, a mări termenul de valabilitate și a îmbunătăți calitățile nutritive ale unui aliment. Agenții de îngroșare stau la baza gastronomiei moleculare, făcând posibilă sferificarea, de exemplu, ceea ce duce la prezentarea creativă și atrăgătoare a bucatelor.

Amploarea producției și comercializării mondiale a agenților de îngroșare este impunătoare. Anual se produc circa 450 000 tone de gelatină și peste 10 000 de tone de agar-agar [1,2]. Aceste cifre reflectă impactul masiv al substanțelor gelifiante asupra sănătății umane și alimentației publice, precum și necesitatea înțelegerii lui. Este important de a ști dozele recomandate de fiecare gelifiant, pentru a evita transformarea proprietăților favorabile a acestora în nocivitate pentru organism.

Agenții de îngroșare se clasifică după proprietățile lor de bază, și anume: originea, puterea de legare a apei, termoreversibilitatea, temperaturile de activare și solidificare și proprietățile organoleptice (gustul și mirosul). Acestea influențează atât alegerea substanței în funcție de scop, cât și procesul tehnologic la care ea trebuie supusă.

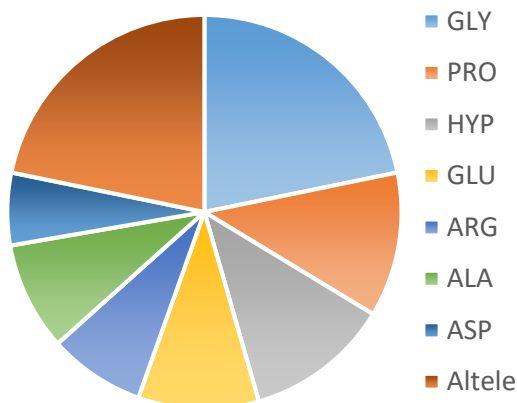
Originea substanțelor gelifiante poate fi animală sau vegetală, astfel obținându-se o proteină sau un polizaharid, respectiv.

În cele ce urmează, vom analiza 3 agenți de îngroșare: gelatina, agar-agarul și pectina.

Gelatina

Gelatina este o substanță proteică, obținută prin hidroliza parțială a collagenului din oase, tendoane și piele, ale bovinelor și porcinelor. Aceasta conține 19 din cei 20 de aminoacizi găsiți în natură, însă nu este o proteină completă, deoarece îi lipsește triptofanul, un aminoacid esențial. Structura de aminoacizi a gelatinei este prezentată în Fig. 1.

Figura 1. Conținutul de aminoacizi în gelatină



Din punct de vedere al proprietăților importante în producere și consum, gelatina este aproape lipsită de gust și miros. Este un solid fragil, vitros, cu o nuanță ușor gălbuie. Gelatina conține 8-13% umiditate și are o densitate relativă de 1,3-1,4. Când granulele de gelatină sunt înmuiate în apă rece, ele se hidratează în particule discrete și umflate. Încălzite, aceste particule se dizolvă pentru a forma o soluție. Comportamentul soluțiilor de gelatină este influențat de temperatură, pH, conținut de cenușă, metodă de fabricație și concentrație. Gelatina este termoreversibilă, ceea ce înseamnă că jeleul obținut poate fi topit și resolidificat. Temperatura de topire a jeleurilor pe bază de gelatină este relativ joasă, și anume 35°C, ceea ce o face să se topească în gură. Respectiv, o serie de utilizări, precum îngroșarea cremelor, mousse-urilor și produselor lactate sunt caracteristice acestui gelifiant [3].

Procesul tehnologic al gelificării cu gelatină include:

- înmuierea acesteia în apă rece (pulberea în proporții de 1:5 sau 1:6, foile în exces de apă foarte rece);
- încălzirea până la topire (60-70°C);
- amestecarea cu lichidul de gelificat;
- răcirea până la 15°C (stabilizarea totală a gelatinei este în decursul a 6-24 ore, la frigider).

Este important ca gelatina să nu fie fiartă, deoarece își poate pierde proprietățile de îngroșare a produsului alimentar.

Gelatina comercializată pe piață se clasifică după puterea sa, exprimată în bloom. De regulă, în Republica Moldova gelatina are între 180 și 220 de grade bloom. În funcție de puterea gelatinei, se calculează proporțiile care trebuie folosite. De exemplu, rețeta sugerează adăugarea a 10g de gelatină de 220 Bloom. În cazul în care se lucrează cu gelatină de 180 Bloom, se face un recalcul al proporțiilor, utilizându-se 12.2g în aceleași condiții. Cu cât este mai mare puterea gelatinei, cu atât mai puțină se adaugă pentru un rezultat similar.

Un alt factor important care influențează puterea de gelificare a gelatinei este compoziția propriu-zisă. Produsele ce conțin zahăr, calciu și alcool contribuie la gelificare, în timp ce fructele tropicale, acizii și sarea împiedică acest proces. În acest context se recomandă fierberea (pasteurizarea) în prealabil a fructelor tropicale, pentru a distruge enzima papaină, ce se conține în ele și care are un efect negativ asupra îngroșării compoziției. Produsele excesiv acide se gelifică cu alți agenți de îngroșare, cum ar fi pectina.

Agar-agarul

Agar-agarul este o substanță de origine vegetală, obținută din alge roșii sau brune, în special Gracilaria și Gelidium. Este cel mai cunoscut substituent al gelatinei, fiind potrivit pentru persoanele cu restricții alimentare de ordin confesional sau medical.

Din punct de vedere chimic, agar-agarul este un amestec de polizaharizi, fiind compus din 70% agaroză și 30% agarobioză, a căror structură este prezentată în Fig. 2 (a, b).

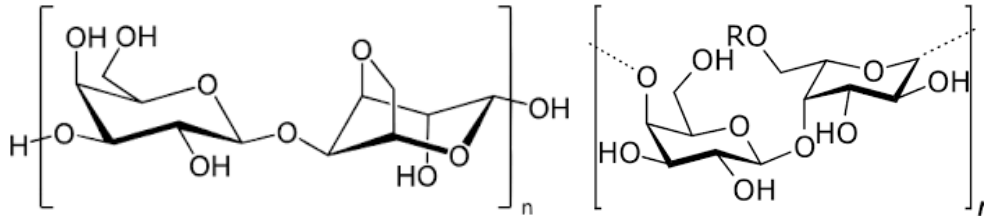


Figura 2. Structura chimică a agar-agarului: a – agaroză; b – agarobioză

Din punct de vedere nutrițional, agar-agarul constituie o fibră alimentară, contribuind la digestia optimă și la senzația de sațietate. Totuși, se recomandă consumul acestuia cu cantități mari de lichide și în limita a 0.5-1.5g pe zi (pentru adulți). Doza maximă pe zi a consumului agar-agar este de 5g. Efectele adverse ale consumului excesiv de agar-agar pot include malabsorbția vitaminelor și mineralelor în intestine și diareea.

Agar-agarul posedă o serie de proprietăți utile în producție. Acesta poate fi folosit în compoziții cu pH între 5 și 8, nu necesită ioni adăugători de metale (cum ar fi potasiul sau calciul) pentru a se solidifica și este cel mai puternic agent de îngroșare natural [4].

Astfel, el este de 3-5 ori mai puternic decât gelatina, iar puterea agar-agarului găsit în supermarketele din Chișinău este de 1200 Bloom. Lucrul dat sugerează necesitatea unor cantități foarte mici de agar-agar pentru gelificarea compozițiilor, ceea ce face depășirea dozelor recomandate aproape imposibilă. De asemenea, jeleurile pe bază de agar-agar au temperatură înaltă de topire (85°C), fapt util în vremea caniculară, în sezonul nupțial, pentru candy-bar-uri în aer liber. Comparativ cu jeleurile din gelatină, care se topesc la soare, cele cu agar-agar rămân intacte în aceste condiții.

Procesul de preparare a jeleurilor pe bază de agar-agar este foarte simplu: se amestecă praful de gelifiant cu compoziția, se încălzește până la $T_{activare}=95-100^{\circ}\text{C}$, se toarnă în forme și se lasă la răcit. Atingând temperatura de 40°C, agar-agarul începe să se solidifice. Ca și gelatina, agar-agarul este termoreversibil, adică jeleurile pot fi topite și refăcute.

Pectina

Pectina este un alt agent de îngroșare vegetal, fiind extrasă din fructe și, mai rar, din legume. Cea mai valorificată sursă de pectină o constituie cojile de citrice (portocale, lămâi, lime), dar și resturile de mere obținute după extragerea sucului. Cu cât sunt mai coapte și moi fructele, cu atât mai puțină pectină conțin. Valorile medii ale concentrațiilor de pectină în diferite surse sunt reprezentate în Tab. 1 [5,6].

Structura chimică a pectinei este una complexă, fiind chiar diferită de la caz la caz (în dependență de sursa de pectină, modul de extracție, zona geografică de amplasare a plantelor etc.). Totuși, principalul zaharid din componența acesteia o constituie acidul galacturonic, unele molecule ale căruia sunt esterificate cu metanol (Fig. 3).

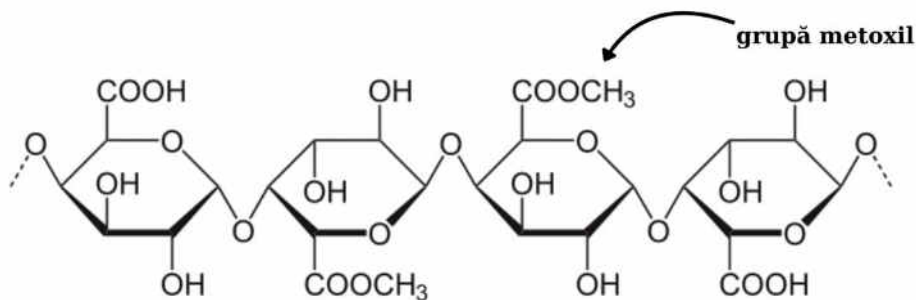


Figura 3. Structura chimică simplificată a pectinei

Inițial, în natură, 80% din aceste molecule sunt legate cu radicalul CH₃, însă, în procesul extracției, o bună parte din radicali se pierde. Astfel, produsul finit poate avea un grad de esterificare mai mare sau mai mic de 50%. În funcție de tip, se aleg și produsele de gelificat cu pectina respectivă.

Pectina cu conținut înalt de metoxil (HM - high metoxil pectin), având un grad de esterificare > 50%, necesită mediu puternic acid (cu pH între 2 și 3.5) și multă substanță uscată (zahăr) ca să gelifice. Astfel, ea poate fi utilizată la îngroșarea dulcețurilor, gemurilor cu conținut înalt de zahăr și marmeladelor. De asemenea, se recomandă adăugarea a puțină sare de lămâie în compoziția de gelificat, în cazul în care aceasta nu conține inițial suficient acid.

Pectina cu conținut scăzut de metoxil (LM - low metoxil pectin), cu un grad de esterificare mai mic de 50%, poate îngroșa compoziții cu pH neutru spre acid și nu necesită o cantitate mare de zahăr. Totuși, este nevoie de adăugarea ionilor de calciu, pentru ca pectina LM să acționeze. Utilizarea acestui fel de pectină se recomandă la prepararea gemurilor cu conținut scăzut de zahăr și la îngroșarea iaurturilor (datorită conținutului natural de calciu în ele).

Un al treilea tip de pectină o constituie cea amidată (LMA). Ea este obținută prin tratarea pectinei LM cu amoniac. Aceasta nu necesită ioni de calciu ca să acționeze, ceea ce o face a fi cea mai universală din tot asortimentul de pectine. Din această categorie face parte pectina NH, care este utilizată pe larg în patiserie și cofetărie la prepararea umpluturilor. Un mare avantaj al pectinei NH este rezistența la congelare.

Tabelul 1

Conținutul de pectină în fructe și legume

Sursa de pectină	Tipul	Conținut de pectină, %
Reziduuri de mere	Substanță uscată	10-15%
Coajă de citrice	Substanță uscată	20-30%
Semințe de floarea soarelui (reziduuri)	Substanță uscată	10-20%
Sfeclă de zahăr	Substanță uscată	10-20%
Caise	Fruct proaspăt	1%
Cireșe	Fruct proaspăt	0.4%
Portocale	Fruct proaspăt	0.5-3.5%
Morcov	Fruct proaspăt	1.4%

Procesul de preparare a gelurilor pe bază de pectină include:

- amestecarea pectinei cu zahărul;
- introducerea amestecului în lichidul preîncălzit (40-50°C), amestecând bine, pentru a evita formarea cocloașelor;
- aducerea la 80-85°C;
- răcirea pentru câteva ore la frigider.

Nutrițional, pectina este un carbohidrat complex, o fibră alimentară, cu diverse beneficii asupra sănătății umane. Pectina contribuie la eliminarea toxinelor și a metalelor grele din organism, previne constipația, elimină grăsimile din sânge, controlează producția de colesterol și trigliceride, susține echilibrul energetic al organismului prin întârzierea absorbției zahărului în intestine [7]. Totodată, depășirea dozei de 20g de pectină pe zi nu este recomandabilă.

Concluzie

Agenții de îngroșare conferă produselor alimentare lichide consistența necesară. Acest lucru îmbunătățește experiența consumatorului și permite lărgirea sortimentului de produse pe care o întreprindere de alimentație publică le poate oferi. Totodată, substanțele gelifiante au impact asupra termenului de valabilitate și proprietăților nutritive ale alimentelor, dar și ajută la optimizarea proceselor în bucătărie. Unele produse, cum ar fi torturile, nu ar rezista decât între 12 și 24 de ore, dacă ar avea în compoziția lor fructe crude, fie ele proaspete sau congelate. Deci, trebuie să fie prelucrate termic și cu agent de îngroșare, proces care ar mări intervalul de consum sigur până la câteva zile. Pregătirea în prealabil a unor semifabricate pe bază de pectină NH și congelarea acestora permite optimizarea muncii. Mai mult ca atât, agenții de îngroșare enumerați mai sus prezintă beneficii nutritive pentru populație și, fiind consumate în limita dozelor recomandate, pot contribui la sănătatea publică.

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POTENȚIALUL ACTUAL TURISTIC AL REGIUNILOR DIN REPUBLICA MOLDOVA

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Rezumat. În urma efectuării lucrării date a fost stabilită situația economico-turistică în ultimii trei ani în Republica Moldova. Au fost studiate tipurile de servicii turistice, reprezentate prin numărul de cazări în funcție de regiune și de an. S-a apreciat nivelul cazării prin numărul de camere, prin numărul de turiști rezidenți și nerezidenți, care a constituit pentru hoteluri și moteluri - 17,0 mii de cazări (15%); tabere de vacanță - 6,3 mii de cazări (29%); pensiuni turistice - 5,7 mii de cazări (23%); structuri de odihnă - 4,8 mii de cazări (10%); cămine pentru vizitatori - 1,1 mii de cazări (23%). Trebuie de menționat că, numărul de înnoptări a turiștilor în structurile de primire turistică colectivă a prevalat în 2019 în comparație cu restul anilor și a constituit 1304 mii înnoptări. S-a demonstrat că cauzele acestor devieri semnificative s-au datorat apariției neașteptate a pandemiei provocate de Covid-19.

Cuvinte cheie: turism, cazare, primire turistică colectivă, înnoptări

Introducere

Republica Moldova este o țară cu istorie bogată și peisaje naturale de o frumusețe fermecătoare, aceasta deținând un potențial turistic în regiunile rurale. Îmbină o combinație perfectă între tradiții autentice, ospitalitate, dar și frumusețe naturală. Aceste regiuni oferă oportunități pentru dezvoltarea industriei turistice durabile, care să contribuie ulterior la economia locală. Cu toate că, țara dispune de resurse variate, de unicitate culturală, potențialul turistic al regiunilor rurale rămâne neexploatat [1]. Scopul acestei lucrări constă în analiza în profunzime a potențialului turistic în regiunile rurale din Republica Moldova, identificarea resurselor naturale, culturale, dar și analiza modalităților prin care potențialul poate fi valorificat într-un mod eficient și sustenabil. Prin această analiză, se propune de evidențiat importanța vitală a dezvoltării turismului rural pentru Republica Moldova și să se ofere perspective și recomandări pentru o creștere echilibrată și benefică, atât pentru comunitățile locale, cât și pentru mediul înconjurător.

1. Valorificarea resurselor naturale din RM

În urma analizei surselor științifice evaluate, s-a constatat că Republica Moldova poate valorifica resursele sale naturale. Aceasta dispune de un relief variat, ce include dealuri pitorești și văi încântătoare, ce oferă turiștilor oportunități pentru drumeții și ciclism [2]. Există diverse rezervații naturale, cum ar fi: Rezervația Plaiul Fagului, Pădurea Domnească, Prutul de Jos, dar și parcuri naționale, cum ar fi Parcul Național Orheiul Vechi, care reprezintă destinații populare pentru iubitorii de natură. Ce ține de resursele culturale, Republica Moldova are o moștenire culturală bogată, ce se reflectă în satele cu specific tradițional, bisericile de lemn, dar și mănăstirile medievale. Multe localități organizează festivaluri și evenimente culturale, unul din acesta ar fi "Festivalul Național al Vinului", care adună anual peste 130 mii de vizitatori, oferind oportunitatea de a experimenta tradițiile și obiceiurile locale [1].

Comunitățile rurale sunt recunoscute pentru ospitalitatea lor, dar și pentru capacitatea de a oferi turiștilor experiențe autentice, cum ar fi participarea la diverse activități tradiționale, dar și la meșteșugurile locale cum ar fi: croșetatul, împletitul din paie, pănuși, țesutul covoarelor, broderia,

prelucrarea artistică a piei și blănurilor [2]. Există și o varietate de tradiții și ritualuri locale, cum ar fi nunțile tradiționale și sărbătorile religioase (Paștele, Crăciunul, sfântul Andrei) care sunt adesea incluse în pachete turistice pentru a oferi turiștilor o ședere cât mai autentică. Ghizii locali sunt disponibili pentru a oferi informații turiștilor despre istoria locală. În regiunile rurale, există o gamă largă de opțiuni de cazare, pensiuni, case de oaspeți și cabane rustice. Unele dintre cele mai vizitate pensiuni de cazare în mediul rural sunt: Pensiunea La Popas situată în comuna Colibași din raionul Strășeni; Pensiunea Casa Verde situată în localitatea Țîpova; Pensiunea Casa de Vis din orașul Soroca [1].

2. Infrastructura turistică

În urma studiul datelor statistice privind turismul național, s-a constatat că numărul de camere disponibile în Republica Moldova în perioada 2020-2022 oferă o perspectivă asupra evoluției pieței locuințelor în această țară. Numărul de camere disponibile constituie un indicator important pentru a înțelege oferta de locuințe și cererea dintr-o anumită regiune sau întreaga țară [3]. În anul 2020 totalul de camere disponibile a fost de 3693. În anul 2021 numărul total de camere disponibile a fost de 3556 ; în anul 2022 se înregistrează 3855 de camere disponibile. Creșterea procentuală de la 2020 la 2021 este -3,71%. Anul 2021 la 2022 înregistrează o creștere de 8,42%. Creșterea procentuală în anii de la 2020 (3693 camere disponibile) la 2022 (3855 camere disponibile) a fost calculată după formula:

$$C_p = [(3855 - 3693) / 3693] \times 100 = 4,38\% \quad (1)$$

Această creștere reflectă faptul că, numărul de camere disponibile în Republica Moldova a crescut cu aproximativ 4,38% între anii 2020 și 2022. Rezultatele analizate arată că, în ciuda unei scăderi minore în 2021, numărul total de camere disponibile în Republica Moldova a înregistrat o creștere generală în intervalul de timp analizat. Este important de remarcat că, aceste cifre reflectă doar numărul de camere disponibile și nu reflectă, neapărat, disponibilitatea lor reală pentru locuit sau scopuri turistice. Regiunea de Nord a înregistrat o creștere constantă în numărul de camere disponibile. Regiunea Centru a avut o fluctuație cu o scădere în 2021 urmată de o creștere semnificativă în 2022. Regiunea de sud a avut o creștere moderată între 2021 și 2022 [3]. Per ansamblu, numărul total de camere disponibile în Republica Moldova a crescut în perioada analizată. Regiunea Centru a fost principalul factor care a influențat tendința generală de creștere (Tabelul 1).

Tabelul 1.

Nivelul de cazare în cele trei regiuni ale RM

Regiunea	Nivelul de cazare, camere/an		
	2020	2021	2022
Nord	1090	1090	1117
Centru	1922	1794	2022
Sud	681	672	716

În perioada ianuarie - septembrie 2023, numărul total de turiști cazați în structurile de primire turistică din Moldova a fost de 295,2 mii. Din acest total, 157,1 mii de vizitatori (aproximativ 53,2%) au fost rezidenți, în timp ce 138,1 mii de vizitatori (aproximativ 46,8%) au fost turiști nerezidenți. Comparativ cu aceeași perioadă a anului precedent (ianuarie-septembrie 2022), numărul turiștilor nerezidenți cazați a crescut cu 16,3 mii de persoane, reprezentând o creștere de aproximativ 13,4% [3]. În același timp, numărul turiștilor rezidenți cazați a crescut cu 19,8 mii de persoane, reflectând o creștere de aproximativ 14,4%. Aceste creșteri au fost observate în toate tipurile de structuri de primire turistică, așa ca:

- Hoteluri și moteluri: cu 17,0 mii de cazări
- Tabere de vacanță: cu 6,3 mii de cazări
- Pensiuni turistice: cu 5,7 mii de cazări
- Structuri de odihnă: cu 4,8 mii de cazări
- Cămine pentru vizitatori: cu 1,1 mii de cazări

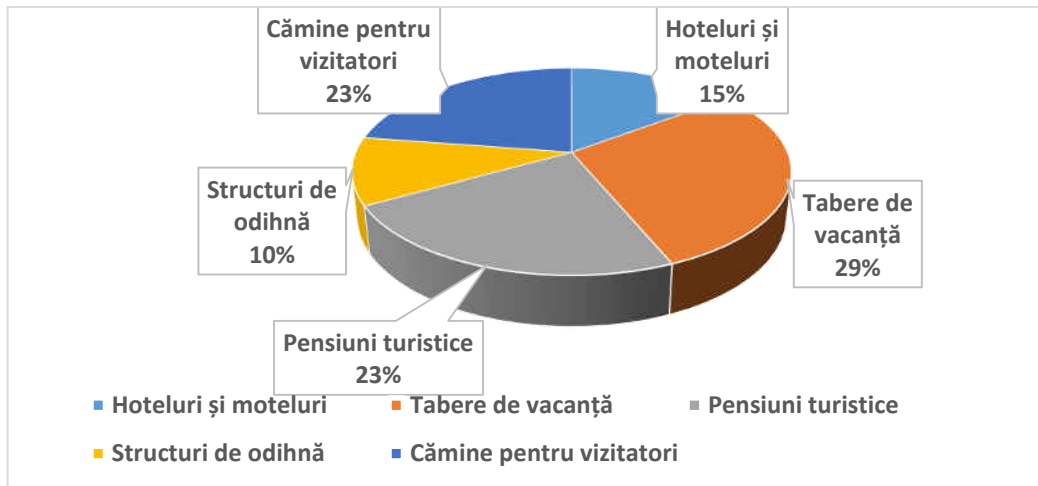


Figura 1. Tipuri și structuri de primire turistică [3]

În ceea ce privește distribuția geografică a turiștilor, municipiul Chișinău a atras cea mai mare pondere, cu 65,8% din totalul turiștilor cazați. Regiunea de dezvoltare Centru a reprezentat 20,8%, în timp ce regiunea de sud a avut 6,2%, Nordul 6,0%, iar UTA Găgăuzia 1,2%. Aceste date concretizează o creștere a industriei turismului în Moldova în perioada 2020-2022, evidențiind o creștere a atracției turistice atât pentru rezidenții locali, dar și pentru cei străini, și o diversificare a preferințelor de cazare și destinații turistice [3].

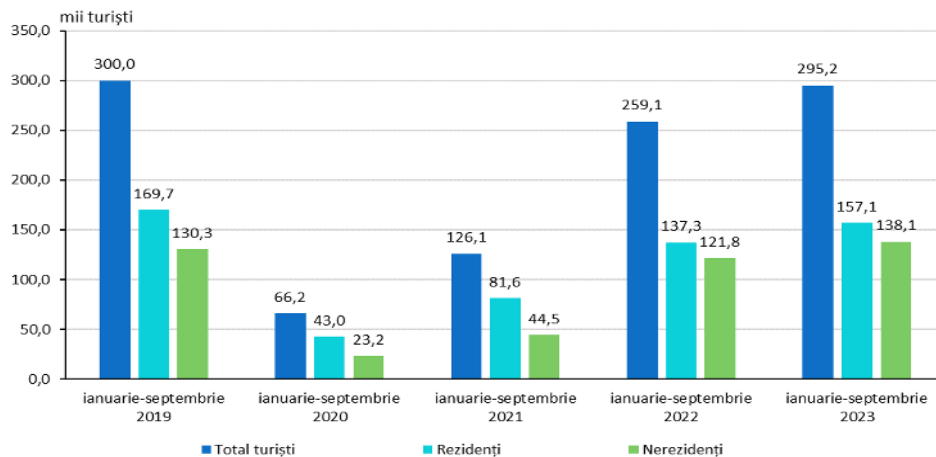


Figura 2. Turiști cazați în structurile de primire turistică colectivă (mii turiști) [3]

În perioada ianuarie-septembrie 2023, înnopțările înregistrate în structurile de primire turistică din Moldova au atins 1117,3 mii, determinând o creștere de 65,9 mii de înnopțări sau aproximativ 6,3% față de aceeași perioadă a anului anterior. Această creștere a fost remarcată în diverse tipuri de structuri de cazare, cu excepția pensiunilor turistice și agroturistice, precum și a hotelurilor și motelurilor, care au înregistrat scăderi. Astfel, din totalul înnopțărilor, aproximativ 73,2% au fost realizate de turiștii rezidenți, în timp ce 26,8% au fost înregistrate de turiștii străini. Acest lucru arată că majoritatea înnopțărilor sunt generate de turiștii locali [3]. În ceea ce privește capacitatea de cazare, numărul total de locuri oferite turiștilor în structurile de primire turistică a crescut cu 6,0% față de aceeași perioadă a anului precedent. Cele mai mari creșteri de cazare au fost observate în pensiuni turistice și agroturistice, cămine pentru vizitatori și tabere de vacanță pentru elevi. Durata medie de ședere a unui turist în structurile de primire turistică în această perioadă a fost de 4,8 zile. Aceste date indică gradul de ocupare a locurilor de cazare în diversele facilități turistice și reflectă gradul de atracție pentru turiști [3].

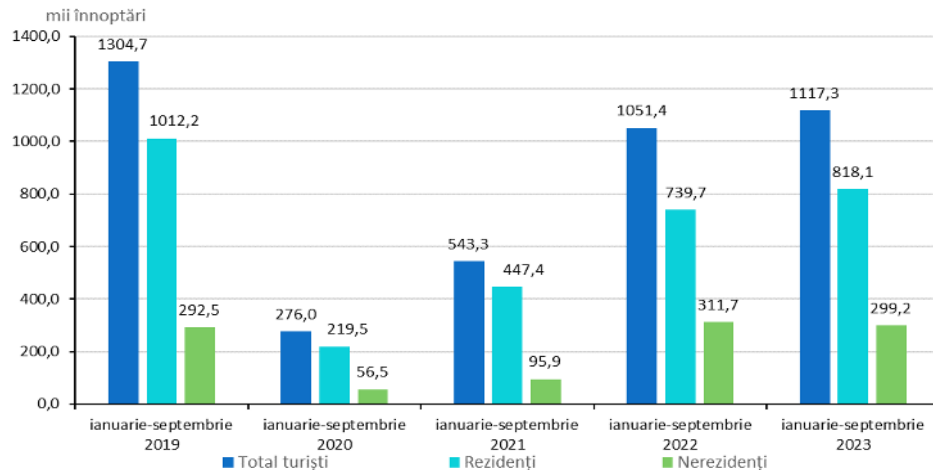


Figura 3. Numărul înnoptărilor în structurile de primire turistică colective (mii înnoptări) [3]

3. Cauzele care au influențat numărul de cazări

Scăderea semnificativă a numărului de cazări în 2020, urmată de o creștere în 2021 și continuarea acestei creșteri până în prezent, poate fi influențată de mai mulți factori. În 2020, industria turistică a fost grav afectată de restricțiile legate de Covid-19, cum ar fi închiderile de frontieră, carantine obligatorii și închiderea temporară a hotelurilor și altor facilități de cazare [3]. Mulți oameni și-au amânat călătoriile și vacanțele în timpul pandemiei, iar odată cu reducerea restricțiilor, s-a observat o creștere bruscă a numărului de cazări. În încercarea de a-și recâștiga clienții și de a stimula cererea, multe hoteluri și alte facilități de cazare au oferit reduceri, oferte speciale și pachete promoționale în 2021. Pandemia a schimbat modul în care oamenii călătoresc și își petrec timpul liber. Mulți preferă acum destinații mai puțin aglomerate, mai apropiate de natură sau călătorii mai lungi în loc de călătorii scurte. Aceste schimbări de preferințe pot influența cererea de cazare în diferite regiuni [3].

Concluzie

În urma efectuării analizei potențialului actual turistic din diverse regiuni ale Republicii noastre în ultimii trei ani (2019-2023), se poate de concluzionat că Republica Moldova poate și valorifică resursele sale naturale, printr-o varietate de tradiții și ritualuri locale, reflectate prin organizarea festivaluri, concertelor, etc. S-a constatat că, în funcție de nivelul de cazare, numărul de camere disponibile reprezintă un indicator important pentru a înțelege oferta de locuințe și cererea dintr-o anumită regiune sau întreaga țară. A fost apreciat nivelul cazării prin numărul de camere, prin numărul de turiști rezidenți și nerezidenți, care a constituit pentru hoteluri și moteluri - 17,0 mii de cazări (15%); tabere de vacanță - 6,3 mii de cazări (29%); pensiuni turistice - 5,7 mii de cazări (23%); structuri de odihnă - 4,8 mii de cazări (10%); cămine pentru vizitatori - 1,1 mii de cazări (23%). S-a demonstrat că cauzele acestor devieri semnificative s-au datorat apariției neașteptate a pandemiei provocate de Covid-19 [3].

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POTENȚIALUL TURISMULUI RURAL DIN RAIONUL CAHUL, REPUBLICA MOLDOVA

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Rezumat. În urma efectuării lucrării date, a fost analizată zona cu potențial turistic rural enorm, și anume raionul Cahul, situat în sudul Republicii Moldova. S-a stabilit că raionul Cahul este gazda nenumăratelor pensiuni (Casa Bunicului, Eco-Village Văleni), case rurale (La Bunica Clava, La Savetuca) etc., care au fost întemeiate de familii locale pentru a promova frumusețea turismului rural și bucatele tradiționale moldovenești preparate din ingrediente proaspete și ecologice cultivate local. S-a apreciat că gastronomia Cahulului este diversă, oferind cele mai de bază bucate moldovenești, dar și bucate specifice sudului. Localitatea Slobozia Mare din raionul Cahul, Moldova, se distinge prin renumitele rețete inedite de dulceață și boia de la sud. În timpul pandemiei, a fost deschisă o pensiune în casa rurală, cu bucate deosebite specifice regiunii. În satul Roșu din același raion, o rețetă tradițională de colțunași cu struguri a popularizat regiunea. În sudul Moldovei, plachia de pește reprezintă o mâncare tradițională, preparată cu pește proaspăt, roșii, ceapă și verdețuri, iar iahnia de pui este o altă delicatesă apreciată în bucătăria moldovenească, servită cu diverse garnituri. Aceste rețete autentice reflectă bogăția și diversitatea culinară a regiunii, păstrând tradițiile și aromele locale.

Cuvinte cheie: Cahul, pensiune, casă rurală, gastronomie, tradiție

Introducere

Raionul Cahul, situat în sudul Republicii Moldova, este o zonă cu o bogată tradiție culturală și istorică, dar și cu o gastronomie variată și atrăgătoare pentru vizitatori. În ceea ce privește pensiunile, acestea sunt o opțiune populară pentru turiștii dornici să exploreze frumusețea și farmecul regiunii Cahul [1]. Unitățile de cazare din raionul Cahul sunt diversificate, oferind o gamă largă de facilități și servicii pentru a satisface diferitele nevoi ale călătorilor. De la pensiuni rurale pitorești, situate în satele tradiționale, până la vile elegante sau complexe turistice moderne, opțiunile sunt variate și pot acoperi diverse preferințe și bugete. Gastronomia din raionul Cahul este o altă atracție majoră pentru vizitatori. Această zonă este renumită pentru bucatele sale tradiționale moldovenești, preparate cu ingrediente proaspete și într-un stil autentic. Printre preparatele populare se numără plăcinte rumene, sarmalele cu mămliguță, dar și bucate din pește proaspăt, dat fiind faptul că raionul Cahul este bogat în resurse naturale, având numeroase lacuri și râuri. Unitățile de cazare din raionul Cahul oferă o varietate de opțiuni culinare, de la bucate tradiționale moldovenești până la preparate internaționale și reinterpretări moderne ale bucătăriei locale. Mulți dintre proprietarii pensiunilor, caselor rurale și ale complexelor turistice sunt pasionați de gastronomie și folosesc ingrediente locale și de sezon pentru a crea experiențe culinare autentice și memorabile pentru oaspeți [2].

Diversitatea pensiunilor și caselor rurale din raionul Cahul. Cahul, un oraș pitoresc din sudul Republicii Moldova, este renumit pentru peisajele sale idilice, atmosfera liniștită și opțiunile variate de turism rural. Printre atracțiile sale se numără pensiunile rurale „Casa Bunicului”, „Eco-Village Văleni”, diverse case rurale cum ar fi „La Savetuca”.



Figura 1. Curtea a Casei Bunicului [3]

„Casa Bunicului” este o agropensiune care s-a format din dragostea față de familie, de tradiții, și de planul nostru natal. Este situată în satul Pașcani, Raionul Cahul, și se învecinează cu râul Prut și cu lacul natural Manta, ce oferă o priveliște superbă. Pensiunea mai oferă și o bucătărie de invidiat, cu bucate tradiționale autentice gătite doar din produse naturale, aroma cărora reîntorc turiștii de nenumărate ori, iar ospitalitatea gazdelor reprezintă felul de a fi al poporului nostru. Pensiunea „Casa Bunicului” este echipată cu un restaurant, foșoare pentru oaspeți, zone pentru grătar și teren de joacă pentru copii. Aici, oaspeții se pot bucura de numeroase activități în aer liber și sportive, inclusiv plimbări cu barca, ciclism și birdwatching pentru cei pasionați de natură. De asemenea, în incinta pensiunii se găsește o mini-cramă, unde se poate degusta vinul din brandul familiei Lazăr – „Vin de Pașcani”. Pentru cei ce apreciază gustul tradițional, se organizează ateliere de coacere a pâinii tradiționale, plăcintei și colacilor pe vatră [3].

Fondat la începutul anului 2014, EcoVillage Văleni este o afacere locală dedicată turismului rural, cultural, vitivinicol și ecoturismului. Proprietarii au avut inițial ca scop crearea unui punct de atracție la nivel național și internațional, devenind un exemplu și un motor al dezvoltării rurale în regiune.



Figura 2. Curtea „Casa morarului”, „Casa pescarului”, „Casa ciobanului” și „Casa fierarului” [4]

Pornind de la conceptul unui muzeu tradițional, complexul s-a extins pentru a include capacități de cazare ecologică, un restaurant rustic și o mică vinărie de familie – Corbu Winery. Scopul familiei este de a oferi pachete turistice variate pentru a primi atât turiști străini, cât și locali. În curtea pensiunii sunt amplasate 4 case rustice tematice: fiecare dispune de 2 camere cu intrări separate, echipate cu paturi din lemn, TV, Wi-Fi și băi proprii. Capacitatea totală de cazare a pensiunii este de 24 de locuri [4].



Figura 3. Portul tradițional din Văleni [5]

O altă locație turistică reprezintă Casa rurală „La Savetuca”. Svetlana Vodă, administratorul Casei Rurale „La Savetuca”, este o pasionată promotoare a tradițiilor și culturii locale. În curtea ei, te vei simți ca și cum ai călători în timp, descoperind istoria locului și povestea lui Petru Rareș, fiul nelegitim al lui Ștefan cel Mare, domnitorul Moldovei. Satul Văleni, unde se află casa, este cunoscut ca un sat de pescari, iar legenda spune că Petru Rareș transporta pește cu căruța la Galați pe drumul care astăzi îi poartă numele „Drumul lui Petru Rareș”.

Doamna Svetlana oferă servicii de alimentație publică, servind plăcinte calde și diverse conserve tradiționale, precum zacuscă, ardei, roșii și castraveți, toate cu gust autentic, ca la mama acasă. Specialitatea casei este plăcinta căreia i se zice „pesmeți cu brânză”. Aici puteți gusta bucate tradiționale specifice zonei de sud a Moldovei. Serviciile de agrement prestate includ cântece și portul popular, cu elemente specifice ale portului popular din Văleni, reprezentat prin fustă, pestelcă, ciupag, totoși și batistă, completate de cămașă. Pentru a face vizita și mai memorabilă, Casa „La Savetuca” încântă cu fragmente autentice din folclorul local, invită de a bate doba sau chiar de a purta hainele tradiționale pentru o experiență autentică [5].

„Casa rurală” este situată într-o locație pitorească, chiar la poalele Colinelor de Aur din satul Văleni. Acest adăpost îmbină povestea mai multor generații, inclusiv a bunicii Clava, cu dorința proprietarilor de a oferi turiștilor o incursiune autentică în cultura și tradițiile locale. Casa a fost păstrată în forma sa originală, construită în anul 1961, permițând fiecărui vizitator să se bucure de o călătorie în timp atunci când explorează această pensiune. De la prispa casei și cotloanele vechi, până la grădina înfloritoare care oferă o priveliște încântătoare asupra luncii Prutului, fiecare element contribuie la păstrarea autenticității vieții rurale și atrage tot mai mulți turiști pe aceste meleaguri în căutarea liniștii sufletești. Grădina generoasă este un adevărat paradis pentru cei ce caută gustul copilăriei, oferind căpșuni, cireșe, zmeură, struguri, roșii și multe alte zarzavaturi ce pot fi culese și savurate de către oaspeți. Casa dispune de două camere, fiecare cu trei locuri, un bloc sanitar comun, o bucătărie complet utilată și un foisor în aer liber, toate amplasate într-o curte spațioasă. Încălzirea este asigurată de centrala termică, dar pentru cei care doresc să trăiască atmosfera rurală autentică, se poate aprinde focul în sobă. Proprietarii casei rurale oferă, de asemenea, oferă posibilitatea de a explora dealurile aurii din împrejurimi, unde, cu puțin noroc, se pot observa căprioare sau se poate savura mireasma salcâmlor înfloriți. Și nu în ultimul rând, cea mai gustoasă gutuiata poate fi degustată aici, completând astfel experiența culinară și culturală oferită de Casa Rurală „La Bunica Clava” [6].



Figura 4. Curtea “Casei rurală” [6]

Gastronomia specifică zonei din Sud. Gastronomia specifică populară regiunii date este reprezentată prin persoane concrete ce propun un sortiment original de bucate caracteristice regiunii date. Spre exemplu, localitatea Slobozia Mare din raionul Cahul este cunoscută pentru piața transfrontalieră modernă „Poarta belșugului”. Una dintre cele mai iscusite și cunoscute bucătărese de la sudul Republicii Moldova este Maria Minciună. Bucătăreasa este cunoscută și pentru rețetele inedite de dulceată făcută din roșii cherry, ardei, smochine, floare de salcâm și de soc. Maria Minciună face și renumita boia de la sud din ardei grași, folosită de gospodine în bucate. Covid-ul a făcut-o să-și deschidă pensiune în casa ei, unde propune cazare pentru 2 zile oferind servicii de alimentație reprezentate prin bucate autohtone caracteristice regiunii date [7].

În urma studiului efectuat, a fost descoperită o rețetă de sezon, colțunași cu struguri, o specialitate care se prepare în satul Roșu din raionul Cahul. Această rețetă specifică acestei regiuni a făcut-o publică Dna. Maria Furtună din localitatea s. Roșu. Rețeta constă în primul rând din pregătirea poamei înainte de a fi folosită ca ingredient. Strugurii se spală bine, se taie în jumătate, se scoate sâmburele și se adaugă câte 2 linguri de zahăr, după asta se pun la fiert 10 min. max. Se pregătește foile din aluat, din care se face cercuri cu ajutorul formei speciale sau cu un pahar. Înainte de a pune umplutura, trebuie de întins puțin de tot cerculețele de aluat și după se umple cu câte un strugure. Apoi colțunașii se adaugă în apa clocotindă și se fierb cu adaos de sare și ulei timp de 3 minute [8].

O altă rețetă autentică sudului Moldovei este plachia de pește, care reprezintă un preparat care nu lipsește de pe masa moldovenilor din regiunea dată. Aceasta face parte din tradiția noastră culinară și este pregătită în special din peștele prins în râurile și lacurile Moldovei. Peștele proaspăt, roșiile, ceapa și verdețurile alcătuiesc un buchet de arome delicios [9].



Figura 5. Plachia de pește [9]

Un alt deliciu tradițional moldovenesc constituie Iahnia de pui. Este o rețetă tradițională și una dintre mâncărurile preferate ale moldovenilor. Aceasta este cunoscută sub mai multe nume, în dependență de regiunea unde se gătește: iahnie, ianâie, sous și mâncărică. Poate fi servită cu mămăligă, brânză și smântână, cartofi sau orez [10].



Figura 6. Iahnia de pui [10]

Concluzii

În urma acestei lucrări se poate de concluzionat că, Cahulul găzduiește o varietate de pensiuni și case rurale, care oferă oaspeților experiențe autentice și captivante în mijlocul naturii și tradițiilor locale. S-a constatat că fiecare pensiune sau casă rurală descrisă în lucrare, chiar dacă au anumite caracteristici comune regiunii date, totuși diferă prin specificul său, fie de cazare, de alimentație sau de agrement. Însă cu siguranță se poate de menționat că, raionul Cahul este regiunea unde oaspeții sunt întâmpinați cu ospitalitate și bucate delicioase pregătite cu dragoste și grijă.

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TURISMUL CULTURAL VITIVINICOL ÎN REPUBLICA MOLDOVA

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Rezumat. În urma efectuării acestui studiu, s-a constatat că cultura în Moldova este o componentă importantă pentru industria turismului. Se poate de menționat că viticultura în Republica Moldova are un rol însemnat în dezvoltarea economiei și a turismului cultural, fiind una dintre cele mai vechi și respectate tradiții. Astfel, s-a apreciat faptul că țara noastră are o industrie a vinului bine dezvoltată, cu o suprafață de 148.500 de hectare de vii și cu numeroase vinării recunoscute la nivel internațional. Teritoriul unic, clima prielnică și experiența îndelungată a viticultorilor au contribuit la producerea unor vinuri de calitate superioară. Această bogată tradiție viticolă este, adesea, integrată în experiențele turistice, oferind vizitatorilor oportunitatea de a descoperi procesul de producție a vinului și de a degusta sortimentele locale, ceea ce adaugă un plus de valoare și autenticitate turismului cultural local.

Cuvinte cheie: tradiții, turism cultural, viticultură, vinării

Introducere

În epoca contemporană, turismul cultural și conservarea patrimoniului cultural au devenit aspecte tot mai cruciale pentru dezvoltarea economică și socială a comunităților la nivel global. Cultura Republicii Moldova este comoara fiecărei națiuni. Încă din cele mai vechi timpuri, în operele literare și cercetările științifice, conceptul de cultură a inclus limba, istoria și tradițiile Moldovei. Cultura este considerată unul dintre principalele motive de atracție pentru turiști, deoarece oferă oportunitatea de a experimenta și a înțelege moștenirea culturală și creativitatea unei comunități. Astfel, turismul cultural devine o formă de călătorie care contribuie nu doar la dezvoltarea economică, ci și la promovarea și conservarea patrimoniului cultural al unei țări [1].

Este important că Moldova promovează activ cultura și tradițiile sale prin organizarea diverselor festivaluri și evenimente. De exemplu, anual are loc Festivalul Tradițiilor Vinului, care atrage turiști din întreaga lume. De asemenea, festivalurile de muzică națională, dansuri și bucătărie sunt populare printre turiști [2].

În această lucrare, se evidențiază cultura ca principal factor turistic pentru dezvoltarea țării și pentru îmbogățirea turiștilor cu informații noi.

Aspectele principale ale turismului cultural

Turismul cultural în Republica Moldova este o componentă importantă a industriei turistice și valorifică bogăția și diversitatea patrimoniului cultural și istoric al țării. Acest tip de turism încurajează vizitatorii să exploreze obiectivele culturale și istorice ale localităților, să învețe despre tradițiile și obiceiurile populației locale și să se bucure de experiențe autentice. Cultura și tradițiile o diferențiază semnificativ de alte țări și o fac specială. Turismul cultural în Republica Moldova oferă următoarele posibilități [3]:

- Turiștii au oportunitatea de a descoperi o mulțime de fapte interesante prin care își pot îmbogăți cunoștințele sale culturale;
- Turismul pentru tineret, în care include turismul sportiv, festivaluri vitivinicole, master-class-uri, etc.;

- Turismul rural care pune la dispoziție sejururi în localuri tradiționale sau în sate de vacanță caracteristice regiunii vizitate;
- Participarea la festivaluri regionale, naționale și internaționale;
- Excursii cu teme culturale, care include vizitarea de muzee, locuri istorice și participarea la diferite manifestări culturale;
- Pelerinaje la locuri și monumente istorice religioase;
- Explorarea activităților vitivinicole tradiționale.

Industria vinicolă constituie o ramură importantă în dezvoltarea țării. Moldova are un sol roditor, ceea ce influențează la obținerea vinurilor de calitate înaltă și la dezvoltarea industriei vitivinicole.

Cele mai importante și vestite regiuni producătoare de vin sunt amplasate în zona de nord (Bălți), centru (Codru), sud-est (Nistreana, care include și faimoasa zonă Purcari) și sud (Comrat). Printre cele mai renumite vinării din Republica Moldova se pot enumera [4]:

Crama Cricova este una dintre cele mai mari crame din Republica Moldova, fiind a doua vinărie după suprafața sa, cu vii frumoase, tururi de producere și degustare a vinurilor de calitate superioară. Această vinărie oferă o experiență unică în lumea vinificației și în tradițiile regiunii date [5].



Figura 1. Vinăria Cricova [5]

Crama Asconi reprezintă o colecție de arhitectură rafinată cu peisaje pitorești de neuitat și podgorii masive. Această vinărie reflectă personificarea familiei moldovenești, datorită unei afaceri de familie fondată în anul 1994. Turiștilor li se oferă oportunitatea de a vizita satul rural autohton cu tradiția și cultura sa neobișnuită [6].



Figura 2. Vinăria Asconi [6]

Chateau Cojușna este vinăria care, aidoma mașinii timpului, împarte prezentul de trecut. Fiecare excursie începe cu istoria vinăriei și regiunii în care se află ea. Turiștii iau cunoștință cu diferite tehnologii tradiționale de fabricare a vinurilor autohtone, caracteristice regiunii. Una dintre opțiunile propuse turiștilor, pe lângă degustarea vinurilor autohtone de calitate, li se propune și o varietate de bucate tradiționale. Chateau Cojușna va rămâne asemenea unei oaze la hotarele Europei [7].



Figura 3. Chateau Cojușna [7]

Vinăria Purcari. Încă din anul 1827, această vinărie a devenit prima vinărie oficială în Basarabia, acumulând o istorie specială de-a lungul anilor. Solul său bogat în rubidiu, permite fabricarea vinurilor deosebite față de celelalte vinuri autohtone. Fiind cea mai veche dintre vinăriile din Moldova, *vinăria Purcari* este una dintre cele mai apreciate la nivel internațional, prin obținerea premiilor așa ca Decanter, Challenge International du Vin, Concours Mondial de Bruxelles [8].



Figura 4. Vinăria Purcari [8]

Dintre vinăriile din Moldova, *Mileștii Mici* se bucură de cea mai mare galerie subterană de vinuri. Această vinărie este vestită atât în țara noastră, cât și peste hotarele ei, datorită localului specific și a vinurilor deosebite, care în anul 2005, datorită lor această vinărie a fost inclusă în Cartea Recordurilor Guinness. Un specific caracteristic acestei vinării este că conține podgorii de viță de vie pe întreg teritoriu al Republicii Moldova [9].



Figura 5. Vinăria Mileștii Mici [9]

Denumirea sa vine de la Constantin Mimi, fostul guvernator al Basarabiei, care a lăsat moștenire Moldovei acest castel. Castelul a devenit o vinărie modernă cu o infrastructură dezvoltată, neluând în considerare aspectul său istoric deosebit. Totuși, aceasta a rămas o vinărie care și-a păstrat istoria și tradițiile. Turisții care aleg să viziteze Castelul Mimi, una dintre cele mai spectaculoase vinării din Moldova, se pot bucura atât de vinuri de calitate superioară, cât și de ospitalitatea sa (hoteluri, restaurante, terase și grădină minunată) [10].



Figura 6. Vinăria Castel Mimi [10]

Concluzii

În urma acestei lucrări se poate afirma că, turismul cultural în Moldova nu este doar un potențial neexplorat, ci o comoară ascunsă ce trebuie să fie valorificată în mod corespunzător. Cu o istorie bogată și o diversitate culturală remarcabilă, Moldova oferă o gamă variată de experiențe autentice pentru călători, viticultura având o importanță economică și culturală deosebită. Pe lângă faptul că vinurile moldovenești sunt apreciate la nivel internațional pentru calitatea lor, ele oferă și oportunitatea de dezvoltare în turismul internațional și rural. Susținerea viticulturii poate contribui la conservarea peisajelor tradiționale și la menținerea identității culturale a regiunii. Moldova poate deveni o destinație turistică de prim plan în regiune, îmbogățind nu doar economia țării, ci și viața culturală și socială a locuitorilor săi.

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СПОСОБЫ ПОВЫШЕНИЯ ПИЩЕВОЙ ЦЕННОСТИ ИЗДЕЛИЙ ИЗ ПЕСОЧНОГО ТЕСТА

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Абстракт. Песочное тесто является широко используемой основой для приготовления сладкой и соленой выпечки, включая печенье, пирожные, пироги, тарты и другие изделия, часто употребляемые в качестве перекуса. Его популярность обусловлена удобством в транспортировке, длительным сроком годности, разнообразием, приятным вкусом и высоким содержанием углеводов и жиров, что вызывает ощущение сытости на протяжении длительного времени. Однако, частое употребление изделий из песочного теста может привести к негативным последствиям для здоровья, таким как повышение уровня глюкозы в крови и увеличения концентрации холестерина липопротеинов низкой плотности (ЛПНП). Это связано с высоким содержанием сахаров, предельных жирных кислот и других нежелательных компонентов в песочном тесте.

В качестве способа повышения пищевой ценности изделий на основе песочного теста были рассмотрены преимущества и недостатки использования альтернативных ингредиентов с низким гликемическим индексом, богатых здоровыми жирами, белками и клетчаткой (цельнозерновая мука, аглютиновые смеси, натуральные подсластители и др.). Одним из наиболее эффективных методов является внедрение в рецептуру вторичных продуктов масложировой промышленности. Применение шротов местного производства может существенно расширить ассортимент готовой продукции, а также снизить риск развития сахарного диабета, ожирения и сердечно-сосудистых заболеваний у потребителей.

Ключевые слова: шрот, белки, клетчатка, здоровые жиры, технология приготовления

В настоящее время быстрым и легкодоступным источником калорий для организма человека стали мучные кондитерские изделия, которые пользуются популярностью у населения и часто употребляются в виде перекуса. Однако их химический состав не сбалансирован из-за высокого содержания жиров, углеводов и достаточно низкого количества, а в ряде случаев и полного отсутствия пищевых волокон, минеральных веществ и витаминов [1].

Среди наиболее популярных видов кондитерских изделий можно выделить изделия из песочного теста. Они включают в себя такие изысканные лакомства, как песочные печенье, тарталетки с фруктами, миндальные бисквиты, сладкие кексы и многое другое. Благодаря большому разнообразию и богатому вкусу, эти изделия являются неотъемлемой частью кондитерского ассортимента. Однако, частое употребление изделий из песочного теста может привести к негативным последствиям для здоровья, таким как повышение уровня глюкозы в крови и увеличения концентрации холестерина липопротеинов низкой плотности (ЛПНП). Данные ВОЗ свидетельствуют, что более 80% всех заболеваний взрослых и детей в той или иной степени связаны с нарушением питания (сердечно-сосудистые заболевания, сахарный диабет 2 типа, остеопороз и т.д.) [2].

Для сохранения конкурентоспособности выпускаемой продукции необходимо учитывать не только высокие стандарты качества, предъявляемые потребителями, но и

соответствие требованиям здорового питания [3]. Поэтому важной задачей кондитерской промышленности является разработка и выпуск новых видов продукции с введением в их состав функциональных ингредиентов, не изменяющих органолептических свойств продукта, однако способствующих повышению его пищевой ценности [4].

Целью данной работы явилось изучение возможности улучшения пищевого состава песочного теста за счет использования альтернативных ингредиентов, способных снизить содержание сахаров, предельных жирных кислот, а также увеличить количество клетчатки без потери органолептических характеристик, свойственных данному продукту.

Для того, чтобы оптимизировать состав и вкусовые качества песочного теста были изучены особенности технологии приготовления данного полуфабриката, а также физико-химические изменения, которые происходят во время его механической и термической обработки (Рис. 1).

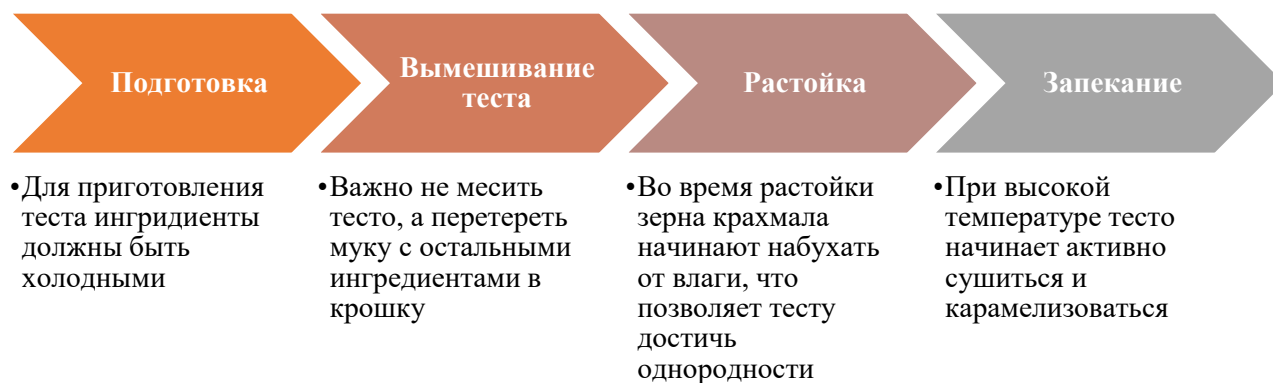


Рис. 1. Особенности этапов приготовления песочного теста [5-7]

Среди особенностей этапов приготовления песочного полуфабриката, можно отметить, что во время вымешивания необходимо не месить тесто, а перетереть муку с остальными ингредиентами в крошку. Мука содержит глютелин и проламин которые в группе при длительном вымешивании образуют глютен. Клейковина имеет большое значение для упругости и эластичности теста, что не соответствует характеристике песочного полуфабриката [8].

В процессе же выпечки наибольшие изменения претерпевают белки и крахмал. При достижении температуры 50-70°C белки начинают денатурировать и коагулировать, высвобождая воду, абсорбированную крахмалом. Часть воды вызывает набухание крахмальных зерен, а другая приводит к их разрыву, формируя клейстер. Под действием высокого давления и объема паров, особенно водяных, поры в тесте расширяются. Обезвоженные белки клейковины и клейстеризованный крахмал формируют скелет для пор, предотвращая обрушение теста. При 150°C происходит реакция Майяра, при которой сахар и белки разлагаются, образуя коричневый оттенок и придавая сладковато-горьковатый вкус изделиям. Этот процесс, называемый карамелизацией, характеризует особенную структуру и вкус выпечки [6, 7].

Таким образом, одним из возможных методов улучшения пищевого состава песочного теста является использование аглютеновых продуктов с повышенным содержанием клетчатки, таких как, например, кукурузная и полбяной мука [4, 9]. Однако, наиболее перспективным альтернативным сырьем являются шроты, которые могут способствовать не только повышению количества клетчатки в готовых изделиях, но также стать источником белка и полиненасыщенных жирных кислот [10].

Шрот представляет собой побочный продукт, получаемый при экстрагировании масла, который в настоящий момент используется, главным образом, в качестве ценного высокобелкового продукта для корма сельскохозяйственных животных. Шроты

отличаются высоким содержанием полноценного белка (до 40%) и наличием жиров (около 15%), богатых полиненасыщенными жирными кислотами, такими как линоленовая и линолевая. Белки этих продуктов превосходят по биологической ценности белки зерновых культур. Кроме того, они обогащены витаминами группы В, Е, калием и фосфором [11]. Таким образом, шроты представляют собой перспективное сырье для создания функциональных кондитерских изделий с повышенной пищевой и биологической ценностью.

Для того, чтобы оценить влияние замещения муки пшеничной на шрот была получена серия проб различных изделий (Табл. 1) на основе стандартной рецептуры полуфабриката - тесто песочное сладкое (ТК1383), в состав которого входит 45% муки высшего сорта, 28% масла сливочного, 20% сахарной пудры и другие компоненты [12].

В качестве аглютенного сырья был использован шрот из миндального ореха (*Prunus dulcis*), произведенный местной масложировой промышленностью. Для улучшения текстуры, предотвращения разделения ингредиентов и повышения устойчивости теста к деформации при обработке в пробы на основе 100% шрота была добавлена ксантановая камедь – природный полисахарид, который обладает уникальными свойствами стабилизации и загустителя [13]. Также было уменьшено количество сливочного масла (на 20%), пропорционально содержанию липидов в миндальном шроте.

Таблица 1

Свойства изделий из песочного теста на основе миндального шрота

Характеристики / Тип пробы	Проба эталон (100% муки пшеничной)	Продукт со 100% шрота с уменьшенным кол-вом жира,	Продукт, мука пшеничная: шрот = 1:1
Изображение			
Выход продукта, %	80	89	84
Внешний вид	гладкая поверхность с еле заметными трещинами	поверхность шероховатая с небольшими трещинами	поверхность гладкая с еле заметными трещинами
Цвет	желтовато-белый, местами с коричневым оттенком	коричневый, местами с темно-коричневым оттенком	светло-коричневый, однородный
Текстура	нежная, рассыпчатая	нежная, рассыпчатая	нежная, рассыпчатая
Вкус	сладкий, без горечи	присутствует небольшая горечь с нотками какао	горечи нет, есть тонкий привкус какао
Запах	сливочный	какао	какао

Полноценное замещение муки пшеничной шротом отобразилось на изделиях проявлением горьковатого послевкусия и более плотной текстурой с шероховатой поверхностью, по сравнению с другими образцами. Проявление подобных характеристик является следствием того, что миндальное масло экстрагируют из орехов, покрытых оболочкой, чьи свойства затем влияют на вкус и текстуру кондитерских изделий. Однако, горьковатость и наличие крупных частиц можно уменьшить за счет тщательного просеивания муки шрота.

Согласно Таблице 1, по органолептическим показателям выделились изделия с 50% замещения пшеничной муки, которые характеризовались нежной и рассыпчатой текстурой, приятным вкусом с нотками какао и устойчивой формой, без трещин.

Химический состав полученных изделий представлен в Таблице 2.

Таблица 2

Химический состав изделий по типу песочное теста

Характеристики Тип пробы	Пробы песочного теста, г/100 г продукта			% от рекомендуемой суточной нормы потребления
	Эталон, 100% муки пшеничной	Продукт, мука пшеничная: шрот = 1:1	Продукт, 100% шрота, с уменьшенным кол-вом жира	
Белки	5.60	6.91	8.15	5.60
Жиры,	21.42	26.46	27.15	23.80
из к-рых насыщенные жирные кислоты	14.91	15.09	12.21	33.13
Углеводы,	51.03	36.93	22.74	14.58
из к-рых сахара	19.69	20.32	20.95	28.13
Пищевые волокна	0.05	0.79	1.53	0.15
Энерг. ценность, ккал	422.54	441.44	420.62	19.21

Согласно Таблице 2, использование шрота миндаля в рецептуре песочного теста способно повысить количество белка в 1,5 раза, а клетчатки – в 30 раз, при этом уменьшив общее содержание углеводов в 2 раза.

Выводы

Таки образом, результаты исследования показали, что применение миндального шрота в рецептуре песочного печенья является целесообразным, так как данный продукт характеризуется высоким содержанием клетчатки, белка и яркими вкусовыми качествами.

Применение шротов местного производства может существенно расширить ассортимент готовой продукции, а также снизить риск развития заболеваний, связанных с питанием, у потребителей. Побочный продукт масложировой промышленности также является выгодным с экономической точки зрения, так как его стоимость является ниже стоимости пшеничной муки, а пищевая ценность намного выше. Внедрение шротов в производство мучных кондитерских изделий может значительно повысить качество продукции, расширить её ассортимент и восполнить недостаток организма пищевыми волокнами, витаминами и микроэлементами.

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SOUS-SECTION SCIENCE DES ALIMENTS

VALORISATION DU POTENTIEL NUTRITIONNEL DES FIGUES RÉCOLTÉES EN RÉPUBLIQUE DE MOLDAVIE

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Résumé. Cet article étudie les stratégies et les possibilités d'exploitation du potentiel nutritionnel des figues cultivées en République de Moldavie par rapport aux figues cultivées dans d'autres pays, en analysant la composition physico-chimique du fruit. Les figues sont des fruits riches en fibres, vitamines et minéraux, offrant de nombreux bienfaits pour la santé et contribuant à une alimentation équilibrée. Les caractéristiques physico-chimiques et l'analyse organoleptique ont été évaluées par des méthodes analytiques standardisées. Etudiant des diverses techniques de transformation, on a constaté que ces fruits peuvent être intégrés dans divers produits alimentaires, cosmétiques et pharmaceutiques. En outre, les résultats de cette étude peuvent fournir des informations précieuses aux producteurs agricoles, aux chercheurs et aux consommateurs, et la culture de ce fruit sur le territoire de la République de Moldavie peut contribuer à la croissance de l'économie locale et au développement de l'agriculture moldave.

Mots clés: figue, potentiel nutritionnel, indices physico-chimiques, alimentation équilibrée

Introduction

Au cours des dernières décennies, l'intérêt pour une alimentation saine s'est considérablement accru partout dans le monde. Dans le contexte de cette tendance, les fruits et légumes sont devenus des points centraux dans les efforts visant à promouvoir une alimentation équilibrée et bénéfique pour la santé humaine. Parmi elles, les figues sont les plus appréciées, en raison de leur contenu nutritionnel et de leurs bienfaits pour la santé [1].

Le figuier *Ficus Carica L.* est une espèce du genre *Ficus* appartenant à la famille des Moracées. Il est originaire d'Asie du Sud-Ouest et se trouve également à l'état sauvage dans la région méditerranéenne.

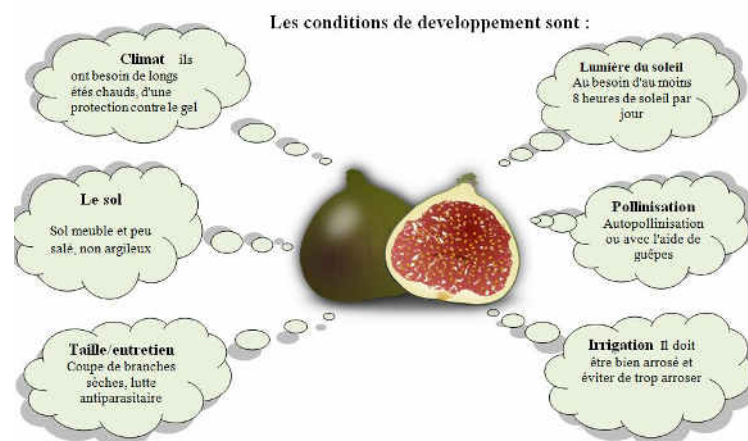


Figure 1. Les conditions favorables pour le développement des figuiers [2]

Description des variétés de figes

Le genre *Ficus* comprend plus de 800 espèces de figes dans le monde. Ainsi, les espèces les plus connues et les plus répandues dans les zones proches de la République de Moldavie seront analysées. Ce type de fruit n'était pas connu et cultivé en RM jusqu'à l'époque du changement climatique. Certaines variétés ont été acclimatées et adaptées, ce sont :

1. Adriatique - Les arbres sont très productifs et ne nécessitent pas beaucoup de soins. Les fruits sont en forme de poire et de taille moyenne, de couleur verte sur la peau et ont une chair rouge fraise. Les graines sont nombreuses et vides.

2. Calimyrna (Lob Injir) - Les figes ont la forme d'un gros oignon, la peau est jaune verdâtre, la chair est ambrée ou fraise claire et les graines sont grosses, nombreuses et fertiles [2].

3. Kadota (Dottato, White Endich, Honey Fig) – Les fruits sont gros, verts en forme de poire et ont une pulpe teintée de violet. Ceux de la deuxième récolte sont de taille moyenne, avec une peau vert jaunâtre, sans pépins et bons pour la conservation.

4. Mission (Black Mission, California Black, Franciscana) – Les fruits sont gros, en forme de poire, de couleur violet-noir et ont une chair fraise. Les graines sont nombreuses et vides.

5. Dinde (Brown Turkey, Black Douro) – Ils sont gros ou très gros, en forme de poire, brun noir et ont une chair ouverte de fraise. Les aiguilles de la deuxième récolte sont moyennes avec une couleur noir violacé à violet rougeâtre.

6. Brunswick (Magnolia) - Les fruits sont peu nombreux, gros, obliquement en forme de poire, la peau est brun rougeâtre et présente une pulpe de fraise et une texture épaisse [2].



Figure 2. Variétés des espèces de figes dans le monde entier [2]

Bienfaits médicaux de la fige *Ficus Carica*

Les fruits du *Ficus Carica* sont une bonne source de nutriments et de composés phytochimiques qui contribuent à améliorer la santé. La fige est très nutritive et riche en fer et en fibres. La consommation quotidienne de fruits frais et secs en quantité adéquate aide l'organisme à avoir une bonne digestion. Il convient de noter que les fruits secs ont une teneur plus élevée en calories et en sucre, ce qui peut entraîner des effets indésirables tels que la constipation et l'obésité. Les parties de la plante *Ficus Carica* qui peuvent être utilisées pour traiter les maladies sont : les feuilles, les racines du figuier et le fruit. Les effets bénéfiques détectés dans les rapports pharmacologiques de cette plante dans son intégralité sur le corps humain sont : antipyrétique, anti-inflammatoire, antispasmodique, vermifuge, hépato-protecteur, anti-constipation, hypoglycémiant, hypocholestérolémiant, hypolipidémique, anticancéreux, cytotoxique, antiviral, antimutagène, anti-angiogénique, érythropoïétique, hémostatique, antimicrobien, antioxydant, effet piègeur de radicaux libres, immunostimulant, activité antigène, potentiel irritant [3].

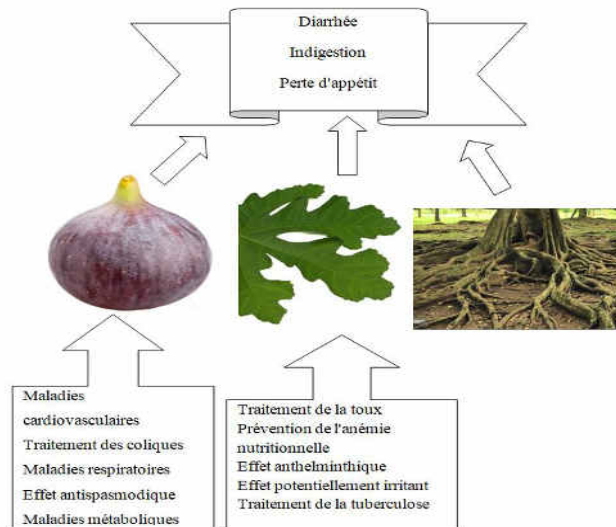


Figure 3. Utilisations anciennes du figuier [3]

Valeur nutritionnelle des figues

La valeur nutritionnelle révèle un complexe de vitamines, de fibres, de minéraux, d'acides aminés et de composés phénoliques aux bienfaits uniques pour le corps humain. La figure 4 reflète le contenu des macroéléments. De cette figure, on constate que les figues sont riches en eau, ce qui constitue 79,11 g/100 g de produit. Vient ensuite la teneur en glucides et saccharose, qui lui appartient la quantité de 35,5 g/100g et des fibres de 3g/100g [2, 3].

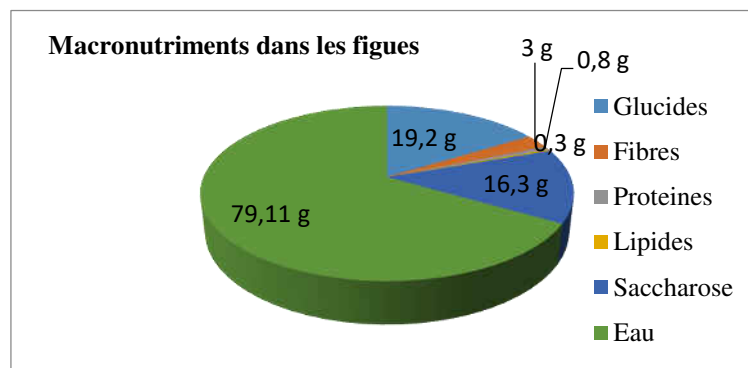


Figure 4. Le contenu en macronutriments dans des figues

L'élément minérale prédominant dans les figues est K qui constitue la valeur de 232 mg/100 g qui est suivit de Ca de 35 mg/100g, Mg – 17 mg/100g et P de 14 mg/100g (tableau 1).

Tableau 1.

Teneur en éléments minéraux [2, 3]

Nom des éléments minéraux	Contenu en minéraux, mg/100g produit
Calcium, Ca	35
Fer, Fe	0,37
Magnésium, Mg	17
Phosphore, P	14
Potassium, K	232
Sodium, Na	1
Zinc, Zn	0,15

La plus grande quantité de vitamines présente la vitamine C avec le contenu de 2 mg/100 g, la vitamine B12 de 4,7 mg/100 g et d'autres vitamines comme B3 et B5.

Tableau 2.

Teneur en vitamines [2, 3]

Nom des vitamines	Teneur en vitamines, unité de mesure
Vitamine C, acid ascorbique	2 mg/100g produit
Vitamine B1, tiamine	0,06 mg/100g produit
Vitamine B2, riboflavine	0,05 mg/100g produit
Vitamine B3, niacine	0,4 mg/100g produit
Vitamine B5, acid pantotenique	0,3 mg/100g produit
Vitamine B6	0,113 mg/100g produit
Vitamine B9, folate, total	6 µg/100g produit
Vitamine B12, coline, total	4,7 mg/100g produit
Vitamines de groupe B	120 µg/100g produit
Vitamine A	142 UI
Vitamine E, alfa-tocopherole	0,11 mg/100g produit
Vitamine K, phyloquinone	4,7 µg/100g produit

La figue contient 74 kcal pour 100 g de fruits frais, soit 3,70 % du total de 2000 cal recommandée quotidiennement (Figure 4).

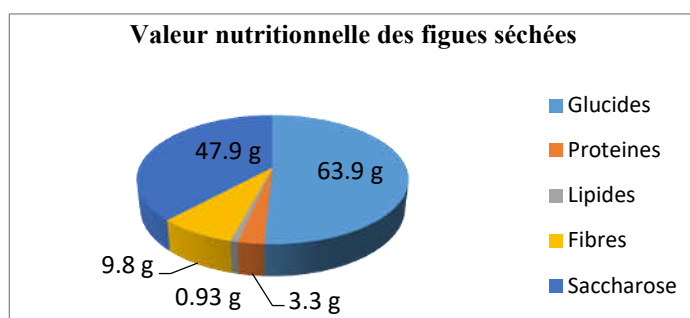


Figure 4. Valeur nutritionnelle des fruits secs

Par rapport aux figues fraîches, les figues séchées sont plus caloriques et riches en fibres, elles peuvent être dégoutées toute l'année. La consommation de 100 g de figues séchées de 249 kcal représente 12 % de l'apport calorique de l'apport quotidien estimé pour un adulte, soit 2000 cal [2]. Deux grandes catégories de composés phytochimiques se trouvent dans les figues : les polyphénols et les caroténoïdes. Les principaux groupes de polyphénols présents dans les figues sont : les acides phénoliques, les flavonones et les anthocyanes qui présentent d'énormes bienfaits pour la santé, notamment contre le cancer et les maladies cardiovasculaires [2]. Les composés phénoliques sont des nutriments alimentaires présents dans tout le monde végétal. Une étude a démontré que le peau a des concentrations plus élevées de composés phénoliques et une capacité oxydante par rapport à la pulpe et que les anthocyanes ont montré un degré de tolérance à la chaleur et un équilibre positif dans l'environnement acide [3]. Une découverte intéressante est que les figues contiennent des quantités plus élevées de composés phénoliques que le vin rouge et le thé.

Les caroténoïdes présents dans les figues comprennent la lutéine, la zéaxanthine, la β -cryptoxanthine et la β -carotène. Yemis et son collaborateur ont identifié ces pigments dans des variétés de figues jaunes et ont découvert que la couleur de la surface des figues change avec le stade de maturation [3].

L'assortiment de produits à base de figues et leur importance dans l'alimentation

Les consommateurs consomment ce fruit pour sa fonctionnalité. Différents produits fonctionnels ont été inventés et enrichis en fibres, protéines et phénols totaux tels que : la viande, les biscuits, les produits laitiers, le pain, le café, etc. Une bonne alternative à l'utilisation des déchets alimentaires consiste à inclure de la poudre de figue dans les biscuits. Le résultat a été positif, car la poudre de figue a une bonne valeur nutritionnelle [2]. Une autre source découverte

fruits, les résultats suivants ont été obtenus : variété Kadota - poids moyen de 40,7 g, taille moyenne de 41,5 mm et variété de Brown Turkey - le poids de 46,5 g, la taille moyenne de 43,2 mm. On peut voir que la variété Brown Turkey est légèrement plus grande que Kadota. Les indices physico-chimiques sont représentés dans le tableau ci-dessous.

Tableau 4.

Détermination des indices physico-chimiques des figues

Variété de figues	Acidité titrable, %	pH	Substances sèches totales, %	Sucres totaux, %	Nitrates, mg/kg
Kadota	1,1	4,924	42 %	40,5 %	39,5
Brown Turkey	0,38	5,160	49 %	47,3%	22,3

Après avoir analysé les résultats obtenus, on constate que l'acidité titrable pour les deux variétés peut varier dans les limites de 0,3 à 1,1 %. Le pH est d'environ 5. La teneur en substances sèches totales varie entre 40 et 50 %. La quantité de sucres totaux indique une valeur comprise entre 40 et 47 %, ce qui prouve que les figues sont très riches en sucres. La teneur en nitrates des deux variétés constitue la valeur entre 22 et 39,5 mg/kg et ça démontre qu'il n'a pas dépassé la norme limite admissible de nitrates de 60 mg/kg.

Conclusion

Après l'étude réalisée, on peut conclure que les figues sont des fruits qui se sont facilement adaptés au climat de notre pays. Les figues sont riches en nutriments tels que les fibres (3 g/100g), les vitamines (vitamine C - 2 mg/100 g, la vitamine B12 - 4,7 mg/100 g, etc.) et les minéraux (K- 232 mg/100 g, Ca - 35 mg/100g, Mg - 17 mg/100g et P - 14 mg/100g), offrant de multiples avantages pour la santé, notamment l'amélioration de la digestion, la régulation de la glycémie et le renforcement du système immunitaire. Il a été établi que, parmi les deux variétés de figues étudiées, la variété Kadota était la plus appréciée, qui a obtenu une note moyenne de 9,6 points. La détermination des indices physico-chimiques a démontré que les figues sont très riches en sucre (40-50%). En déterminant la teneur en nitrates des figues, on peut mentionner que leur consommation est inoffensive pour la santé humaine du point de vue des substances toxiques.

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L'IMPACT DE LA TORRÉFACTION DU CAFÉ SUR SES PROPRIÉTÉS BIOACTIVES

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Résumé. *Cet article examine l'impact de la torréfaction sur les propriétés bioactives du café, mettant en lumière ses effets sur l'activité antioxydante et la teneur en polyphénols. La torréfaction modifie considérablement ces aspects, entraînant la perte de composés bioactifs tout en favorisant la formation de substances potentiellement nocives. Ces facteurs soulignent l'importance de comprendre les implications de la torréfaction sur la santé. Parallèlement, le document souligne les bienfaits pour la santé liés à la consommation de café légèrement torréfié, qui conserve mieux les antioxydants et autres nutriments essentiels. Cette perspective met en évidence la nécessité d'examiner attentivement les processus de torréfaction afin de maximiser les avantages pour la santé tout en minimisant les effets négatifs. Comprendre cette dynamique est crucial pour informer les pratiques de torréfaction et promouvoir une consommation de café plus bénéfique pour la santé.*

Mots clés: *café, torréfaction, antioxydants, polyphénols, santé, substances bioactives*

Introduction

Le café est l'une des boissons les plus consommées au monde, réputée pour ses propriétés bioactives et son goût particulier. Ces propriétés comprennent l'activité antioxydante et la teneur en polyphénols, qui sont essentielles pour ses effets bénéfiques sur la santé. La consommation de café a augmenté de 1,90 % au cours des 3 dernières années pour atteindre 9,4 millions de tonnes par an. Ce produit a une importance économique énorme [2]. Sa saveur et son arôme agréables ainsi que son influence bénéfique sur la santé sont les principales causes de sa consommation toujours croissante [5]. Les grains verts sont des grains brutes non transformées de fruits de café. Ils diffèrent considérablement sous plusieurs aspects du café torréfié régulièrement consommé dans le monde. L'arôme et la saveur souhaités du café utilisé pour la boisson se développent lors de la torréfaction, un processus dépendant du temps et de la température au cours duquel les grains de café subissent une série de réactions entraînant plusieurs changements dans la composition chimique. La torréfaction est une étape importante dans la transformation du café au cours de laquelle les grains verts sont soumis à des traitements thermiques à des températures allant jusqu'à 200-250°C selon le degré de torréfaction souhaité [10]. Cependant, le processus de torréfaction peut affecter ces propriétés de manière significative, ce qui constitue le principal sujet de discussion de cet article.

Effets de la torréfaction sur l'activité antioxydante et la teneur en polyphénols

Des études ont montré que la torréfaction à des températures plus élevées peut entraîner une diminution significative de l'activité antioxydante et de la teneur en polyphénols du café. Par exemple, une étude récente a montré que la torréfaction à des niveaux plus élevés réduit l'activité antioxydante et la teneur en composés phénoliques des deux espèces de café [13].

Diminution de la concentration totale en polyphénols

De nombreuses études ont montré que le degré de torréfaction est étroitement lié à la diminution de la concentration totale de polyphénols dans le café. Par conséquent, le café

intensément torréfié peut avoir une teneur plus faible en composés bioactifs, ce qui peut réduire les effets bénéfiques de la consommation de café sur la santé [17].

Variabilité entre les espèces et les degrés de torréfaction

Il est important de souligner que les effets de la torréfaction peuvent varier en fonction de l'espèce de café et du degré de torréfaction. Par exemple, l'études ont révélé des différences significatives dans la teneur en antioxydants et en polyphénols entre les espèces de café et les degrés de torréfaction [16].

Mécanismes fondamentaux

L'analyse des mécanismes sous-jacents responsables des changements observés est essentielle pour comprendre les interactions complexes entre la torréfaction et les propriétés bioactives du café. La formation de produits de Maillard est l'un de ces mécanismes qui peut avoir un impact négatif sur l'activité antioxydante et la teneur en polyphénols.

Cette réaction chimique peut entraîner la perte de composés bioactifs et la formation de substances pouvant avoir des effets néfastes sur la santé [6]:

- **Formation d'acrylamide:** L'acrylamide est un composé chimique qui peut être généré dans les aliments torréfiés à haute température, y compris le café. Une consommation excessive d'acrylamide peut être associée à des risques pour la santé, tels qu'un risque accru de cancer, d'où l'importance de limiter l'exposition à cette substance.
- **Augmentation des niveaux de composés cancérigènes:** outre l'acrylamide, d'autres substances chimiques pouvant avoir des effets néfastes sur la santé, telles que les hydrocarbures aromatiques polycycliques (HAP), peuvent se former lors de la torréfaction du café à haute température. Ces composés sont connus pour leurs propriétés cancérigènes.
- **Perte d'antioxydants:** le processus de torréfaction peut entraîner la perte d'acides chlorogéniques et de flavonoïdes. Ces antioxydants jouent un rôle important dans la protection des cellules contre le stress oxydatif et la prévention de maladies telles que les maladies cardiovasculaires et le cancer.
- **Diminution de la composition en nutriments:** lors de la torréfaction, d'autres nutriments tels que les vitamines et les minéraux présents dans les grains de café peuvent également être affectés. Une consommation excessive de café torréfié peut donc entraîner une diminution de l'apport en nutriments essentiels.
- **Augmentation de l'inflammation:** Certains produits de dégradation formés lors de la torréfaction, tels que les substances aldéhydes réactives, peuvent induire une inflammation dans l'organisme. L'inflammation chronique est associée à divers problèmes de santé, notamment les maladies cardiovasculaires, le diabète et le cancer.

Café légèrement torréfié : avantages pour la santé

Bien que la torréfaction puisse réduire certaines des propriétés bioactives du café, il est prouvé que la torréfaction légère peut mieux préserver les antioxydants et d'autres nutriments essentiels. La consommation de café légèrement torréfié peut avoir des effets bénéfiques importants sur la santé, notamment en protégeant contre les maladies cardiovasculaires et d'autres affections.

- **Acides chlorogéniques:** Les acides chlorogéniques sont d'importants composés antioxydants présents dans le café qui ont été associés à des effets anti-inflammatoires et protecteurs contre les maladies chroniques telles que le diabète et les maladies cardiovasculaires. La torréfaction légère permet de maintenir la teneur en acides chlorogéniques à des niveaux plus élevés.
- **Perte minimale de nutriments:** la torréfaction légère permet d'éviter dans une large mesure la perte de nutriments essentiels. Par exemple, les vitamines et les minéraux

présents dans les grains de café peuvent être mieux préservés au cours d'un processus de torréfaction plus doux.

- **Réduction des risques pour la santé:** la consommation modérée de café, en particulier de café légèrement torréfié, a été associée à divers avantages pour la santé, tels que la réduction des risques de maladies cardiovasculaires, de diabète et de troubles neurologiques. Cela est dû en partie à sa teneur en antioxydants et autres substances bioactives [10].

Perspectives d'avenir

Les perspectives de recherche futures comprennent l'étude de l'interaction complexe entre les composés bioactifs du café et le processus de torréfaction [10]. En outre, il est nécessaire de mieux comprendre l'impact des différents degrés de torréfaction sur la composition chimique et l'arôme du café [16].

Interaction des composés bioactifs avec le processus de torréfaction

Il est essentiel de comprendre comment les composants bioactifs du café interagissent avec le processus de torréfaction. Par exemple, lors de la torréfaction, les produits de dégradation thermique peuvent avoir un effet négatif sur les propriétés antioxydantes du café. En outre, la recherche montre que le processus de torréfaction peut avoir un effet négatif sur certains composés bioactifs tels que l'acide chlorogénique [12].

Impact sur la composition chimique et l'arôme

Les propriétés bioactives, la composition chimique et la saveur du café sont influencées par le processus de torréfaction. Les processus complexes qui ont lieu pendant la torréfaction peuvent avoir un impact sur la teneur en polyphénols et autres substances bioactives, ainsi que sur les arômes et saveurs uniques du café torréfié.

Conclusion finale

En conclusion, la torréfaction du café est un processus complexe qui influence considérablement ses propriétés bioactives, sa composition chimique et son goût. Il est essentiel de comprendre ces effets pour optimiser le processus de torréfaction et maximiser les bienfaits du café pour la santé.

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PRODUITS APICOLES ET POSSIBILITÉS DE SON VALORISATION

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Résumé. Dans cet article, chacun des produits apicole qui revêtent une grande importance pour la santé humaine sera caractérisé en détail. Ce sont des produits comme le miel, le pollen, la gelée royale, la propolis et le venin d'abeille ont d'immenses propriétés médicale importance. Le miel est utile pour cicatriser les plaies, aide à développer l'hémoglobine, utilisé comme laxatif purificateur de sang, préventif contre le rhume, la toux, les maux de gorge, les affections oculaires, les brûlures et troubles gastro-intestinaux, etc. Le miel a des propriétés antibiotiques et est efficace pour réduire le risque de maladie cardiaque, de cancer et de diabète. Le pollen abaisse la tension artérielle et augmente l'hémoglobine et la teneur en érythrocytes, utile dans l'anémie pernicieuse, la stérilité, l'hypertension, dans les plaintes de le système nerveux et endocrinien.

Mots clés: abeille, miel, pollen, gelée royale, venin d'abeille, propolis.

Introduction

Les produits apicoles biologiquement actifs sont populaires dans le monde actuel en raison de leurs bienfaits prometteurs pour la santé [1]. L'utilisation du miel à des fins nutritionnelles et médicinales remonte à près de 5 000 ans. La collecte manuelle des abeilles était une pratique traditionnelle importante dans les populations anciennes, car il s'agissait d'une méthode individuelle pour obtenir du miel, qui est encore pratiquée actuellement par certaines personnes dans les zones forestières [2]. À ce jour, plusieurs produits apicoles tels que le miel, le pollen d'abeille, la gelée royale, la propolis, la cire d'abeille, le pain d'abeille et le venin d'abeille ont été identifiés comme sources potentielles de composés ayant un potentiel thérapeutique dans la gestion du cancer et des infections par différents types de bactéries, virus et parasites [3].

Le secteur apicole joue un rôle socio-économique très important. En effet, plus de 36 000 apiculteurs tirent leur revenu en totalité ou en partie de cette activité. De plus, l'apiculture joue un rôle essentiel dans la pollinisation des plantes naturelles et cultivées, tout en améliorant la quantité et la qualité des productions végétales, notamment l'arboriculture fruitière, le maraîchage, et les cultures industrielles (Figure 1).

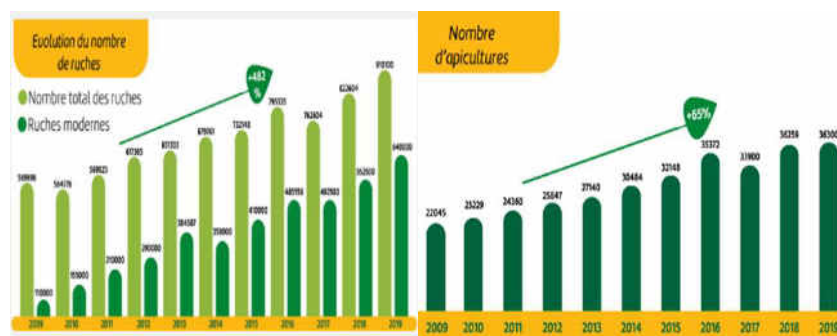


Figure 1. Nombre d'apiculteurs et l'évolution du nombre de ruches

Le comportement de consommation de ces produits varie d'une région à l'autre, d'un pays à l'autre, étant influencé par des facteurs naturels, culturels, socio-démographiques et

psychologiques. Les produits de la ruche peuvent être considérés comme étant symboliques pour un style de vie sain, historiquement étant réputés pour leurs vertus. Ils ont été utilisés comme aliments, médicaments, ingrédients dans les produits de beauté et ont montré leurs bienfaits grâce à leurs propriétés hydratantes, adoucissantes, anti-oxydantes, antivirales, antiparasitaires, anti-inflammatoires, antimutagènes, anti-cancéreux et... Cela justifie le choix du miel comme produit cible dans le cadre du présent projet de recherche [4].

Caractéristique generale de secteure apicole

L'apiculture est une activité ancienne qui suscite de plus en plus d'intérêt parmi les praticiens et la société en général. Il s'agit d'une activité ayant des impacts positifs dans les sphères environnementale, sociale et économique, avec le potentiel de reconnecter ces dimensions et de contribuer au développement durable [5].

L'apiculture est une activité aux impacts positifs dans les domaines environnemental, social et économique, jouant un rôle extrêmement important au sein de l'agriculture familiale. Cela peut également générer des revenus supplémentaires ou créer des opportunités d'emploi [6]. Dans de nombreux pays, les activités apicoles se transmettent de génération en génération. Certains scientifiques ont rapporté que les apiculteurs dont les connaissances ont été transmises par leurs ancêtres ont tendance à avoir plus de colonies d'abeilles et semblent également mieux comprendre à quel point les conditions écologiques sont fondamentales pour une apiculture durable.

Néanmoins, à partir des années 1850, grâce aux progrès de la science apicole et aux nouvelles technologies, l'apiculture devient plus efficace et plus rentable, passant rapidement d'une entreprise familiale à une activité commerciale.

L'importance des aspects traditionnels associés à l'apiculture varie selon les sociétés et les pays et, dans de nombreux cas, reflète des facteurs culturels spécifiques [7-9].

1.1 Tendances mondiales de la consommation annuelle de miel

Globalement, la consommation de miel est très différente. Par exemple, dans les pays qui produisent et exportent la plus grande quantité de miel d'abeille, comme la Chine et l'Argentine, la consommation annuelle est assez faible. Dans le même temps, il existe des situations où la production nationale de miel ne couvre pas les besoins du marché intérieur. Cette situation est caractéristique de certains pays développés.

Tableau 1

Consommation annuelle de miel dans différent countries

Pays	Consommation annuelle de miel, kg/habitant
Italie, France, UK	0,3 - 0,4
Australie, L'Autriche, Allemagne, Grèce, Hongrie, Suisse, Portugal, Canada	0,6 – 0,8
Chine, Argentin	0,1 – 0,2
Danemark	1 – 1,8

La consommation de miel et de larves d'abeilles a probablement fourni des quantités importantes d'énergie, complétant la viande et les aliments végétaux.

2. Classification des produits apicoles

Les produits apicoles sont utilisés comme médecines complémentaires traditionnelles partout dans le monde, notamment dans les pays de l'Est. Les produits apicoles peuvent être divisés en trois catégories :

- la collecte des abeilles, comme la propolis, le miel, le pollen d'abeille, le pain d'abeille;
- les sécrétions d'abeilles, telles que la gelée royale, la cire d'abeille et le venin d'abeille;

- les corps écologiques des abeilles et des ruches, tels que les larves d'abeilles, les carcasses d'abeilles et les vieilles ruches.

Les produits apicoles ont diverses propriétés biologiques telles que des activités antimicrobiennes, anti-inflammatoires, anticancéreuses et antioxydantes. Les protéines, les peptides, les minéraux, les flavonoïdes, les terpènes, les acides gras et les composés phénoliques font partie des composants physiologiquement actifs présents dans les produits apicoles.

2.2 Caractéristiques des types de miel et les propriétés thérapeutiques

Le miel est l'un des médicaments les plus anciens connus. Il était très apprécié au Moyen-Orient. L'utilisation du miel comme médicament n'est finalement apparue que dans la médecine traditionnelle, mais elle renaît aujourd'hui dans la médecine moderne [10].

Il existe trois types de miel:

- miel d'un seul type de fleur:
 - miel de thym
 - miel d'eucalyptus
 - miel d'herbe noire
- miel de deux ou plusieurs types de fleurs:
 - miel multifleurs/ polyfleurs
 - miel de fleurs d'épices
 - miel de montagne
- miel non floral:
 - miel de manne

2.3 Pollen d'abeille

La composition chimique du pollen d'abeille dépend de la provenance de la plante et de son origine géographique, des conditions climatiques, du type de sol, de la race et des activités des abeilles [11]. Le pollen d'abeille contient environ 250 substances, dont des acides aminés, des lipides (triglycérides, phospholipides), des vitamines, des macro et micronutriments et des flavonoïdes [12].

2.4 Le propolis

La propolis, également connue sous le nom de « colle d'abeille », est une substance résineuse naturelle produite par les abeilles pour protéger leurs ruches et lutter contre les infections. Elle est riche en flavonoïdes, terpénoïdes, composés phénoliques et leurs esters, avec plus de 500 composés chimiques identifiés dans la propolis [13]. La propolis est traditionnellement utilisée pour traiter les brûlures, les ulcères, l'asthme et le diabète. En outre, il a été démontré que la propolis présente d'excellentes propriétés anti-inflammatoires, antimicrobiennes et anticancéreuses, et celles-ci ont été largement étudiées. Cependant, il existe peu d'études sur les propriétés anti-allergiques de la propolis [14]. Différents types d'extraits de propolis ont montré des effets anti-allergiques contre l'inflammation allergique, l'asthme, la rhinite allergique et la dermatite atopique. La propolis verte brésilienne est le remède le plus prometteur contre les maladies allergiques, car il a été démontré qu'elle inhibe plusieurs mécanismes physiopathologiques de l'allergie. Les propriétés anti-allergiques de la propolis peuvent être en partie attribuées à l'activité inhibitrice de la propolis sur l'activation des cellules épithéliales, des mastocytes, des basophiles et des éosinophiles et à la libération de divers médiateurs allergiques [15].

Conclusion

Les produits apicoles et l'apithérapie ont une longue histoire qui remonte à l'Antiquité et sont utilisés en phytothérapie et en alimentation en raison de leurs puissantes propriétés cicatrisantes. En étudiant les propriétés de différents types de miel, il a été établi qu'ils possèdent des propriétés nutritionnelles et thérapeutiques, dues à leur teneur en protéines, glucides, vitamines, tanins, et des propriétés antioxydantes dues à la teneur en composés phénoliques et en flavonoïdes qu'ils contiennent. L'ajout de pollen à une matrice alimentaire améliore généralement les propriétés nutritionnelles, fonctionnelles, techno-fonctionnelles et sensorielles des produits alimentaires nouvellement formulés. La propolis est un produit apicole antimicrobien important. Il agit à la fois contre les bactéries Gram-positives et Gram-négatives, ainsi que contre les bactéries aérobies et anaérobies. L'activité de la propolis dépend de la composition chimique et est différente selon les pays.

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ENCAPSULATION LIPOSOMALE DE SUBSTANCES BIOLOGIQUEMENT ACTIVES

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Résumé. Les liposomes sont des substances biologiques possédant une structure chimique complexe. Les Avcestia sont composés uniquement de lipides naturels mais également de cholestérol. Le cholestérol est le lipide de la famille des stérols le plus utilisé dans la fabrication de liposomes (en général à raison de 30% de la composition lipidique). Le cholestérol est un lipide amphiphile. Actuellement, ils peuvent comprendre des lipides et des tensioactifs naturels et/ou synthétiques. Ils ont également une utilité extrêmement répandue dans l'industrie : au cours des 50 dernières années, les liposomes ont trouvé leurs applications dans de nombreux domaines. Tout d'abord, ils ont été largement utilisés dans les domaines de la recherche, notamment pour l'étude des membranes biologiques. Par la suite, les secteurs de la cosmétique a un certain nombre de 107 produits et des compléments alimentaires se sont emparés de ces systèmes de transport de molécules actives. Enfin, ils sont largement utilisés en thérapie, pour l'administration de médicaments 108 produits, de gènes 109 produits et en imagerie moléculaire 11 produits.

Mots clés: Liposomes, encapsulation, utilisation en industrie, pharmaceutique

Introduction

Les liposomes eux-mêmes sont des vésicules sphériques dont la taille peut varier de la dizaine de nanomètres (nm) au micromètre (μm) et qui peuvent comporter une, deux ou plusieurs couches lipidiques organisées en deux compartiments aqueux. Ces bicouches lipidiques sont composées de phospholipides, molécules capables de former spontanément des liposomes au contact de l'eau. La première personne à fabriquer volontairement des liposomes fut Alec Bangham en 1965 [1]. Ces derniers furent largement utilisés dans le domaine médical jusqu'à ce que les réalités d'aujourd'hui soient utilisées pour encapsuler des solutions biologiques.

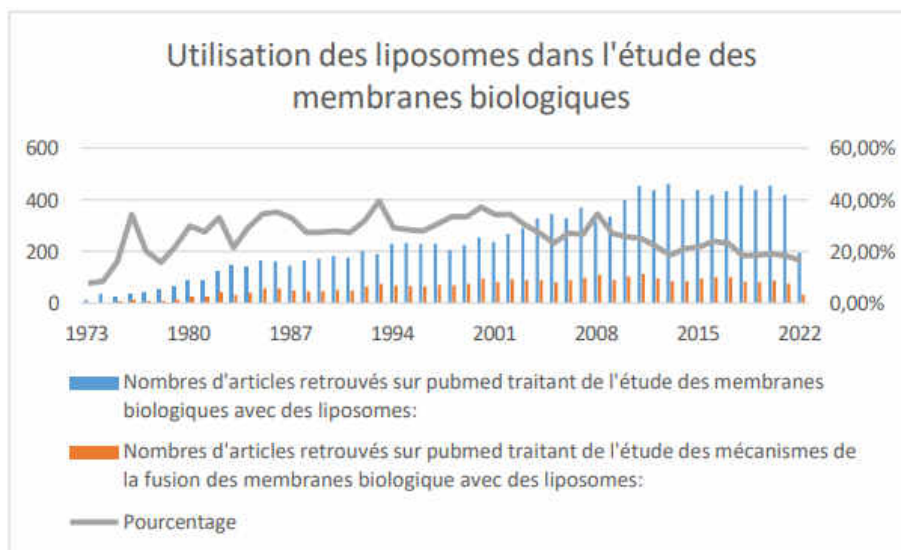


Figure 1. Graphique représentant l'utilisation des liposomes dans l'études membranes biologiques entre 1974 et 2022 [1]

1.1 Histoire des liposomes

Le mot Liposome vient des mots grecs « lipos » (graisse) et « soma » qui signifie « corps » ce qui désigne la qualification des liposomes comme « corps lipidiques ». La première étude des cellules vivantes a eu lieu en 1600 par Anton van Leeuwenhoek à l'aide du premier microscope inventé par Robert Hook qui a révolutionné le développement de la science. Cette étude fut poursuivie par Benjamin Franklin en 1734, publiant pour la première fois les observations dans la « Philosophical Transaction of the Royal Society ». Puis, en 1890, l'étude plus active des liposomes a commencé, ce qui a conduit à l'utilisation des liposomes pour l'étude des membranes biologiques. En 1917, le futur lauréat du prix Nobel de chimie, Irving Langmuir, a décrit les membranes cellulaires comme une couche de lipides. Huit ans plus tard, Gorter et Grendel ont terminé leurs études avec notre vision actuelle des membranes cellulaires comme étant composées de deux couches de lipides formant une membrane lipidique. Actuellement, les liposomes et leurs membranes biologiques sont utilisés dans l'industrie dans divers domaines [2].

En 1972 Singer et Nicolson proposent un modèle décrivant les membranes biologiques (fig. 2)

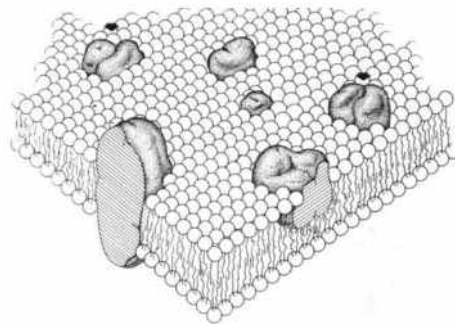


Figure 2. Schéma du modèle de la mosaïque fluide de Singer (1972)

1.2. Caractéristiques des liposomes.

1.2.1. Constituants des liposomes

Les liposomes sont constitués d'une membrane lipidique unilamellaire ou multilamellaire qui sépare un compartiment aqueux du milieu environnant. Cette membrane est composée de phospholipides amphiphiles comprenant une tête polaire hydrophile et une partie lipidique apolaire. Ce dernier possède deux chaînes d'acides gras remplaçant un glycérol lui-même lié au fragment polaire phosphocholine (Figure 3). L'utilisation d'autres types de lipides dans la fabrication des liposomes, comme le cholestérol, pourrait permettre de moduler les propriétés de la membrane lipidique [3].

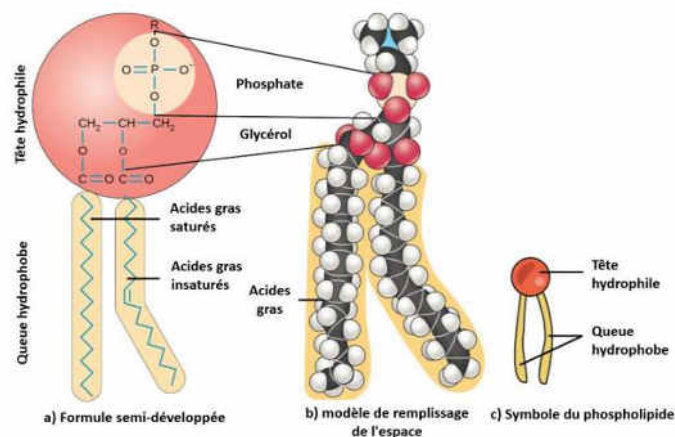


Figure 3. Schémas d'un phospholipide : Représentation d'un phospholipide [3]

1.2.2. Structure des liposomes

La structure des liposomes auto-assemblés dépend beaucoup de la nature et de la conformation tridimensionnelle de ces amphiphiles. En milieu aqueux, ils s'organisent en chaîne de manière à ce que les hydrocarbures soient au centre de la double couche lipidique (Fig. 4).

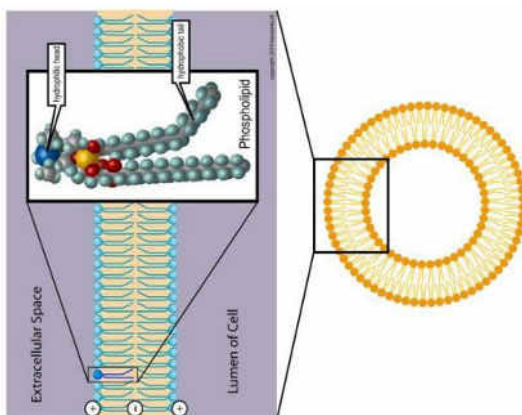


Figure 4. Représentation schématique de l'acencement des phospholipids au sien des liposomes [4]

1.2.3. Classification des liposomes

En général, les liposomes sont classés selon leur taille et leur lamellarité (nombre de couches) [5]. Ainsi, ils sont classés comme suit :

- «Small unilamellar vesicles ou SUV », petites (20 à 100 nm) ;
- «large unilamellar vesicles ou LUVs », de plus grande taille (0,1 μm à 1 μm) ;
- "giant unilamellar vesicles ou GUV" de taille supérieure à 1 μm . Les vésicules multilamellaires sont constituées de plusieurs lamelles et de plusieurs compartiments aqueux. Ils sont également répartis en trois catégories :
 - Les vésicules oligolamellaires ou OLV qui présentent une structure en oignon comprenant en moyenne 5 bicouches concentriques et une taille comprise entre 100 et 500 nm.
 - Vésicules multilamellaires ou MLV qui présentent également une structure en oignon composée de plusieurs lamelles concentriques (entre 5 et 20) et leur taille est supérieure à 500 nm.
 - les vésicules multivésiculaires ou MVV qui sont constituées de plusieurs bicouches non concentriques piégées au sein d'une vésicule plus grande, dont la taille est supérieure à 1 μm (Fig.5).

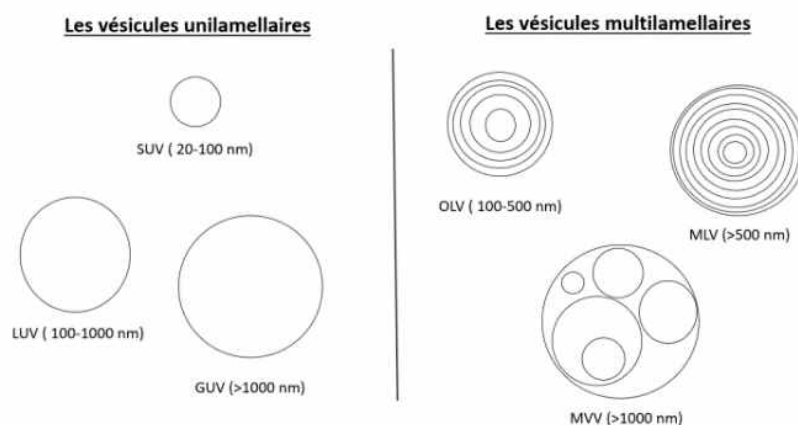


Figure 5. Représentation schématique des 5 principaux types de liposomes décrits par Rongen [6]

2. Encapsulation liposomale de principes actifs

L'encapsulation liposomale consiste à incorporer un principe actif (AP) à l'intérieur du liposome. L'encapsulation peut être effectuée par deux méthodes passive et active.

a) L'encapsulation passive consiste à intégrer (le principe actif) directement dans la préparation de liposomes pendant le processus de formation des liposomes. Il est incorporé soit dans la phase organique s'il s'agit d'une molécule lipophile, ou en phase aqueuse s'il s'agit d'une molécule hydrophile [5, 6].

b) L'encapsulation active, quant à elle, consiste à intégrer (le principe actif) dans des liposomes déjà préformés. La méthode d'encapsulation utilisée sera choisie en fonction des propriétés et des caractéristiques de quarantaine propriétés physico-chimiques de la substance active (taille, charge, solubilité, etc.)

Enfin, la localisation du principe actif dans un liposome dépend de sa nature chimique. Les actifs lipophiles sont introduits dans la bicouche lipidique et les hydrophiles se trouvent dans le noyau aqueux du liposome. Les molécules amphiphiles s'installent entre la phase organique et la phase aqueuse. Ils entreront à la fois dans la bicouche et dans le compartiment aqueux des liposomes.

Application des liposomes

1. Utilisation des liposomes dans le domaine de la recherche

Les liposomes sont des modèles essentiels et fondamentaux pour l'étude de tout phénomène biologique, biochimique, biophysique, pharmacologique ou pharmaceutique. La recherche des liposomes est réalisée par deux méthodes:

- Méthode de transfert d'énergie par résonance entre deux sondes fluorescentes préalablement insérées dans la membrane d'une même population de liposomes. Il s'agit d'une méthode basée sur le "transfert d'énergie par résonance Förster" (Fig. 6).

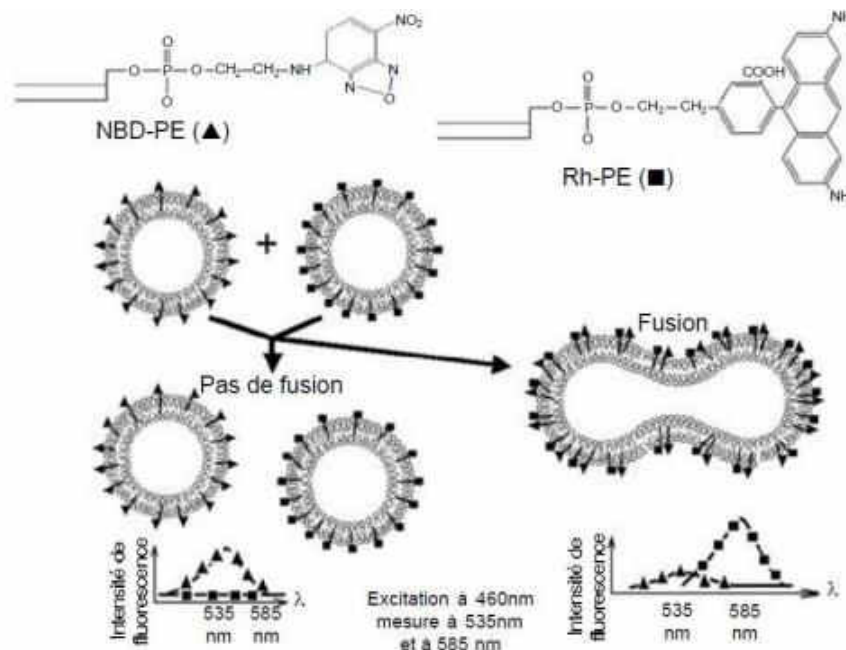


Figure 6. Schématisation de la méthode de transfert d'énergie par résonance entre deux sondes fluorescentes (NDP et Rh) préalablement insérées dans la membrane d'une même population de liposomes [6, 7]

- **Méthode d'inhibition** de fluorescence d'une sonde préalablement insérée dans la membrane d'une population de liposomes

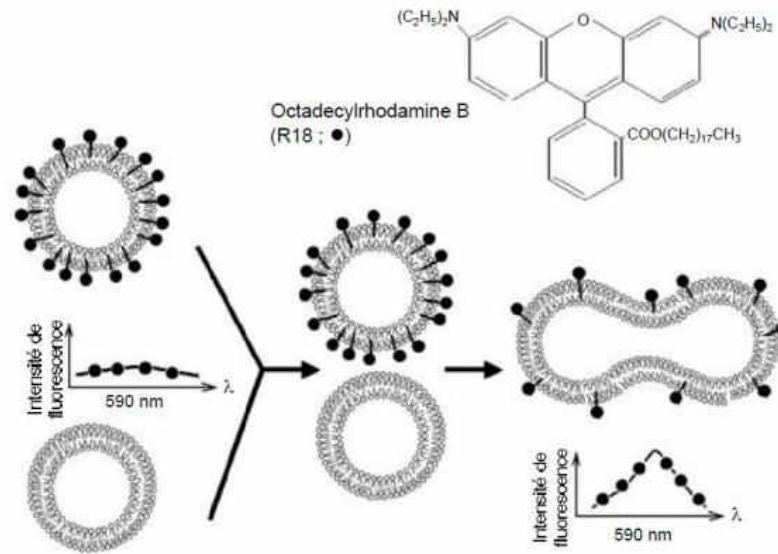


Figure 7. Schématisation de la méthode d'inhibition de fluorescence d'une sonde préalablement insérée dans la membrane d'une population de liposomes [7-9]

Cette méthode utilise un chromophore attaché aux phospholipides d'une famille de vésicules.

2 Utilisation des liposomes dans l'industrie cosmétique

Le premier produit cosmétique composé de liposomes est apparu en 1986. Il a été fabriqué par la marque Dior et s'appelle « Capture Complex Liposomes Résultat ». Ce produit est l'un des premiers remèdes anti-âges sur le marché pour produits de beauté (fig. 8) [9-11].

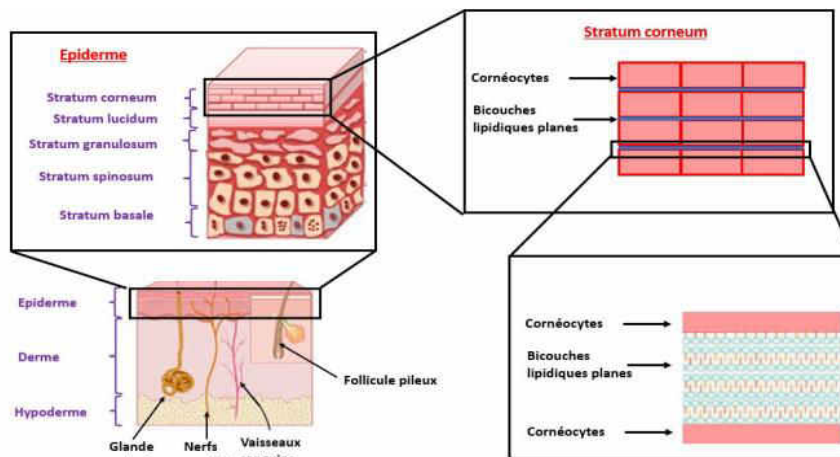


Figure 8. Représentation schématique des différentes couches de l'épiderme et de ses composants [8]

3. Utilisation des liposomes dans le secteur des compléments alimentaires

Les compléments alimentaires sont considérés comme des vitamines et des minéraux.

Aujourd'hui, l'Union européenne autorise l'utilisation de treize vitamines et quinze minéraux (tab. 1) [10-12]

Table 1.

Vitamines et minéraux utilisés dans le domaine des compléments alimentaires [13, 14].

Vitamines	Minéraux
Vitamine A	Calcium
Vitamine B1	Chlorure
Vitamine B2	Chrome
Vitamine B3	Cuivre
Vitamine B5	Fer
Vitamine B6	Fluor (pas de sels de fluor)
Vitamine B8	Iode
Vitamine B9	Magnésium
Vitamine B12	Manganèse
Vitamine C	Molybdène
Vitamine D	Phosphore
Vitamine E	Potassium
Vitamine K	Sodium
	Zinc

Conclusion

Depuis leur découverte il y a 50 ans, les liposomes ont été largement étudiés. Leur composition lipidique (principalement des phospholipides) ainsi que leur structure ont été définies. Leurs caractéristiques physicochimiques se sont avérées très intéressantes pour l'encapsulation, la protection et le transport de molécules actives. De plus, il a été démontré que leur composition lipidique influençait fortement leurs caractéristiques physicochimiques, notamment la fluidité, la stabilité et la perméabilité de leurs bicouches lipidiques. Il est ainsi primordial de maîtriser ces caractéristiques pour produire des liposomes permettant le transport de molécules actives in vivo ainsi que leur libération au niveau d'une cible. De nombreuses méthodes ont été développées afin de produire des liposomes de tailles et lamellarités variées (SUV, LUV, MLV, MVV etc.) avec des volumes d'encapsulation différents. Les liposomes sont confrontés à des problèmes d'instabilité physique (agrégation), chimique (oxydation) et enzymatique. Il s'avère que la méthode privilégiée pour leur conservation est la lyophilisation car elle permet notamment de limiter les altérations chimiques des phospholipides induites par l'eau.

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ALIMENTATION DU FUTUR : SOLUTIONS POUR UNE ALIMENTATION MONDIALE DANS UN MONDE EN MUTATION

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Résumé. La nourriture est une nécessité fondamentale pour la vie, la croissance, la survie et le maintien d'un bon fonctionnement de l'organisme. La demande alimentaire croissante conduit les producteurs et les consommateurs à rechercher des sources alimentaires alternatives à haute valeur nutritionnelle. Dans cette article on a examiné les principales tendances du développement mondial des nouvelles technologies de transformation des aliments entre 2021 et 2030, qui sont les suivantes: (1) l'utilisation de protéines d'algues ou d'insectes comme alternative aux protéines animales. Les insectes comestibles et les macroalgues sont des aliments alternatifs riches en protéines (jusqu'à 70 %), en fibres (~30 %), ainsi qu'en peptides et polysaccharides ayant des activités antimicrobiennes, antioxydantes, antihypertensives, antidiabétiques, antidépressives, antitumorales et immunomodulatrices; (2) l'utilisation de matériaux d'emballage alimentaire comestibles - ce qui nécessite l'exigence de matériaux d'emballage alternatifs présentant des caractéristiques biodégradables et renouvelables uniques; et (3) l'immersion 3D alimentaire qui pourraient être considérées comme une approche de personnalisation de la nutrition, de conception d'aliments personnalisés et de simplification des chaînes d'approvisionnement alimentaire.

Mots clés: protéines, insectes, algues, imprimante 3D

Introducere

L'augmentation de la population mondiale (+30 % par rapport aux 7,5 milliards d'habitants actuels attendus d'ici 2050) et l'évolution des modes de consommation mondiaux vers une consommation plus élevée de produits d'origine animale affectent le secteur de la production animale [1]. La pénurie de protéines est un sujet de préoccupation mondial et des recherches approfondies sont en cours pour trouver de nouvelles sources de protéines durables. Ainsi, une alternative pour lutter contre la catastrophe future est de trouver un aliment alternatif, parmi lequel figurent les protéines d'insectes et d'algues.

1. Protéines d'insectes et d'algues

On sait que les insectes constituent une excellente source de protéines. Mais pour une raison quelconque, les gens refusent d'en manger. Certes, les appels à l'abandon de l'élevage se sont multipliés récemment. Cela signifie que vous devrez chercher une alternative [2].

Des fermes d'élevage d'insectes - grillons, chenilles, fourmis et criquets - ouvrent déjà leurs portes aux États-Unis et aux Pays-Bas. Leur viande est riche en protéines, mais l'élevage de ces animaux est beaucoup moins cher et plus sûr en termes d'environnement et d'émissions de gaz à effet de serre. En effet, les élevages représentent aujourd'hui jusqu'à 51 % de toutes les émissions de méthane dans l'atmosphère [3]. Compte tenu de tout cela, il est temps de s'habituer aux plats à base de chenilles et de grillons. Par exemple, le chef du restaurant danois Noma, René Redzepi, prépare des galettes de burger aux insectes. Et apparemment, cela s'avère délicieux. Après tout, ce restaurant occupe la deuxième place au classement mondial [4].

Les algues sont un autre produit qui contient un pourcentage élevé de protéines. L'homme cultive des algues depuis l'Antiquité. Cependant, les marcophytes ne sont connues comme source de protéines qu'au cours des deux dernières décennies. Pour la production de protéines alimentaires, la chlorelle, la spiruline (*Arthrospira*), le *Scenedesmus* et le *Phyllophora* sont cultivées à l'échelle industrielle. Ce n'est pas un hasard si le choix s'est porté sur ces plantes - dans des zones relativement petites, il est possible d'obtenir un volume important de produits alimentaires. Les plantes sont cultivées sans prétention, ce qui permet leur utilisation dans des biosystèmes intégrés.

Cependant, la production de ces algues est limitée par le manque de ressources technologiques : il n'existe pas d'installations permettant de cultiver et de traiter des matières premières à l'échelle industrielle avec une utilisation illimitée de l'eau douce et de la lumière du soleil. Il convient également de considérer le coût de production, qui est assez élevé pour une production à grande échelle [5, 6]. En cherchant une solution à ce problème, les chercheurs se sont tournés vers les algues brunes (*Fucus*, *Laminaria* et *Sargassum*). Le fait est que ces macrophytes ne sont pas capables de synthétiser des substances organiques à partir de substances inorganiques par chimio et photosynthèse. Leurs besoins en éclairage et en eau sont donc négligeables. Des zones de culture importantes ne sont pas non plus nécessaires - comme leurs «frères» - les algues vertes et les algues brunes poussent confortablement dans des zones limitées [7].

Plusieurs études récentes publiées dans la littérature proposent l'utilisation d'algues entières ou d'extraits d'algues pour le développement de nouveaux produits alimentaires, avec des études examinant la digestibilité et la biodisponibilité de la biomasse algale dans diverses matrices alimentaires. Par exemple, 1) les propriétés sensorielles, physiques et chimiques, l'activité antioxydante et la digestibilité in vitro de la biomasse de microalgues comme ingrédient alternatif pour les biscuits ont été évaluées [8]; 2) une évaluation nutritionnelle, physique et sensorielle de la biomasse d'*Arthrospira platensis* pour l'enrichissement des collations a été étudiée [9] ; 3) on a étudié l'influence de la biomasse de spiruline sur les qualités technologiques et nutritionnelles des pâtes de pain de blé a également [10] ; 4) les propriétés physiques et antioxydantes du pain sans gluten enrichi en algues brunes (*Ascophyllum nodosum*) ont été étudiées par Różyło et al. (2017) [11]; et 5) la biosorption des protéines, des minéraux (Na, P, Ca et Mg) et des composés phénoliques d'une collation (maïs extrudé) enrichie en *Porphyra columbina* a été étudiée par Cian et al. (2014) [12]. Toutes ces études ont montré les effets prometteurs de la consommation de produits à base d'algues dans des études expérimentales in vitro liées à la biodisponibilité des nutriments [13].

Pour pouvoir utiliser habilement les algues à des fins alimentaires, il est nécessaire de prendre en compte leur teneur en protéines, fibres alimentaires, acides gras oméga-3, pigments, vitamines et microéléments, ainsi que leur goût, leur biodisponibilité et leur aptitude à la transformation. Voici les principales utilisations des algues dans les aliments à valeur ajoutée :

- Les algues conviennent aux substituts du poisson et des crustacés en raison de leur goût spécifique, qui va de l'umami, salé, herbacé et noisette à neutre [14].
- Les algues peuvent apporter une contribution significative à l'apport d'acides gras oméga-3 et remplacer ainsi la viande de poisson dans l'alimentation. Les acides gras à longue chaîne tels que l'acide eicosapentaénoïque (EPA, C20 : 5 ω 3) et l'acide docosahexaénoïque (DHA, C22 : 6 ω 3) sont couramment obtenus à partir de l'huile de poisson et peuvent être remplacés directement par certaines microalgues [15].
- Les algues sont une source majeure de pigments naturels tels que les carotènes (β -carotène, lycopène et astaxanthine) et les xanthophylles (lutéine et zéaxanthine), qui ont de nombreux effets physiologiques positifs sur la santé humaine [16].
- La vitamine B12, appelée cobalamine, présente principalement dans les produits d'origine animale, est également produite par certaines algues, notamment *Arthrospira platensis*. Cette algue est donc intéressante pour prévenir d'éventuelles carences résultant d'un régime végétalien [17].

- En termes de micronutriments tels que les minéraux, les algues contiennent du zinc, du fer, du sélénium, du potassium et du calcium, qui sont des micronutriments essentiels à la consommation humaine et au métabolisme [18].

2. L'impression 3D alimentaire

Dans le contexte de croissance démographique mondiale, une solution pour l'alimentation du futur serait d'utiliser plus largement la création alimentaire à l'aide de l'imprimante 3D. L'impression 3D d'aliments pourrait être considérée comme une approche de personnalisation de la nutrition, de conception d'aliments personnalisés et de simplification des chaînes d'approvisionnement alimentaire. Il pourrait être plus cher que les produits alimentaires conventionnels, mais il satisfera vos goûts, arômes, la texture, les composants du régime alimentaire, une vision de la nourriture, une impression artistique de la nourriture et un mode de consommation alimentaire personnelle [19]. Ainsi, il est utilisé comme aliment militaire et spatial, ainsi que comme aliment diététique spécifique [20].

L'idée de fabriquer de la nourriture avec une imprimante 3D a été partagée en 2010, lorsqu'un groupe de scientifiques du Massachusetts Institute of Technology a présenté la première imprimante 3D, « Cornucopia », pour recréer de la nourriture [21]. La première imprimante alimentaire, au lieu de papier ordinaire, était chargée de produits alimentaires, que la machine refroidissait, mélangeait et utilisait pour créer le produit fini. L'imprimeur pourrait « imprimer » des plats jusqu'alors inconnus avec une valeur nutritionnelle, une qualité et un goût prédéterminés [21].

L'un des sujets les plus discutés est celui de la viande artificielle et, bien entendu, l'impression 3D est indispensable. Ainsi, en septembre 2019, la société israélienne *Redefine Meat* a annoncé avoir levé 6 millions de dollars pour développer son système d'impression 3D de viande. Le projet travaille sur une technologie qui permettra de produire des « alternatives à la viande » à base de plantes, ou plutôt des repas complets – steaks, rôtis et ragoûts – à partir d'ingrédients naturels. Les techniciens et les chercheurs d'ici sont carrément obsédés par ce qu'ils font. L'objectif principal de la startup est d'imprimer des steaks si juteux et si riches en goût que même les mangeurs de viande les plus exigeants ne pourront pas les distinguer des vrais [22].

3. Films d'emballage comestibles

L'emballage alimentaire constitue un domaine important de la recherche alimentaire en raison de son rôle primordial dans la protection et le confinement des denrées alimentaires. Les polymères traditionnellement dérivés du pétrole répondent à la part du lion des besoins en matériaux d'emballage. Cependant, les consommateurs d'aujourd'hui sont davantage préoccupés par l'impact environnemental et les risques sanitaires de ces polymères synthétiques [23].

La production mondiale de plastique a atteint 380 millions de tonnes et a connu une forte augmentation au cours des dernières décennies, où 40 % du plastique produit est utilisé dans des applications d'emballage [24]. Bien que le plastique soit très pratique comme matériau d'emballage, en raison de son faible prix, de sa résistance mécanique élevée, de sa commodité de moulage, de sa thermoscellabilité et de son poids plus léger, une utilisation massive de matériaux d'emballage en plastique peut entraîner des effets néfastes sur l'environnement [25]. Par exemple, les déchets plastiques ne se dégradent pratiquement pas, leur élimination dans une décharge prendra des centaines d'années et l'élimination du plastique par incinération peut produire des gaz hautement toxiques [26]. Le plastique est donc considéré comme la menace la plus importante dans la résolution de la pollution terrestre [27].

Depuis quelques décennies, les consommateurs sont également conscients de l'impact du plastique sur l'environnement. Par conséquent, les exigences en matière de matériaux d'emballage alternatifs garantissant une durée de conservation améliorée avec une bonne qualité et un impact moindre sur l'environnement sont cruciales dans l'industrie de l'emballage alimentaire.

Les emballages comestibles sont traditionnellement utilisés pour améliorer l'apparence et la conservation des aliments, et ils ont suscité une attention considérable au cours des dernières décennies en raison de la possibilité de substitution partielle par des matériaux d'emballage synthétiques non biodégradables [28]. Le rôle principal du film comestible est de contrôler la perte d'humidité et de réduire les taux de réactions chimiques indésirables afin d'améliorer la qualité et la sécurité d'une large gamme d'aliments transformés et frais [29]. De plus, l'incorporation de divers additifs alimentaires tels que des antimicrobiens, des antioxydants, des arômes et des colorants dans la matrice du film comestible étend encore leurs applications [30].

Les matériaux d'emballage comestibles sont des polymères naturels obtenus à partir de polysaccharides, de protéines (animales ou végétales), de lipides ou de combinaisons de ces composants [31]. Selon Market Research Futures (MRFR), le marché des emballages comestibles (à base de protéines, lipides, polysaccharides et autres) vaudra 2,14 milliards de dollars d'ici 2030, avec un taux de croissance annuel composé (TCAC) de 6,79 % (2022-2030), contre 783,32 millions de dollars en 2021 [32]. Les films comestibles ont été identifiés comme une source saine de protection des aliments contre divers éléments, car ils sont naturels, peu coûteux et renouvelables. La possibilité d'incorporer des ingrédients fonctionnels et une excellente biodégradabilité glorifie encore son attrait. Des recherches approfondies ont été menées pour déterminer le meilleur résultat et minimiser les inconvénients grâce à de nouveaux concepts tels que l'approche du film composite et l'application de la nanotechnologie.

Conclusion

En conclusion, l'adoption de ces innovations dans notre alimentation représente une opportunité de promouvoir un système alimentaire plus durable, garant à la fois de notre bien-être et de l'environnement. En explorant et en mettant en œuvre ces solutions, on peut contribuer à bâtir un avenir plus sain et plus équilibré pour les générations futures.

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LES PHÉNOMÈNES PHYSIQUES ET CHIMIQUES LORS DU TRAITEMENT DES ALIMENTS

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Résumé. *Le traitement des aliments entraîne diverses modifications physiques et chimiques qui affectent la composition, les propriétés et les caractéristiques nutritionnelles des produits bruts. Les modifications de texture, rendent l'aliment plus facilement consommables, favorisant, en effet l'assimilation des nutriments. Cependant, une exposition prolongée à la chaleur peut entraîner une texture plus molle ou une dégradation excessive. Donc, les changements peuvent avoir des effets variés sur la qualité, la sécurité et la valeur nutritionnelle des aliments, et les phénomènes physico-chimiques jouent un rôle capital dans la régulation et l'établissement des proportions, conditions et procédures nécessaires pour le traitement optimal des produits alimentaires.*

Mots clés: *traitement physique, traitement chimique, production, conservation*

Introduction

Le traitement des produits alimentaires représente l'ensemble des techniques et des procédés utilisés pour préparer, transformer, conserver et distribuer les aliments. L'objectif principal du traitement des produits alimentaires est d'améliorer la sécurité alimentaire, de prolonger la durée de conservation des aliments, de préserver leurs qualités nutritionnelles et de répondre aux besoins et aux préférences des consommateurs.

Les procédés de fabrication pour la conservation du produit, sont : la cuisson, la fermentation, l'extraction, la pasteurisation, la stérilisation, la congélation, la déshydratation, le mixage, la filtration, l'évaporation, ainsi que l'ajout d'additifs alimentaires tels que les conservateurs, les colorants et les arômes. Au cours des procédés de transformation, les aliments sont soumis à des modifications liées à des traitements physiques et chimiques [1].

Les traitements physiques sont caractérisés par des procédés thermiques (cuisson, pasteurisation, stérilisation) et mécaniques (l'homogénéisation, l'émulsifiassions, le broyage) [2].

Les traitements chimiques (l'hydrogénation catalytique, la glycosylation par réaction de Maillard [3]).

Le traitement des produits alimentaires implique souvent la transition des produits d'un état à un autre. Pour expliquer ça, il faut analyser les changements qui peuvent survenir.

Caractéristiques physico-chimiques lors du traitement des aliments

Un changement physique représente un changement dans l'état de la matière.

Exemples: la coupe d'un aliment en morceaux, le sucre qui se dissout dans l'eau, la crème glacée fondant [4]. Un aspect important des changements physiques sont les états d'agrégation. Il existe trois états principaux de la matière: solide, liquide et gazeux (Figure 1).

Selon leur composition et la façon dont ils ont été traités, les aliments peuvent être trouvés dans différents états d'agrégation:

- État solide (les fruits et les légumes, les produits céréaliers, les viandes, les poissons).
- État liquide (le jus de fruits, le lait).
- État gazeux (dans certaines boissons gazeuses).

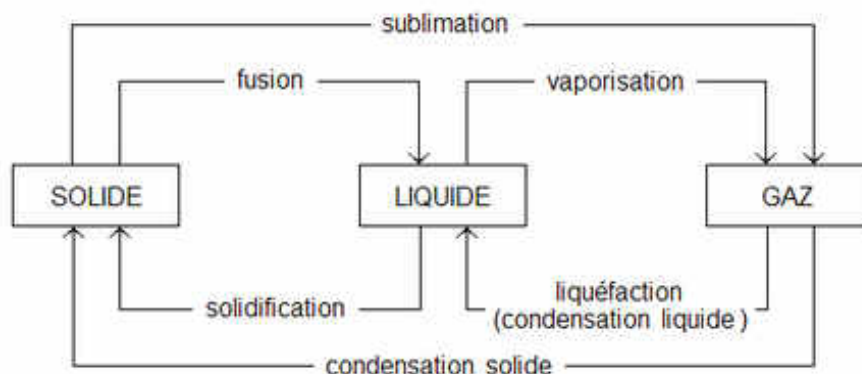


Figure 1. Les trois états d'agrégation de la matière

Mais, grâce aux diverses technologies apparues, on peut aussi obtenir une série d'états de transition:

- État semi-solide (les crèmes et les purées).
- État colloïdal (émulsions – la mayonnaise et suspensions – le jus de fruits avec pulpe).

Un changement chimique représente un changement dans la composition et la nature d'une substance. Exemples: la caramélisation, l'oxydation des fruits – les bananes passent du jaune au noir.

Un changement chimique peut être constaté selon certains indices, comme le dégagement de gaz, l'odeur et le changement de couleur. Donc, la surveillance des indices de changements chimiques à toutes les étapes de la fabrication d'aliments est absolument nécessaire pour garantir la qualité et la sécurité des produits alimentaires finis. Cela nécessite une combinaison de tests analytiques et de contrôles de processus de fabrication tout au long de la chaîne de production, comme les suivantes:

- L'analyse des matières premières qui inclut des tests pour détecter la présence de contaminants chimiques tels que les métaux lourds ou les toxines naturelles.
- Le contrôle des paramètres de la température et du temps de traitement, pour éviter les réactions chimiques indésirables telles que la dégradation des nutriments.
- L'analyse de la composition chimique, qui peut révéler des changements dans les niveaux de nutriments.

Applications des phénomènes physico-chimiques dans l'industrie alimentaire

Une large application des changements physiques et chimiques est présente dans l'industrie alimentaire, notamment à l'étape de fabrication.

Car les matières premières et une grande variété des aliments sont riches en enzymes endogènes, ils représentent des milieux favorables à la croissance des micro-organismes, responsables d'altérations.

Pour les éliminer, différentes stratégies peuvent être mises en œuvre. Les micro-organismes et enzymes peuvent être exclure par un traitement physique, thermique, à hautes pressions, soit séparer physiquement par microfiltration, pour les milieux liquides. Les multiples propriétés physiques et chimiques permettent également de modifier les conditions physico-chimiques pour rendre le produit moins vulnérable [6].

Exemples: La diminution de la température (surgélation), la diminution de l'activité de l'eau (séchage) et la diminution d'autres conditions défavorables comme les agents antibactériens.

Une autre application des propriétés physico-chimiques concerne la structure des macromolécules qui composent les aliments.

Avec le libre accès à l'air, l'oxydation des lipides se produit. Elle s'accélère avec l'augmentation de la température et provoque la dégradation des graisses et des huiles.

Les protéines présentes dans les aliments subissent des changements lorsqu'elles sont soumises à la chaleur. La chaleur peut dénaturer les protéines, ce qui signifie qu'elles changent de structure. Cela peut entraîner une coagulation des protéines, comme dans le cas de la cuisson des œufs.

Le traitement thermique des glucides entraîne des modifications des sucres. Lors de la cuisson, une partie des sucres contenus est dégradée. Dans certains cas, une dégradation plus profonde des sucres se produit – processus de caramélisation.

La caramélisation est la dégradation profonde des sucres lorsqu'ils sont chauffés au-dessus de leur point de fusion avec formation de produits de couleur foncée. Lorsqu'il est chauffé au cours du processus technologique dans un environnement légèrement acide ou neutre, une inversion partielle se produit avec formation de glucose, qui subissent d'autres transformations.

Conclusions

Au cours du traitement mécanique et thermique, ont lieu beaucoup des changements physiques et chimiques importants, qui affectent les produits culinaires. Leur goût, leur couleur, leur odeur, leur poids, leur valeur nutritionnelle et leur digestibilité changent. Cela se produit à la suite de modifications dans la structure des protéines, des lipides, des glucides, des vitamines et des minéraux. Cependant, les changements physiques et chimiques dans l'industrie alimentaire sont essentiels pour garantir la sécurité alimentaire, prolonger la durée de conservation, améliorer la qualité et encourager l'innovation [7].

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APPLICATION DU DEUXIÈME PRINCIPE DE LA THERMODYNAMIQUE À L'INDUSTRIE ALIMENTAIRE

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Résumé. L'article analyse les aspects liés à l'application du 2^{ème} principe de la thermodynamique dans les procédés chimiques et dans l'industrie agroalimentaire, notamment dans les procédés de congélation, d'ébullition, de sublimation, de condensation et de liquéfaction. Tous ces processus revêtent une importance majeure pour l'homme et l'environnement et constituent des éléments de base de l'industrie alimentaire.

Mots-clés: industrie alimentaire, principe de la thermodynamique, congélation, sublimation

Introduction

Le deuxième principe de la thermodynamique consiste en ce que la chaleur ne circule pas d'un corps à une température donnée vers un autre corps à une température plus élevée, sans travail mécanique de l'extérieur.

L'unité de mesure de l'entropie est J/K.

Selon ce principe thermodynamique, les processus suivants se déroulent:

- l'échelle des températures devient asymétrique.
- les basses températures sont plus difficiles à produire.

Ce principe a été énoncé de plusieurs manières:

La première affirmation est celle de Carnot, qui a dit que la chaleur ne peut pas passer d'elle-même (naturellement) d'un corps plus froid à un corps plus chaud.

$$Q_{\text{cede}} = Q_{\text{reçu}}$$

La deuxième affirmation est celle de Kelvin-Planck: il est impossible de fabriquer une machine thermique fonctionnant de manière cyclique et ayant pour seul effet de prélever de la chaleur à partir d'une source unique et de la convertir en travail mécanique.

La troisième affirmation est celle de Clausius : il est impossible de réaliser une machine thermique fonctionnant de façon cyclique et ayant pour seul effet de transmettre la chaleur d'une source à une autre. La chaleur est transmise d'une source à une autre de température plus élevée.

Processus réversibles et irréversibles. Un processus réversible est un processus idéal dans lequel le système et l'environnement peuvent être ramenés à leur état initial en passant, en sens inverse, par les mêmes états intermédiaires (Fig. 1).

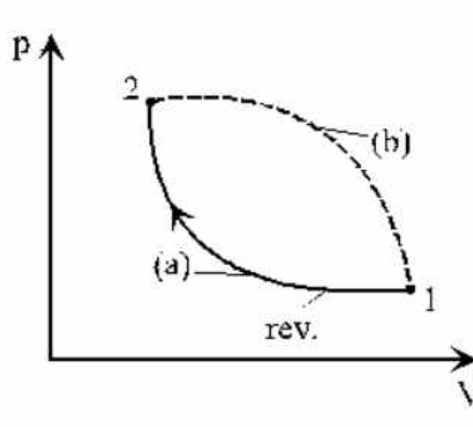


Figure 1. Transformation reversible

Une machine thermique fonctionnant dans un cycle composé uniquement de processus réversibles produit un travail mécanique maximal et un rendement maximal, alors qu'une machine à cycle réversible consomme un travail mécanique et un rendement maximal.

Les processus réversibles consistent en une séquence d'états d'équilibre et sont représentés dans les diagrammes par des lignes continues.

$$\oint_{\text{rev}} \frac{\delta Q}{T} = 0$$

Tout processus qui n'est pas réversible est irréversible. Un processus dynamique est irréversible et vice versa.

Le deuxième principe de la thermodynamique est également largement utilisé dans

$$\frac{Q - |Q_0'|}{Q} \leq \frac{T - T_0}{T}$$

l'industrie alimentaire, dans les processus de phase tels que la congélation, l'ébullition, la liquéfaction, la sublimation. Ces processus sont d'une importance majeure dans les schémas technologiques de production de certains aliments.

Le premier processus, la congélation, consiste à refroidir les produits à des températures inférieures au point de solidification de l'eau. Le processus de congélation d'un produit alimentaire peut être divisé en trois phases distinctes:

- le refroidissement du produit de sa température initiale à la température à laquelle commence le processus de congélation proprement dit.
- le refroidissement du produit depuis sa température initiale jusqu'à la température à laquelle le processus de congélation proprement dit commence (solidification de l'eau contenue dans le produit).
- le refroidissement du produit de la température de congélation à la température finale.

Pendant la congélation, la perte de poids est due exclusivement à des processus physico-chimiques. Jusqu'à ce que les premières couches du produit soient congelées, les pertes sont dues à l'évaporation de l'eau de la surface du produit pendant la phase de congélation, lors du refroidissement à la température finale et du stockage, la perte de poids est due à la sublimation de la glace à la surface du produit. Lors du processus de congélation, il est recommandé de congeler rapidement les aliments afin d'éviter d'en altérer la texture et le goût.

Un autre processus dans lequel le deuxième processus de la thermodynamique est utilisé est l'ébullition, qui consiste en la transformation d'un liquide en vapeur -c'est l'évaporation, un processus qui consomme de la chaleur, le phénomène se produisant à la surface du liquide et à n'importe quelle pression.

Lorsque l'évaporation se produit dans toute la masse du liquide, avec formation de bulles de vapeur, le processus est appelé ébullition et se déroule à pression et température constantes.

La chaleur absorbée nécessaire à l'évaporation du liquide est appelée chaleur latente de vaporisation et est égale à la chaleur latente de condensation. Le transfert de chaleur entre la surface de transfert de chaleur et le liquide en ébullition est particulièrement complexe.

L'ébullition est utilisée:

- dans l'industrie légère, dans le raffinage du sucre et de l'huile,
- dans les conserveries, dans la teinture des tissus.
- dans les centrales thermiques pour la production de vapeur à des fins énergétiques (chaudières à vapeur).

En médecine pour la stérilisation.

La sublimation est le phénomène par lequel une substance passe, par chauffage, de l'état solide directement à l'état de vapeur (gazeux), sans passer par l'état liquide.

Le phénomène de sublimation est endothermique, c'est-à-dire qu'il se produit avec une absorption de chaleur. Des exemples de substances qui subliment sont le naphthalène, l'iode, etc.

La liquéfaction est le processus de transformation d'un gaz en liquide. Un cas particulier de ce processus est la condensation. La liquéfaction d'un gaz est obtenue en le refroidissant à une température de et en extrayant la chaleur latente de vaporisation.

La condensation est le phénomène par lequel une vapeur devient liquide en dégageant une quantité de chaleur, appelée chaleur latente de condensation.

La condensation peut se produire pour la vapeur d'une seule substance ou pour un mélange de substances, comme suit:

- en gouttelettes, lorsque la vapeur condensée ne mouille pas la surface de refroidissement;
- sous forme de film ou de pellicule, lorsque le condensat mouille parfaitement la surface de refroidissement, le liquide étant présent sous forme de film continu.

Conclusions

L'importance du deuxième principe de la thermodynamique réside dans le fait qu'il établit une direction préférentielle pour l'évolution des systèmes physiques. Il met en avant la notion d'entropie comme mesure du désordre et souligne que les processus naturels tendent vers un état de plus grand désordre, ce qui a des implications cruciales dans de nombreux domaines, notamment en ingénierie, en sciences de l'environnement et en biologie.

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ÉMULSIONS ALIMENTAIRES

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Résumé. La nutrition est l'un des nombreux domaines dans lesquels les émulsions jouent un rôle clé. L'étymologie du terme émulsion vient du mot grec « emulgere » qui signifie « traire ». Le domaine alimentaire comprend un vaste vocabulaire scientifique sur ce sujet, composé de processus et de phénomènes qui se produisent dans les aliments. Il existe plusieurs types d'émulsions caractéristiques de chaque produit alimentaire, par exemple le lait est une émulsion de type H/E, elles possèdent également une série de caractéristiques chimiques comme la floculation ou le crémage, qui sont en même temps des processus observables expérimentalement (coagulation du lait, etc.). Ainsi, s'il n'était pas possible d'effectuer le processus d'émulsification, des aliments tels que la margarine, la mayonnaise ou la crème glacée ne seraient pas connus sous leur forme actuelle. Ce fait s'applique également aux émulsifiants. Mais il est prouvé que les émulsions jouent un rôle essentiel dans l'obtention de produits alimentaires de haute qualité et plus attractifs pour les consommateurs, car elles influencent grandement la consistance et le goût des aliments.

Mots clés: colloïde, aqueuse, huileuse, stabilisation, émulsifiants

Introduction

Au fil du temps, les émulsions sont devenues un sujet scientifique très populaire en raison de leurs nombreuses utilisations dans différents domaines tels que la médecine, la cosmétique et enfin la technologie alimentaire. Pour ce dernière émulsions été l'élément clé qui confère aux produits alimentaires leur qualité supérieure.

Tout d'abord, de nombreux aliments naturels sont constitués soit partiellement ou entièrement sous forme d'émulsions ou étaient dans un état émulsionné à un moment donné au cours de leur production, ces aliments sont le lait, la crème, le beurre, la margarine, la mayonnaise et la crème glacée [1,3].

Ainsi il y a deux facteurs majeurs qui ont été déterminés et stipulés et qui ont contribué à la conception et à la fabrication plus rationnelles de produits à base d'émulsion avec des propriétés améliorées, ils sont: le développement d'une approche scientifique plus rigoureuse pour comprendre les propriétés des émulsions alimentaires et le développement de nouvelles techniques analytiques pour caractériser les propriétés des aliments [1].

Caractéristiques générales, structure et formation d'émulsions alimentaires

Une émulsion est défini comme un mélange hétérogène de deux substances liquides qui sont non miscibles, l'une étant dispersée sous forme de petites gouttes dans l'autre. Les deux phases liquides d'une émulsion diffèrent par la nature des deux liquides : si l'une des phases est constituée de molécules polaires (l'eau en règle générale), l'autre phase est apolaire (huile, autres graisses).

Aussi dans le rôle des phases se sont toujours deux liquides qui ne se mélangent pas spontanément (l'eau et l'huile), mais qui vont grâce à des opérations spécifiques comme battre, secouer, écraser ou ajouter de quelques émulsifiants, ce processus est appelé émulsification, et cela est souvent réalisé à l'aide d'appareils tels que des homogénéisateurs, après quoi les émulsions adopteront un aspect macroscopiquement homogène, mais microscopiquement hétérogène [5].

Les émulsifiants et leur rôle pour les émulsions alimentaires

Afin d'obtenir des émulsions stables, des substances stabilisantes, inertes vis-à-vis des deux phases, appelées émulsifiants, sont ajoutées. Ils peuvent être classés en trois groupes en colloïdal, tensioactif et solide.

Un émulsifiant a une extrémité hydrophile (comme l'eau) et une extrémité lipophile (comme l'huile) (Fig.1). Ces parties relient les phases hydrophile et lipophile de qui se constitue l'émulsion.

L'extrémité hydrophile est attirée vers la phase aqueuse, et l'extrémité lipophile vers la phase huileuse, et cela les lie ensemble.

Les émulsifiants fonctionnent également en formant un film autour des globules d'une phase, les empêchant de se réunir à nouveau ou de « coaliser », donc les gardant suspendus dans la phase continue.

Quelques exemples d'émulsifiants naturels couramment utilisés comprennent le jaune d'œuf, la moutarde et la lécithine de soja, mais il existe également de nombreux émulsifiants synthétiques en suspension [6].

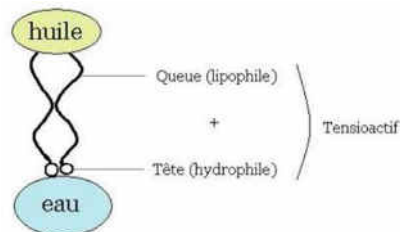


Figure 1. Structure de l'émulsifiant (tensioactif)

Importance des émulsifiants pour l'alimentation

Les émulsifiants jouent un rôle crucial dans l'industrie alimentaire en offrant de nombreux avantages:

- les émulsifiants contribuent à la douceur, à l'onctuosité et à la sensation en bouche globalement agréable de nombreux produits alimentaires
- ils aident à prévenir la séparation et à maintenir une texture homogène, prolongeant la durée de conservation des produits et améliorant leur apparence
- les émulsifiants peuvent aider à réduire la quantité de graisse requise dans certains produits sans compromettre la texture, ce qui donne lieu à des formulations plus saines.

Types d'émulsifiants dans les aliments

- Lécithines - dérivées de sources comme le soja et les œufs, les lécithines sont des émulsifiants polyvalents utilisés dans une large gamme de produits, notamment le chocolat, les produits de boulangerie, la margarine et les vinaigrettes.
- Polysorbates - les polysorbates sont des émulsifiants synthétiques utilisés dans diverses applications alimentaires, notamment les glaces, les sauces et les boissons, pour améliorer la texture et la stabilité.
- Gommages - certaines gommages, comme la gomme arabique et la gomme xanthane, sont souvent utilisées dans les vinaigrettes, les boissons et les produits de confiserie [9].

Types d'émulsions

Il existe quatre types d'émulsions qui sont importantes, ou potentiellement importantes, dans les aliments.

1. Les émulsions eau dans huile (E/H) sont caractérisées par le beurre, la margarine, et les pâtes à tartiner à base de matières grasses en général. Ceux-ci dépendent de leur stabilité plus sur les propriétés de la graisse ou de l'huile et du tensioactif utilisé que dans les propriétés de la phase

aqueuse et, de ce fait, il y a moins de paramètres qui peuvent varier pour contrôler leur stabilité (Fig.2).

2. Dans les émulsions huile dans eau (H/E), les gouttelettes d'huile sont en suspension dans une phase aqueuse continue. Ce sont les plus polyvalents des types d'émulsions; ils existent sous de nombreuses formes (mayonnaise, crème liqueurs, crèmes, garnitures à fouetter, mélanges pour crème glacée) et leurs propriétés peuvent être contrôlées en faisant varier à la fois les tensioactifs utilisés et les composants présents dans la phase aqueuse (Fig. 2).

3. Le troisième type d'émulsion est l'eau dans l'huile dans l'eau (E/H/E), qui est en fait une émulsion (H/E) dont les gouttelettes elles-mêmes contiennent des gouttelettes d'eau (c'est-à-dire sont sans émulsions). Ce sont les émulsions les plus difficiles à produire et à contrôler car les gouttelettes d'eau contenues dans les gouttelettes d'huile doivent être stables, tout comme les gouttelettes d'huile contenues dans la phase aqueuse continue (Fig. 2).

4. Le quatrième type d'émulsion est l'émulsion huile dans eau dans huile (H/E/H), qui est une double système d'émulsion dans lequel la phase dispersée est une émulsion huile dans eau (H/E) et la phase continue est de l'huile ou de la graisse plastique (Fig. 2) [4].

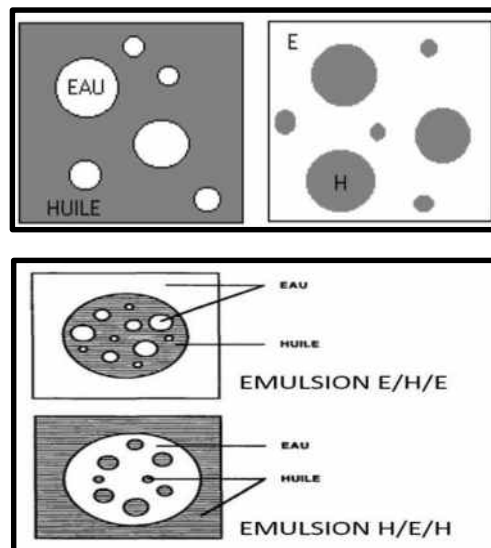


Figure 2. Émulsions simples ((E/H); (H/E)) et Émulsions complexes (E/H/E et H/E/H) [2]

Mécanismes de déstabilisation des émulsions

La floculation et la coalescence sont deux types d'agrégation de gouttelettes. La floculation se produit lorsque deux ou plusieurs gouttelettes se réunissent pour former un agrégat dans lequel les gouttelettes conservent leur intégrité individuelle, tandis que la coalescence est le processus par lequel deux ou plusieurs gouttelettes fusionnent pour former une seule gouttelette plus grosse (par exemple, la formation de crème à la surface du lait qui montre la stabilisation insuffisante du lait par la caséine) [8].

Le crémage et la sédimentation sont deux formes de séparation gravitationnelle. Le crémage décrit le mouvement ascendant des gouttelettes en raison du fait qu'elles ont une densité inférieure à celle du liquide environnant, tandis que la sédimentation décrit le mouvement descendant des gouttelettes en raison du fait qu'elles ont une densité plus élevée que le liquide environnant (Fig. 3) [8].

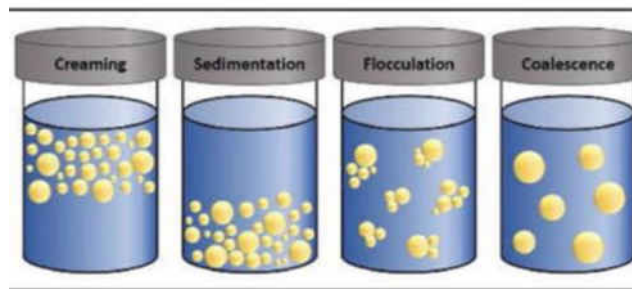


Figure 3. Mécanismes de déstabilisation des émulsions

Conclusion

Les émulsions et tous leurs processus associés jouent un rôle majeur dans l'industrie alimentaire, qui est l'un des plus grands utilisateurs de la technologie des émulsions. En effet, de nombreux produits alimentaires existent sous forme émulsionnée, notamment de nombreuses vinaigrettes, crèmes, etc. En d'autres termes, la plupart des produits alimentaires sur le marché sous leur forme connue sont le résultat de la dispersion de deux ou plusieurs émulsions et de l'effet coalescent d'émulsifiants. La technologie des émulsions est donc un sujet très vaste et important dans le domaine alimentaire.

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PROFIL NUTRITIONNEL ET THÉRAPEUTIQUE DU KOMBUCHA

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Résumé. *Le kombucha est une boisson fermentée à base de thé et de sucre, fermentée par une culture symbiotique de bactéries et de levures (SCOBY). Il contient des phytoconstituants tels que des flavonoïdes, des polyphénols, des acides organiques, des acides aminés, des vitamines, des minéraux et des enzymes hydrolytiques, qui contribuent à son profil nutritionnel et thérapeutique. Ces composés ont été associés à des effets antioxydants, anti-inflammatoires, anticancéreux, antimicrobiens et hépatoprotecteurs. Il a été démontré que le kombucha peut avoir des effets bénéfiques sur la santé, notamment en réduisant le risque de diverses maladies. Différents types de thé peuvent être utilisés pour produire le kombucha, ce qui entraîne des variations dans sa composition chimique et ses effets sur la santé. La communauté microbienne du kombucha comprend des bactéries telles que *Bacillus coagulans*, *Lactobacillus nagelii* et *Gluconacetobacter*, ainsi que des levures telles que *Brettanomyces*. La durée de fermentation et la base de thé utilisée peuvent également influencer les profils microbiens et chimiques du kombucha.*

Mots clés: *kombucha, fermentation, bactéries, nutriments, thé*

Introduction

Kombucha est le nom de la boisson obtenue à partir de la fermentation de thé, principalement du thé noir (il existe également d'autres variétés qui peuvent servir de base à sa préparation, comme le thé vert et le thé oolong, également connu sous le nom de thé bleu), à laquelle on ajoute du sucre comme substrat de fermentation [1]. Bien que cette boisson ait été préparée à l'origine avec du thé, il est possible de trouver des variantes à base d'infusions comme la menthe, le citron, la mélisse ou le jasmin [2]. Le goût de la boisson est légèrement acide et légèrement gazeux, ce qui lui vaut d'être mieux acceptée par les consommateurs. Quelques produits métaboliques de la Symbiotic symbiotique de bactéries et de levures (SCOBY), comme l'acide acétique et d'autres acides organiques, possèdent des propriétés antibactériennes et empêchent la contamination de la boisson par des bactéries pathogènes [3-6].

Histoire

Le thé Kombucha est né dans le nord-est de la Chine vers 220 av. J.-C. et était apprécié pour ses effets revigorants et détoxifiants. En 414 de notre ère, le Dr Kombu a utilisé le kombucha pour soigner les problèmes digestifs de l'empereur Inkyo, et le kombucha a alors été importé de Chine au Japon. Pendant la Seconde Guerre mondiale, la consommation de kombucha s'est étendue au-delà des pays européens, de la Russie et de l'Afrique du Nord. Après la Seconde Guerre mondiale, les taux de cancer étaient plus faibles dans les régions russes consommant du kombucha que dans les régions n'en consommant pas. Dans les années 1950, la société italienne a atteint son apogée en matière de consommation de boissons kombucha. En Allemagne, dans les années 2000, le kombucha était consommé comme un rafraîchissement pratique contre les affections, les amygdales et les maladies métaboliques.

Actuellement, la consommation de kombucha s'est répandue dans le monde entier car il s'agit d'un diurétique naturel. Il est rempli de probiotiques sains et aide à décomposer les aliments et à éliminer plus rapidement les déchets et les toxines [7-9].

La fermentation du kombucha

La fermentation du kombucha peut être influencée par plusieurs facteurs, tels que la température, le pH, l'oxygène, le substrat, la concentration en sucre, l'origine du SCOBY, la géométrie du récipient et le temps de fermentation. Toute variation de ces facteurs peut interférer avec les caractéristiques sensorielles, les propriétés chimiques et la qualité nutritionnelle, et peut influencer les activités biologiques [10, 11].

La période de fermentation du kombucha est généralement connue pour nécessiter un minimum de 3 jours et un maximum de 60 jours, en fonction des pratiques culturelles. La fermentation du kombucha s'effectue à température ambiante, ce qui optimise le temps de fermentation. Le saccharose est utilisé comme principale source de carbone à une concentration de 5 à 20 %, fournissant le milieu et les nutriments nécessaires au développement des micro-organismes. Un SCOBY ou le liquide résultant d'une fermentation précédente à une concentration de 10 % peut être utilisé comme culture de départ pour la fermentation [3].

Composants chimiques du kombucha

Le kombucha est composé d'un certain nombre d'acides organiques, de sucres, de vitamines, d'acides aminés, d'amines biogènes, de purines, de pigments, de lipides, de protéines, de certaines enzymes hydrolytiques, d'éthanol, de caféine, de dioxyde de carbone, de polyphénols, d'anions, de minéraux, d'acide D-saccharique-1, 4-lactone (DSL) et de métabolites bactériens [12]. La composition chimique des feuilles de thé utilisées pour produire le kombucha a été bien étudiée et aura un impact sur la concentration des composés dans le kombucha. La présence et les quantités de certains composés chimiques dépendent des micro-organismes présents dans le SCOBY, des paramètres de fermentation (durée et température), de la concentration en saccharose, du type de thé utilisé et de la méthode analytique utilisée pour la quantification. Si le saccharose est utilisé comme principale source de carbone pour la fermentation, l'acide acétique sera le principal métabolite produit [13]. D'autres acides organiques tels que l'acide gluconique et l'acide glucuronique sont également produits au cours du processus de fermentation. Si l'on laisse le processus de fermentation se poursuivre trop longtemps, le pH diminue et le produit devient imbuvable [14].

L'effet thérapeutique

Le thé Kombucha est un aliment fonctionnel qui présente plusieurs avantages prophylactiques et thérapeutiques. Les effets bénéfiques de cette boisson dépendent des matières premières, du type de sucre, de la durée de fermentation et de la composition de la culture de départ [7].

Le kombucha a de nombreux effets bénéfiques sur la santé humaine, tels que la désintoxication du sang et la réduction du taux de cholestérol, de la pression artérielle, de la calcification des reins, des problèmes inflammatoires, de l'arthrite, des rhumatismes, des symptômes de la goutte, de l'obésité, des troubles menstruels, des bouffées de chaleur de la ménopause, de l'insomnie, du stress et des perturbations nerveuses. Le kombucha est également connu pour stimuler les fonctions hépatiques, les systèmes glandulaires, le système immunitaire et la production d'interféron, améliorer la santé des cheveux, de la peau et des ongles, améliorer la vue, normaliser l'activité intestinale et équilibrer la flore intestinale, et prévenir la formation d'infections de la vessie. On sait que les effets bénéfiques du kombucha sont attribués aux métabolites libérés pendant le processus de fermentation [15].

Certains essais cliniques et expériences non humaines concernant les effets anticancéreux, antioxydants, antibactériens, antifongiques, hépatoprotecteurs et d'autres effets bénéfiques pour la santé des boissons Kombucha [16].

Les polyphénols du thé présents dans le Kombucha peuvent empêcher l'altération des gènes, inhiber la propagation des cellules cancéreuses et provoquer l'apoptose des cellules

cancéreuse, et que la capacité d'éliminer les métastases a été déterminée comme des fonctions concevables pour les caractéristiques anticancéreuses [16].

Des études sur les bienfaits des boissons kombucha pour la santé ont montré que le kombucha contient un taux élevé de nombreux composés aux propriétés antioxydantes plus élevées que celles du thé non fermenté, comme les polyphénols, les catéchines, l'acide ascorbique et le DSL. Les polyphénols sont des agents éducatifs considérés comme de puissants antioxydants qui protègent les cellules contre le stress oxydatif en neutralisant les radicaux libres et les espèces réactives de l'oxygène (ROS). La plupart des études de recherche ont prouvé que l'activité antimicrobienne est attribuée principalement à la présence de divers acides organiques (en particulier l'acide acétique) et au niveau élevé de composés phénoliques créés au cours de la fermentation. En outre, le kombucha contiendrait des substances antibiotiques ayant des propriétés antimicrobiennes [15].

Conclusion

Le thé Kombucha est une boisson fermentée aux multiples bienfaits pour la santé, dont la désintoxication, la réduction du cholestérol, la régulation de la pression artérielle, l'amélioration de la santé digestive et immunitaire, ainsi que des effets positifs sur la peau, les cheveux et les ongles. Les composants chimiques du kombucha, tels que les acides organiques, les polyphénols et les vitamines, contribuent à ses propriétés thérapeutiques. Les études ont montré que le kombucha possède des effets anticancéreux, antioxydants, antibactériens et hépatoprotecteurs. Sa consommation régulière peut aider à prévenir diverses maladies et à améliorer le bien-être général.

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VAPORISATION ET CONDENSATION DANS LE CYCLE DE VIE

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Résumé. Dans cet article, nous analyserons le processus physico-chimique de vaporisation et de condensation de la nature et des aliments. La vaporisation est le phénomène par lequel une substance liquide passe à l'état gazeux. La condensation est la réaction inverse, c'est à dire le passage de l'état gazeux à l'état liquide. Au cours de ces deux processus, la température reste constante. La vaporisation sous vide est présente jusqu'à ce que la pression de vapeur atteigne une valeur maximale. La vaporisation dans l'atmosphère gazeuse est un processus lent qui provoque la transformation d'une substance liquide en vapeur ou en gaz dans l'atmosphère d'une autre substance gazeuse. L'évaporation, comme l'ébullition standard à pression atmosphérique, est de 100°C, c'est le processus par lequel la substance de l'état liquide passe à l'état gazeux (vapeurs).

Mots clés. vaporisation, condensation, état gazeux

Introduction

Dans ce travail de laboratoire, nous analyserons les processus de vaporisation et de condensation dans le processus physico-chimique dans la nature et dans les aliments. L'évaporation et la condensation sont deux processus fondamentaux dans le cycle de l'eau et dans de nombreux autres aspects de notre vie quotidienne. Ces processus, qui se produisent naturellement dans la nature et sont activement utilisés dans de nombreuses applications technologiques [1].

1. Qu'est-ce que c'est la vaporisation?

Lorsque nous entendons parler de vaporisation, nous pensons au processus par lequel l'eau bout et donc l'évaporation de l'eau a lieu. Théoretiquement, la vaporisation est le phénomène par lequel une substance liquide passe à l'état gazeux [2].

2. Qu'est-ce que c'est la condensation?

La condensation est la réaction inverse, c'est à dire le passage de l'état gazeux à l'état liquide (Figure 1).

3. Température

Température de vaporisation et de condensation. La vaporisation a lieu pendant le processus d'absorption de la chaleur de l'extérieur. La condensation se produit avec le dégagement de chaleur de l'extérieur. Durant ces deux processus la température reste constante [3].

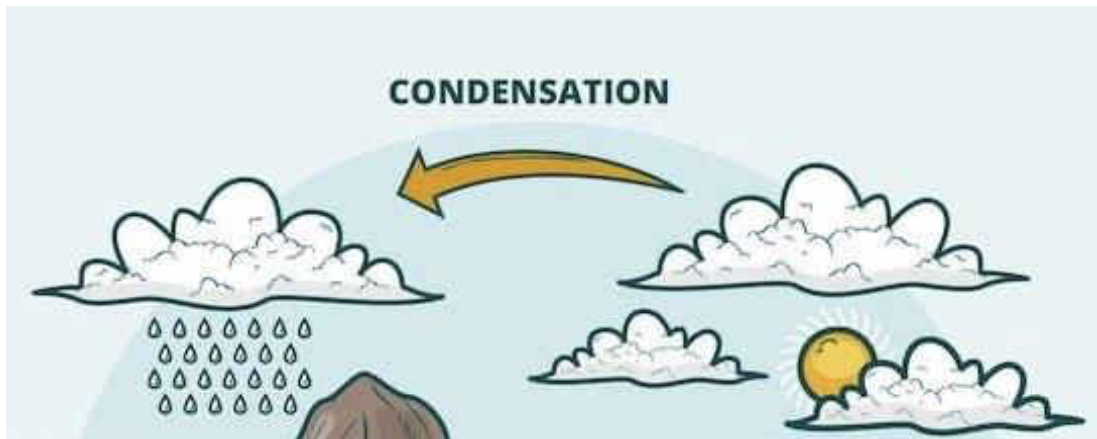


Figure 1. Processus de condensation [2]

Formules de calcul :

$$\lambda = Q/m;$$

$$\lambda_{\text{vap}} = \lambda_{\text{cond.}}$$

4. Évaporation sous vide

La condensation est le processus par lequel la vapeur d'eau présente dans l'air est transformée en eau liquide. La condensation est importante pour le cycle de l'eau car peuvent produire des précipitations, qui constituent le principal moyen par lequel l'eau retourne sur Terre. elle forme des nuages [4].

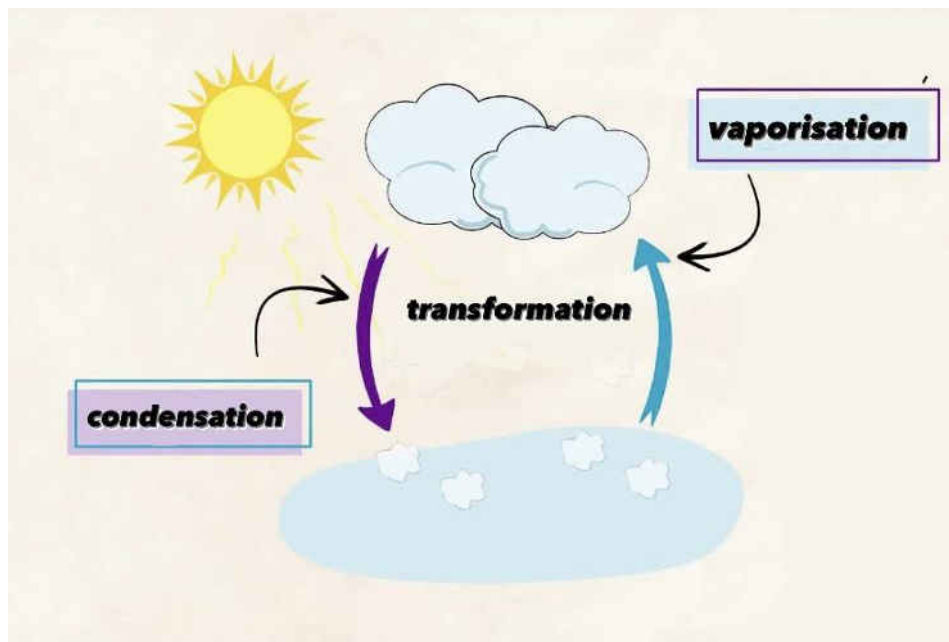


Figure 2. Processus de vaporisation [3]

5. Vaporisation en atmosphère gazeuse

Processus par lequel une substance liquide se transforme en vapeur ou en gaz dans l'atmosphère d'une autre substance gazeuse. Les facteurs d'influence de ce processus sont la température, la pression et les propriétés physiques et chimiques des substances impliquées dans cette réaction [4].

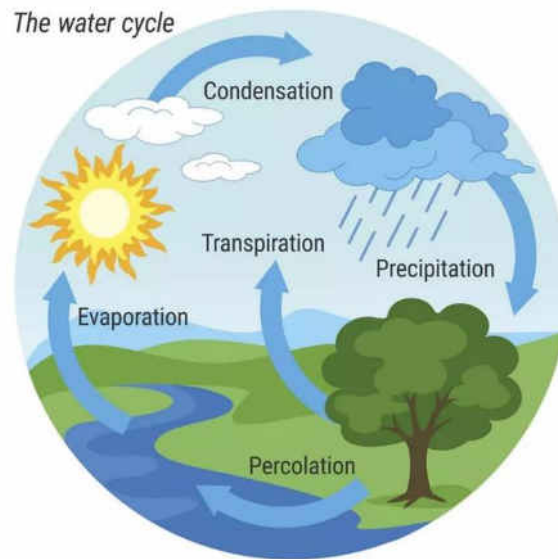


Figure 3. Le cycle d'eau [4]

6. Vaporisation

En physique, plus précisément dans le domaine de la physique appelé thermodynamique, le point de condensation est étudié notamment dans les chapitres dits des transformations de phase, des lois des gaz et de la calorimétrie [5].

7. Cuisson

Le point d'ébullition de l'eau à la pression d'une atmosphère physique est très proche de 100 °C. La pression atmosphérique diminue avec l'altitude et donc la température à laquelle l'eau bout diminue. L'ébullition est le processus par lequel une substance liquide se transforme en vapeur ou en gaz lorsque sa température atteint le point d'ébullition spécifique de cette substance à une pression donnée. Image 5- la température d'ébullition est illustrée en différents degrés de mesure (Fahrenheit, degrés Celsius et Kelvin) [5].

8. Explication des phénomènes naturels

L'évaporation est la principale voie par laquelle l'eau liquide retourne dans le circuit général de l'eau sous forme de vapeurs dans l'atmosphère. Les océans, les mers, les lacs et les rivières fournissent environ 90 % de l'humidité atmosphérique par le processus de vaporisation, et les 10 % restants proviennent de la transpiration des plantes [6].

9. Pression de vapeur des solutions

La dépendance à la pression de vapeur et à la concentration dans la solution d'un composant "i" a été établie, sur la base de données expérimentales, par Raoult et montre qu'à température constante, la pression partielle de vapeur d'un composant au-dessus de la solution est directement proportionnelle à sa concentration en solution [6].

Conclusion

L'évaporation et la condensation sont deux processus fondamentaux dans le cycle de vie de l'eau et dans de nombreux autres processus naturels et technologiques. Ils sont responsables de la circulation de l'eau dans l'atmosphère, de la production d'énergie et de nombreuses autres applications technologiques essentielles.

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LES PRODUITS CARNÉS DÉSHYDRATÉS

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Résumé. Les produits carnés déshydratés gagnent en popularité mondialement pour leur similitude avec la viande fraîche et leur longue conservation. Par exemple, en Turquie, le pastirma, en Amérique du Nord, le jerky, au Brésil, le carne-de-sol, en Afrique du Sud, le biltong, en Afrique du Nord, le kaddid et en Espagne, la cecina. Cet article analyse l'impact des méthodes de déshydratation sur la viande. Les techniques incluent la déshydratation au soleil ou à l'air chaud, sous vide, par ultrasons, par sublimation, par le froid, par micro-ondes, par pompe à chaleur, par champ électrique pulsé et par fenêtre de réfraction. Les méthodes traditionnelles, comme l'exposition au soleil ou à l'air chaud, sont lentes et peuvent altérer la couleur, rétrécir, altérer le goût, les nutriments et les lipides, et réduire la vitesse de réhydratation. Des méthodes modernes et combinées ont été développées mondialement pour éviter ces effets négatifs, offrant des avantages par rapport aux méthodes traditionnelles.

Mots clés: séchage, qualité alimentaire, produits carnés, micro-ondes, vide

Introduction

La demande d'aliments non seulement sains mais aussi facilement accessibles ne cesse de croître, une tendance qui s'observe à l'échelle mondiale. La viande est connue pour être une source essentielle de protéines, d'acides aminés et de vitamines du complexe B, appréciée pour sa composition unique et son goût inimitable [1]. Cependant, la nature périssable de la viande fraîche, caractérisée par une teneur élevée en eau, un pH légèrement acide et la présence d'hydrates de carbone et de protéines, la rend sujette à la détérioration microbienne et enzymatique, ce qui limite sa durée de déshydratation [2]. Pour prolonger la durée de conservation de la viande et des produits à base de viande, il est essentiel d'utiliser des méthodes de conservation efficaces. Le séchage est l'une des méthodes les plus anciennes et les plus pratiques de conservation et de transformation des aliments et est toujours privilégié, en particulier dans les climats chauds et humides. Le processus de séchage consiste à éliminer l'eau des aliments par évaporation ou sublimation, ce qui présente des avantages tels que la stabilité en rayon, la facilité de transport et de stockage, et s'avère utile dans les situations de crise ou de catastrophe naturelle [3]. Ces aliments déshydratés peuvent être d'une importance cruciale pour fournir de riches sources de protéines aux populations sous-alimentées des pays en développement, car ils n'ont pas besoin d'être réfrigérés pendant le transport ou le stockage.

Produits carnés séchés

Les produits à base de viande séchée sont définis comme des produits à base de muscle entier ou de viande hachée et formée ayant subi une déshydratation, ce qui leur confère des propriétés sensorielles uniques et une stabilité accrue. Il s'agit notamment de diverses spécialités de viande séchée telles que le jambon, le biltong (d'Afrique du Sud), le pastirma (de Turquie), le bundner fleisch (de Suisse), le bœuf séché (des États-Unis), le rougan et le shafu (de Chine), entre autres. Le jerky est classé par le ministère américain de l'agriculture comme un produit carné prêt à consommer, traité thermiquement et de longue conservation, avec un a_w de 0,85 et un rapport humidité/protéines de 0,75. Le kilishi est un autre produit carné à humidité intermédiaire,

spécifique aux zones tropicales, préparé à partir de viande de bœuf séchée au soleil et assaisonnée avec de la pâte d'arachide écrémée [4]. On peut également citer le Kargyong (saucisses fumées et séchées), le Satchu (viande de bœuf ou de yak séchée/fumée) et le Suka ko masu (viande de buffle séchée/fumée) provenant de l'est de l'Himalaya. Il existe également une variété de produits carnés déshydratés ou de longue conservation, tels que le porc déshydraté, les snacks de poulet, les chips de poulet, les snacks à base de céréales et de viande de poulet, les morceaux de poulet déshydratés, les snacks micro-ondables prêts à consommer à base de viande d'animaux de différentes espèces, les anneaux de viande déshydratée et les cubes de bœuf déshydraté.

Caractéristiques de la déshydratation

La capacité de rétention d'eau, l'état des protéines du muscle et sa structure microscopique déterminent les propriétés de réhydratation de la viande déshydratée. Le diamètre des fibres musculaires et l'espace entre les groupes de fibres musculaires sont réduits au cours de la déshydratation. Le taux de réduction de la teneur en eau pendant la déshydratation est élevé dans la viande préparée par rapport à la viande crue [5]. Les dommages causés par la chaleur au cours de la déshydratation de la viande se caractérisent par un arôme de brûlé, une dureté et une granulosité. La conceptualisation de la distribution de l'eau dans la viande pendant la déshydratation peut aider à optimiser le processus, ce qui peut être réalisé par de nouvelles techniques non destructives telles que l'imagerie hyperspectrale. Pour étudier cet aspect, des images en pixels ont été prises à différentes périodes et à six longueurs d'onde spécifiques dans des tranches de bœuf. En ce qui concerne la valeur nutritionnelle de la viande déshydratée, seules deux études ont été menées dans les années 1940 (tableau.1.). Elles concernaient des viandes déshydratées et emballées obtenues par des méthodes aujourd'hui tombées en désuétude. La plupart des pays ont leurs propres produits traditionnels à base de viande déshydratée, qui présentent des caractéristiques sensorielles similaires (tableau.1.). Le kilishi et le biltong sont deux de ces produits, couramment consommés dans les pays africains. Les produits à base de viande séchée ont une texture durcie et un aspect ridé en raison de la réduction du volume, et la viande présente parfois une croûte dure à la surface [6]. Des composés aromatiques sont produits dans les produits carnés à la suite de l'oxydation des lipides, ce qui donne à la viande une saveur caractéristique [7]. La couleur de la viande séchée varie du rouge au brun en fonction de la température de cuisson. L'ajout de sel et de nitrates/nitrites peut également modifier la couleur et la saveur. L'arôme caractéristique de la viande séchée est dû aux métabolites produits par l'action des enzymes sur la viande [8].

Différences entre les types de déshydratation

Les produits carnés déshydratés à forte teneur en viande ont une teneur en humidité et en eau liée plus élevée. Le processus de séchage affecte de manière significative la teneur en humidité totale, la composition en graisses totales et en acides gras de la viande séchée et des produits à base de viande. Les produits carnés séchés au soleil ont une teneur en eau plus élevée que les produits carnés séchés à l'air et les produits carnés séchés à l'air ont une teneur en eau plus élevée que les produits carnés lyophilisés [9]. Le séchage sous vide augmente considérablement la teneur totale en matières grasses, tandis que la lyophilisation et le séchage sous atmosphère modifiée la réduisent. Les produits carnés déshydratés préparés ont une teneur en humidité, en graisse et en cendres inférieure à celle des produits carnés crus déshydratés [10]. L'augmentation de la teneur en viande dans les produits carnés déshydratés entraîne également une augmentation de la teneur en matières grasses et en protéines. L'utilisation d'assaisonnements dans les produits de viande déshydratée augmente également la teneur en cendres des produits.

Tableau 1.

Effets de certains traitements physiques sur les caractéristiques sensorielles et nutritionnelles des produits carnés.

Traitement	Produit carné	Effets
Vieillessement à sec	Viande de bœuf [5][6][7] - Viande de porc	- Plus de saveur, de tendresse et de jutosité dans le bœuf. - Goût umami dans la viande de bœuf et de porc. - Modifications nutritionnelles non étudiées.
Durcissement à sec	- Porc, bœuf, mouton [11] - Produits carnés [12] - Produits carnés de différents animaux	- Augmentation de la température de stockage. a légèrement diminué la digestibilité des protéines de porc séchées. - La qualité des protéines n'est pas significativement réduite lors de la déshydratation. - Texture durcie, aspect ridé, saveur caractéristique, couleur brune et noircissante
Traitement haute pression	- Viande de bœuf, de porc, de poulet - Différents produits carnés - Bœuf et lapin muscles - Produits à base de viande - Magret d'oie - Coupes de viande d'agneau - Jambon - Viande prête à manger produits [8][9] - Jambon de porc	- Valeur nutritionnelle inchangée. - Les vitamines et les composés aromatiques de faible poids moléculaire restent intacts. - Digestibilité améliorée. - Tendresse améliorée, modification de la qualité de la couleur. en fonction du contenu en myoglobine. - Tendresse améliorée. - Arômes dorés, livrés et oxydés. - Digestibilité améliorée. - Aucun changement dans les propriétés sensorielles. - Couleur plus pâle et texture plus douce.
Basse température longue durée (LTLT) et cuisson sous vide	- Viande - Viandes d'agneau et de porc - Bœuf - Viande de poulet - Porc - Bœuf mariné	- Tendresse accrue et meilleure apparence. - Saveur accrue. - Tendresse accrue. - Augmentation de la tendresse et de la couleur. - Rouge brunâtre avec une légère couleur verte.

Conclusion

Les produits carnés déshydratés constituent une solution efficace pour la conservation de la viande et des produits carnés, offrant une alternative durable et facilement transportable à la viande fraîche. Ces produits présentent une variété de méthodes de déshydratation, chacune ayant ses propres avantages et effets sur la qualité du produit final. Bien que les méthodes de déshydratation traditionnelles puissent avoir des effets négatifs sur la texture et la qualité nutritionnelle, les technologies nouvelles et combinées offrent des solutions pour éviter ces problèmes. L'importance de ces produits est évidente dans le contexte mondial de la demande croissante d'aliments durables et abordables, en particulier dans les pays en développement. Il est donc essentiel de poursuivre la recherche et le développement des méthodes de déshydratation de la viande pour répondre aux besoins actuels et futurs de l'industrie alimentaire.

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**SECȚIA INGINERIE MECANICĂ INDUSTRIALĂ ȘI
TRANSPORTURI**

**SECTION OF INDUSTRIAL MECHANICAL ENGINEERING
AND TRANSPORT**

ANALIZA CINEMATICĂ A MECANISMULUI BIELĂ-MANIVELĂ. METODE CLASICE ȘI MODERNE DE CALCUL (CALCUL NUMERIC ÎN LIMBAJUL DE PROGRAMARE PYTHON)

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Rezumat. *Importanța analizei cinematice în cazul mecanismelor plane este benefică în primul rând pentru determinarea stării de mișcare a tuturor elementelor mecanismului studiat sau a punctelor de interes care aparțin elementelor mecanismului fără a se lua în considerare forțele care provoacă mișcarea. De obicei aplicăm analiza cinematică la mecanisme ale căror dimensiuni sunt cunoscute, și reprezentate la un coeficient de scară conform standardului SR EN ISO 5455:1997. Astfel prin intermediul analizei cinematice se pot determina parametrii cinematici precum poziția elementului sau a punctului studiat, traiectoria descrisă de punctul studiat, vitezele și accelerațiile liniare și respectiv unghiulare. În lucrare a fost folosită schema mecanismului bielă-manivelă pentru determinarea distribuției vitezelor (teoretic) prind diferite metode clasice precum metoda centrului instantaneu de rotație, metoda rabaterii, metoda proiecțiilor și metoda poligoanelor de viteză. În final a fost efectuat și un calcul numeric pentru un ciclu complet de funcționare a mecanismului în limbajul de programare Python.*

Cuvinte cheie: *analiza cinematică a mecanismelor, mecanism bielă-manivelă, metode de calcul, limbaj de programare Python*

Introducere

În lucrare au fost trecute în revistă principalele metode de analiză cinematică a mecanismului bielă manivelă. În prima parte a lucrării au fost arătate la nivel teoretic următoarele metode clasice:

- calculul distribuției vitezelor prin metoda centrului instantaneu de rotație, această metodă a fost folosită cu preponderență în timpul rezolvării problemelor la disciplina *Mecanica Teoretică* [1];
- calculul distribuției vitezelor prin metoda rabaterii și metoda proiecțiilor, metode care derivă din metoda centrului instantaneu de rotație;
- calculul distribuției vitezelor prin metoda construirii poligoanelor de viteză, metodă care a fost folosită la realizarea proiectului de an la disciplina *Mecanisme* [2].

În partea a doua a lucrării a fost prezentat o metodă modernă și anume un exemplu numeric de calcul pentru determinarea distribuțiilor vitezelor și accelerațiilor, calcul realizat prin intermediul limbajului de programe Python, care pe lângă calculul numeric propriu zis ne permite și vizualizarea rezultatelor obținute în timp real nu doar pentru o poziție oarecare, ca în cazul metodelor clasice, dar ne permite să determinăm și vizualizăm parametrii cinematici studiați pentru un ciclu cinematic complet în timpul funcționării mecanismului [3].

Limbajul de programare Python a fost ales pentru a realiza calculul numeric și vizualizarea calculului deoarece în anul I de studii am urmat cursul *Bazele Programării Calculatoarelor* în care am studiat bazele programării în limbajul Python. Pe de altă parte acest limbaj de programare este tot mai folosit la scară mondială din cauza avantajelor pe care le prezintă față de alți concurenți, și anume [3]:

- Python are un cod simplu și flexibil astfel încât este ușor de înțeles și citit, chiar și pentru începători;
- Python poate fi folosit gratis (open source) și este multifuncțional (crearea de aplicații web, calcule numerice, calcule ingineresti, crearea aplicațiilor grafice) datorită numărului mare de pachete, module și biblioteci, care la rândul său sunt disponibile gratuit;
- Python poate fi folosit pe toate platformele și sistemele de operare (Windows, macOS și Linux).

Există diferite clasamente în ceea ce privește care limbaj de programare este cel mai popular și utilizat la nivel global. În majoritatea acestor clasamente în top se află Python, astfel în fig. 1 este prezentat clasamentul oferit de compania IEEE Spectrum pentru anul 2023 [4].



Figura 1. Exemplu clasament limbaje de programare pentru 2023

1. Analiza cinematică. Metode clasice de calcul.

a) *Metoda centrului instantaneu de rotație.* Este o metodă grafo-analitică ce se bazează pe faptul că la un moment dat distribuția de viteze este aceeași cu cea dintr-o mișcare de rotație în jurul centrului instantaneu de rotație cu viteza unghiulară ω . Această metodă a fost folosită cu preponderență la rezolvarea problemelor în cadrul disciplinei *Mecanica Teoretică*.

Vom considera mecanismul bielă-manivelă din fig. 2 pentru care vom determina vitezele punctelor A și B prin metoda centrului instantaneu de rotație.

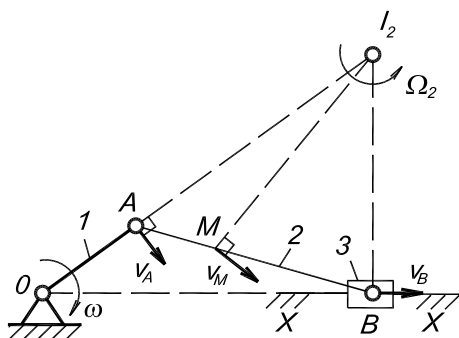


Figura 2. Metoda centrului instantaneu de rotație

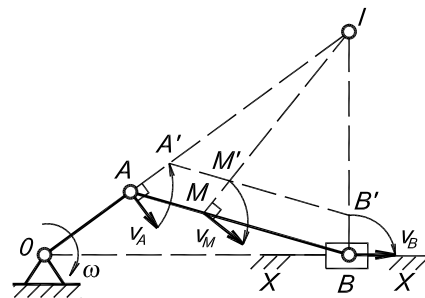


Figura 3. Metoda rabaterii

Soluția teoretică: Manivela 1 efectuează mișcare de rotație, biela 2 mișcare plan-paralelă, iar patina 3 mișcare de translație. Punctul A, aparține simultan manivelei și bielei, are viteza

complet determinată $v_A = OA \cdot \omega$, care este perpendiculară pe OA și sensul de rotație dat de viteza unghiulară ω .

Punctul B aparține simultan și bielei și patinei are viteza paralelă ghidajului xx . Prin urmare pentru bielă sunt îndeplinite condițiile pentru aplicarea metodei centrului instantaneu de rotație. Ridicând perpendiculare în A și B pe suporturile vitezelor acestor puncte, se obține centrul instantaneu de rotație I_2 . Viteza unghiulară în jurul său este $\Omega_2 = \frac{v_A}{I_2A} = \frac{OA}{I_2A} \omega$, unde $v_B = I_2B \cdot \Omega_2 = \frac{I_2B}{I_2A} \cdot OA \cdot \omega$. Viteza unui punct arbitrar M de pe bielă se obține ca într-o mișcare de rotație în jurul lui I_2 cu viteza unghiulară Ω_2 .

b) *Metoda rabaterii*. Această metodă este prezentată în figura 3.

Soluția teoretică: Viteza punctului A este perpendiculară pe OA și are modulul $v_A = OA \cdot \omega$; iar punctul B are viteza paralelă ghidajului xx . Se rabate cu $\frac{\pi}{2}$ viteza \bar{v}_A și se obține punctul A' . Din A' se duce o paralelă la AB , care intersectează în punctul B' perpendiculara ridicată în B pe xx . Segmentul BB' se rabate cu $\frac{\pi}{2}$ în sens opus cu \bar{v}_A și se obține la scară viteza \bar{v}_B . Pentru determinarea vitezei unui punct M de pe bielă, se construiește centrul instantaneu de rotație I , se unește M cu I și se obține punctul M' la intersecția cu AB' . Segmentul MM' se rabate cu $\frac{\pi}{2}$ în același sens cu BB' și se obține viteza \bar{v}_M la scară.

c) *Metoda proiecțiilor*. Această metodă este prezentată în figura 4.

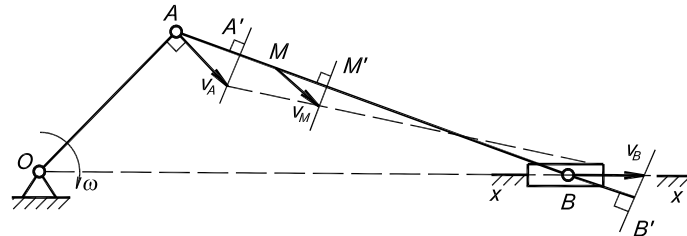


Figura 4. Metoda proiecțiilor

Soluția teoretică: Viteza punctului A are modulul $|\bar{v}_A| = OA \cdot \omega$, este perpendiculară pe O_1A , iar sensul este dat de ω . Viteza punctului B are suportul perpendicular pe O_2B . Se construiesc proiecțiile $AA' = BB'$, iar viteza \bar{v}_B se obține ridicând în punctul B' o perpendiculară pe AB până intersectează perpendiculara pe O_2B .

d) *Metoda poligoanelor de viteză*. Această metodă este de asemenea o metodă grafo-analitică prezentată în figura 5 și a fost folosită cu preponderență în cadrul disciplinei *Mecanisme* pentru determinarea distribuției vitezelor la proiectul de an.

Soluția teoretică: Viteza punctului A are modulul $|\bar{v}_A| = OA \cdot \omega$, este perpendiculară pe OA , iar sensul este dat de ω . Pentru determinarea vitezei punctului B vom scrie ecuația vectorială a lui Euler în mișcare plan-paralelă, când considerăm că punctul B se mișcă în raport cu punctul A . Viteza \bar{v}_B are suportul paralel cu ghidajul xx . Viteza \bar{v}_{BA} are suportul perpendicular pe AB . Deci se poate scrie ecuația vectorială $\bar{v}_B = \bar{v}_A + \bar{v}_{BA}$, care se reprezintă în planul vitezelor.

Construind vectorul $\overline{pa} = \overline{v_A}$, se duce prin a , extremitatea lui $\overline{v_A}$, o perpendiculară pe AB (suportului lui $\overline{v_{BA}}$); iar prin p , originea lui $\overline{v_A}$ o paralelă la xx , obținându-se astfel punctul b , extremitatea lui $\overline{v_B}$. În planul vitezelor ecuația vectorială se scrie $\overline{pb} = \overline{pa} + \overline{ab}$.

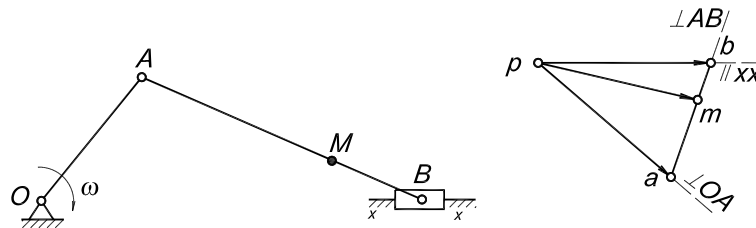


Figura 5. Metoda poligoanelor de viteză

Viteza punctului M se determină aplicând teorema asemănării. Punctul m se găsește pe ab – omologul lui AB – astfel că $\frac{am}{ab} = \frac{AM}{AB}$. În planul vitezelor, viteza punctului M este $\overline{v_M} = \overline{pm}$.

Viteza unghiulară ω_2 se determină cu ajutorul relației $\overline{v_{BA}} = \omega_2 \times \overline{AB}$, de unde $\omega_2 = \frac{|\overline{v_{BA}}|}{|\overline{AB}|}$, iar sensul său este anti orar stabilit cu de vectorul \overline{ab} .

2. Analiza cinematică. Metoda modernă. Calculul numeric în Python

Și în acest caz vom folosi schema aceluiași mecanism bielă-manivelă după cum este prezentat în figura 6, unde r reprezintă lungimea bielei OA , l reprezintă lungimea bielei AB , h reprezintă distanța AC și respectiv d_1 este OC , iar d_2 este CB . Pentru a putea scrie codul în limbajul de programare Python vom avea nevoie de relațiile analitice de calcul. Astfel o primă relație de calcul pentru deplasarea pistonului pe axa orizontală ar fi:

$$x = d_1 + d_2 = r \cdot \cos \theta + \sqrt{(l^2 - r^2 \cdot \sin^2 \theta)}. \quad (1)$$

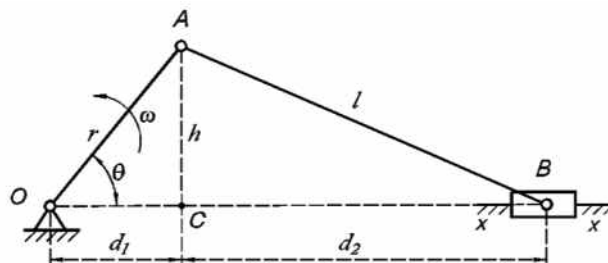


Figura 6. Schema mecanismului bielă-manivelă pentru calculul numeric

Programul de calcul numeric (codul în Python) îl vom scrie pentru determinarea deplasării, vitezei și accelerației pistonului (punctul B) pentru un ciclu cinematic complet atunci când unghiul θ se modifică la o rotație completă a manivelei OA . Cunoscând relația de calcul (1) deplasarea pistonului (punctul B), putem relativ destul de simplu să determinăm atât viteza punctului B (derivata de ordinul 1, $v = \dot{x}$), cât și accelerația punctului B (derivata de ordinul 2, $a = \ddot{x}$). Prin urmare putem obține relațiile analitice de calcul pentru calculul vitezei și accelerației pentru punctul B :

$$v = \dot{x} = -r \cdot \dot{\theta} \cdot \sin \theta - \frac{r^2}{2\sqrt{l^2 - r^2 \sin^2 \theta}}, \quad (2)$$

$$a = \ddot{x} = -r \cdot \dot{\theta}^2 \cdot \cos \theta - \frac{4 \cdot r^2 \cdot \dot{\theta}^2 \cos 2\theta (l^2 - r^2 \cdot \sin^2 \theta) + (r^2 \cdot \dot{\theta} \cdot \sin 2\theta)^2}{4\sqrt{(l^2 - r^2 \cdot \sin^2 \theta)^3}} \quad (3)$$

Pe lângă limbajul de programare Python vom folosi și bibliotecile Numpy pentru calculul numeric, biblioteca Scipy pentru calculul derivatelor de ordinul unu și doi, dar și biblioteca Matplotlib pentru vizualizarea rezultatelor după rularea codului. Pentru a putea efectua calculul numeric propriu zis vom stabili următoarele date: $r = 150 \text{ mm}$ lungimea manivelei OA , $l = 350 \text{ mm}$ lungimea bielei AB , iar turația manivelei OA o vom considera $n = 500 \text{ min}^{-1}$.

Codul Python pentru determinarea deplasării, vitezei și accelerației punctului B pentru o rotație completă a manivelei:

```
1 import numpy as np
2 from numpy import pi, sin, cos
3 import matplotlib.pyplot as plt
4 from scipy.misc import derivative
5
6 r = 150 # lungime manivela OA
7 l = 350 # lungime biela AB
8 rpm = 500 # turatia manivelei
9 omega = (2*pi*rpm)/60 # rad/sec
10
11 def deplasare_B(t):
12     d1 = r*cos(omega*t)
13     d2 = np.sqrt(l**2-(r**2*sin(omega*t)*sin(omega*t)))
14     return d1+d2
15
16 def viteza(t):
17     return derivative(deplasare_B,t)
18
19 def acceleratia(t):
20     return derivative(viteza,t)
21 timp = np.linspace(0, .5, 350)
22 unghi = omega*timp*180/pi
23 x = deplasare_B(timp)
24 v = viteza(timp)
25 a = acceleratia(timp)
26 plt.figure(figsize=(9,6))
27 plt.subplot(3,1,1) # graficul deplasarii
28 plt.plot(unghi, x, 'b')
29 plt.ylabel('Deplasare mm')
30 plt.tight_layout(pad=3.0)
31 plt.xlim(0,360) # 1 rotatie completa
32 plt.subplot(3,1,2) # graficul vitezei
33 plt.plot(unghi, v, 'orange')
34 plt.ylabel('Viteza mm/s')
35 plt.tight_layout(pad=3.0)
36 plt.xlim(0,360) # 1 rotatie completa
37 plt.subplot(3,1,3) # graficul acceleratiei
38 plt.plot(unghi, a, 'r')
39 plt.ylabel('Acceleratia mm/s^2')
40 plt.xlabel('Unghiul in grade')
41 plt.tight_layout(pad=3.0)
42 plt.xlim(0,360) # 1 rotatie completa
43 plt.show()
```

După rularea codului von obține reprezentările grafice figura 7 pentru deplasarea, viteza și accelerația punctului B pentru o rotație completă a manivelei.

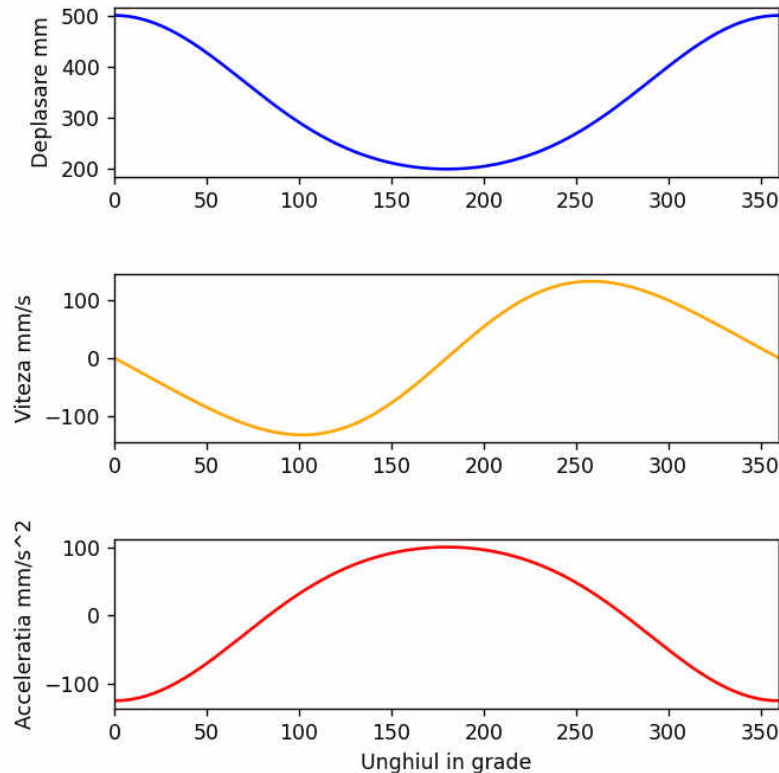


Figura 7. Rezultatul obținut după rularea codului

Concluzii

În lucrare a fost realizată o analiză a metodelor clasice și moderne de analiză cinematică pentru mecanismul bielă-manivelă. Dacă metodele clasice ne oferă posibilitatea să calculăm deplasarea, viteza sau accelerația pentru o poziție a mecanismului cu ajutorul metodei moderne de calcul numeric în limbajul Python putem obține rezultatul foarte rapid pentru mai mulți parametri concomitent pentru întreg ciclul cinematic (în cazul cercetat pentru o rotație completă a manivelei). Pentru cercetările ulterioare ne propunem să realizăm astfel de calcule și pentru alte tipuri de mecanisme.

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PREMISE DE DEZVOLTARE ALE CENTRALELOR FOTOVOLTAICE PLUTITOARE ÎN COMUNITĂȚI ENERGETICE RURALE ÎN REPUBLICA MOLDOVA

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Rezumat. *Articolul prezintă aspecte ale potențialului de energie din surse regenerabile din țară, cu accent pe producția de energie electrică din instalații fotovoltaice. De asemenea, se analizează o soluție specifică cu privire la implementarea instalațiilor fotovoltaice, și anume, centralele fotovoltaice plutitoare (CFP), precum și exemple de utilizare a acestei soluții pentru a servi comunitățile energetice din zonele rurale propuse. Totodată, sunt prezentate exemple de utilizare a acestei soluții pentru a servi comunitățile energetice din zonele rurale. Aceste soluții pot fi văzute ca pași care vor anticipa o strategie energetică națională pe termen lung pentru sectorul energetic. O tranziție eficientă către sisteme energetice decarbonate necesită găsirea de soluții inovatoare pentru a crește penetrarea surselor de energie din surse regenerabile, pentru a schimba viitorul sistem energetic prin promovarea și evaluarea perspectivelor inovatoare, ceea ce este ratificat și în conceptul Strategiei Energetice către 2050 din republica Moldova.*

Cuvinte cheie: *tranziție energetică, strategie energetică, energie din surse regenerabile, centrale fotovoltaice plutitoare, comunitate energetică rezilientă.*

Introducere

În lumea de astăzi, care se confruntă cu provocările schimbărilor climatice și cu epuizarea surselor convenționale de energie, rolul surselor regenerabile de energie devine din ce în ce mai important. În acest context, energia solară se evidențiază prin potențialul său de eficiență și curățenie fără precedent. Pentru a utiliza în mod cât mai eficient acest potențial, tehnologia modernă oferă abordări inovatoare, iar una dintre acestea este proiectarea de centrale solare pe suprafețe de apă. Proiectarea și funcționarea centralelor solare pe apă oferă o serie de avantaje. În primul rând, permite utilizarea eficientă a spațiilor mari de apă pentru a găzdui panouri solare, minimizând conflictele cu utilizarea terenurilor fezabile pentru agricultură. Acest lucru este valabil mai ales în mediile cu terenuri limitate și cerere crescută de energie. În plus, apa poate servi ca agent de răcire naturală pentru panourile solare, sporind eficiența și longevitatea acestora.

Aspectul economic al proiectării centralelor solare de producere a energiei electrice este evaluat prin luarea în considerare a costurilor de infrastructură, echipament și întreținere. Cu toate acestea, pe termen lung, astfel de investiții pot fi justificate datorită costurilor scăzute de exploatare și a furnizării stabile de energie electrică.

Studiul de caz privind dezvoltarea CFP în comunități energetice rurale din Centrul Moldovei

Elementele structurale din CFP sunt clasificate ca elemente verticale, elemente de susținere utilizate pentru asamblarea modulului solar, elemente de conectare a modulului solar utilizate pentru asamblarea modulului solar și a punctului de sprijin, elemente de sprijin pentru asamblarea punctelor de sprijin și creșterea rigidității orizontale a structurilor și elemente principale pentru asamblarea celorlalte elemente și a geamandurii. Toate elementele structurale sunt conectate cu ajutorul unor șuruburi din oțel inoxidabil. Lungimea elementelor structurale este stabilită la 12,6

m pentru a facilita manipularea în timpul fabricării sistemului structural. Complexul fotovoltaic plutitor de generare a energiei electrice este format din structuri unitare cu o lungime de 12,6 m și o lățime de 11,5 m, în care sunt instalate 33 de panouri solare cu dimensiuni de 1966 mm × 1000 mm și cu puterea de generare de 300 W. Pentru studiu de caz în comunitatea energetică rurală din Centrul Moldovei a fost ales lacul Ghidighici. Aflăm numărul de unități structurale cu formulele:

$$Nr_{u.s.} = \frac{C_f}{P_u} = \frac{103000}{9,9} = 10404 \text{ unit.}; \quad (1)$$

unde: $Nr_{u.s.}$

reprezintă numărul de unități structurale;

C_f - capacitatea fotovoltaică, din figura 3.7., kW;

P_u - puterea instalată a unității structurale, kW;

Aria unității structurale

$$S_{u.s.} = L \cdot l = 12,6 \cdot 11,5 = 145 \text{ m}^2; \quad (2)$$

unde: $S_{u.s.}$ reprezintă aria unității structurale, m²;

L - lungimea, m;

l - lățimea, m;

Aria aproximativă a centralei fotovoltaice plutitoare

$$S_{CFP} = S_{u.s.} \cdot Nr_{u.s.} = 145 \cdot 10404 = 1,508 \text{ km}^2; \quad (3)$$

unde: S_{CFP}

reprezintă aria centralei fotovoltaice plutitoare;

Complexul de generare fotovoltaică plutitoare din clasă este format din 10404 structuri unitare, care sunt clasificate în trei tipuri: Tipurile A, B, C, care sunt prezentate în figura 1. Tipul A este modelul de bază, tipul B este combinația dintre tipul A și un pod de pontoane, iar tipul C este structura utilizată pentru instalarea dispozitivelor electrice, cum ar fi convertorul. Podul de pontoane este construit pentru a instala echipamentele electrice și este, de asemenea, utilizat ca rută de deplasare pentru muncitori.

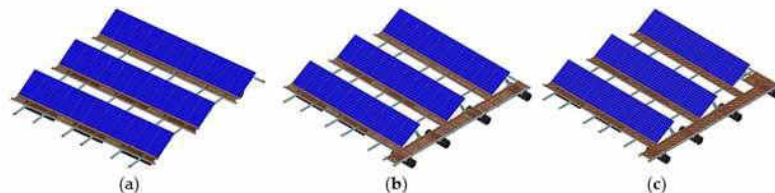


Figura 1. Structura unității (a) tip A (mod de bază); (b) tip B (cu punct de sprijin); (c) tip C (pentru instalarea dispozitivului electric) [1]

Capacitatea de generare a fiecărui tip de structură unitară este prezentată în tabelul 1.

Tabelul 1.

Numărul și capacitatea de generare a fiecărei structuri unitare.

Elemente de structură	Tip A	Tip B	Tip C
Nr. de unități de structură	8323	729	1352
Nr. de module solare pe unitate de structură	33	30	29
Capacitatea de producție pe unitate de structură, kW	9,9	9,0	8,7

Calculul densității de putere se bazează pe aplicarea următoarelor formule [2]:

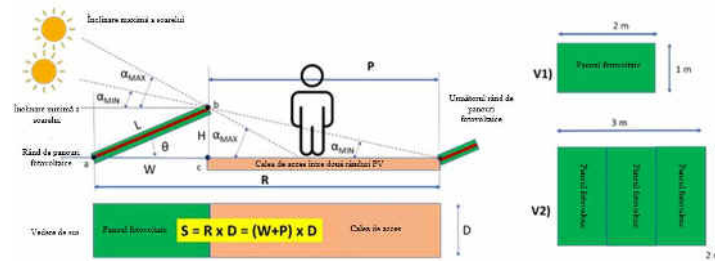


Figura 2. Geometria rândurilor PV pentru instalarea pe construcții plutitoare fotovoltaice [2]

$$S = R \cdot D = (W + P) \cdot D = (L \cos \theta + H / \tan \alpha_{MIN}) \cdot D; \quad (4)$$

$$= (L \cos \theta + L \sin \theta / \tan \alpha_{MIN}) \cdot D; \quad (5)$$

$$S_{1kW} = S / P_{PV_panel} \cdot \quad (6)$$

Pentru $\theta = 35^\circ$ (cel mai bun unghi de înclinare pentru cea mai mare cantitate de energie pe parcursul unui an) și pentru $\alpha_{MIN} = 12^\circ$ (cel mai mic unghi de înclinare a soarelui în timpul iernii, fără umbră) analizăm două tipuri de instalații fotovoltaice:

- rânduri de un panou fotovoltaic de 1966 x 1000 mm, având PV = 300 W/panou (valoare conservatoare, pot exista valori mai mari) și montate cu partea mică pe orizontală (tip „landscape”). Prin urmare, lungimea L este egală cu $L_{PV} = 2$ m, în timp ce adâncimea rândului este egală cu $l_{PV} = 1$ m.
- șiruri de 3 panouri fotovoltaice de aceeași dimensiune de 1966 x 1000 mm, având aceeași putere PV = 300 W/panou. Lungimea L este, prin urmare, egală cu 3 m, în timp ce adâncimea rândului este egală cu 2 m. Puterea rândului este $3 \times 300 = 900$ W.

Suprafața totală necesară pentru un rând poate fi dedusă ca fiind:

$$S_{V1} = (2 \cos 35^\circ + 2 \sin 35^\circ / \tan 12^\circ) \cdot 1 = 7,03 m^2; \quad (7)$$

$$S_{V2} = (2 \cos 35^\circ + 2 \sin 35^\circ / \tan 12^\circ) \cdot 3 = 21,11 m^2; \quad (8)$$

$$S_{1kW_V1} = 7,03 / 0,3 = 23,43 m^2 / kW; \quad (9)$$

$$S_{1kW_V2} = 21,11 / 0,9 = 23,45 m^2 / kW; \quad (10)$$

Valoarea de 23,4 m² / kW a fost calculată în cea mai dificilă situație din timpul iernii, când soarele are un unghi de înclinare minimă și maximă foarte scăzut (cel mai scăzut este așteptat pentru 21 decembrie).

Aria finală a centralei

$$S_{CFPfinal} = S_{1kW_V1} \cdot C_f = 23,45 \cdot 103000 = 2,41 km^2.; \quad (11)$$

unde: $S_{CFPfinal}$ reprezintă aria finală a CFP, km²;

S_{1kW_V1} - suprafața totală necesară pentru un rând, m²;

C_f - capacitatea fotovoltaică, din figura, kW;

Suprafața lacului constituie 4,15 km².

Rezultă că pentru această geometrie a panourilor fotovoltaice se acoperă cu structuri unitare doar o suprafață a lacului de $2.41 / 4.15 \times 100 = 58 \%$, ceea ce este o proporție acceptabilă, care nu poate afecta negativ ecosistemul lacului.

Conform datelor din [9], în sectorul Chișinău, în ziua de 21 din 20 decembrie 2022, avem $\alpha_{MIN} = 12^\circ$ în intervalul de timp dintre 9h:34m și 14h:32m, ceea ce înseamnă că nu există umbră timp de aproximativ 5 ore. Din același site, se poate deduce că $\alpha \geq \alpha_{MIN} = 10^\circ$ pentru 5 ore și 40 de minute (o perioadă mai lungă cu 13,3 %), astfel încât terenul necesar pentru 1 kW se calculează, de asemenea, pentru 10° .

$$S_{v_{1,10^\circ}} = (2 \cos 35^\circ + 2 \sin 35^\circ / \tan 10^\circ) \cdot 1 = 8,15 m^2; \quad (12)$$

$$S_{1kW_{v_{1,10^\circ}}} = 8,15 / 0,3 = 27,16 m^2 / kW; \quad (13)$$

Pentru această variantă este:

$$S_{CFPfinal} = \text{aprox. } 2.8 \text{ km}^2. \quad (14)$$

Rezultă că pentru această a doua geometrie a panourilor fotovoltaice, cu plasare mai distanțată decât în cea anterioară și cu umbrire mai mică în perioada critică de iarnă (13.3% mai mare perioadă fără umbrire pe 21 decembrie), se acoperă cu structuri unitare doar o suprafață a lacului de $2.8 / 4.15 \times 100 = 67 \%$, ceea ce este o proporție acceptabilă, care la rândul ei nu poate afecta negativ ecosistemul lacului.

Concluzii

Introducerea de centrale cu panouri flotante pe lacul Ghidighici sau pe altul similar reprezintă a soluție fezabilă, care nu afectează ecosistemul specific lacului și care permite, și realizarea de alte activități (pescuit, navigație pe lac etc.), în condițiile obținerii unei puteri instalate corespunzătoare fără ocuparea terenurilor adiacente cu abordarea diferitor geometrii ale rândurilor PV pentru instalarea pe construcții plutitoare fotovoltaice.

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PROCEDEE CONSTRUCTIV-TEHNOLOGICE DE REDUCERE A NIVELULUI DE ZGOMOT ȘI VIBRAȚII ÎN TRANSMISIILE PLANETARE PRECESIONALE

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Rezumat. Optimizarea transmisiilor mecanice și, îndeosebi celor planetare precesionale, este una din preocupările ingineresti primordiale atât la etapa proiectării angrenajelor cât la etapa exploataării. În lucrare sunt abordate aspectele generale privind reducerea nivelului de zgomot și vibrații în transmisiile cu angrenare. Prezentate avantajele transmisiilor planetare precesionale față de celelalte tipuri de transmisii mecanice și domeniile de utilizare a acestora. Punctul forte al lucrării este elaborarea procedurii de reducere a nivelului de zgomot și vibrații în transmisiile planetare precesionale prin executarea blocului satelit cu un anumit grad de flotabilitate în timpul funcționării. Această metodă constructivă permite compensarea erorilor de execuție și asamblare, ceea ce, în final duce la micșorarea impactului vibro-acustic al transmisiei. În final pe lângă efectul pozitiv asupra apariției zgomotului și vibrațiilor oferă o construcție simplă și o majorare a fiabilității reductorului prin reducerea sarcinii dinamice. Doar prin studiul continuu în domeniul transmisiilor planetare precesionale va fi obținută o transmisie performantă cu o fiabilitate și emisii fonice minimale.

Cuvinte cheie: transmisie planetară precesională, vibrație, zgomot, microdeplasări.

Introducere

Reducerea nivelului de zgomot și vibrații în transmisii cu angrenare este un subiect important în ingineria mecanică. Pentru a obține performanțe superioare în transmisiile cu angrenare, trebuie respectate o serie de aspecte cruciale:

- **Proiectarea geometriei angrenajului:** Dimensiunile și formele dinților angrenajului au un impact semnificativ asupra nivelului de zgomot și vibrații. Factori precum înălțimea dintelui, jocul la piciorul danturii și geometria generală a angrenajului trebuie să fie optimizați pentru a minimiza zgomotul;
- **Calitatea suprafețelor de contact:** Suprafețele dintelui trebuie să fie prelucrate cu precizie pentru a minimiza asperitățile și a reduce frecarea. O finisare adecvată a suprafețelor contribuie la reducerea zgomotului și a vibrațiilor;
- **Lubrifierea corespunzătoare:** Utilizarea unui lubrifiant adecvat și a unei cantități corecte de lubrifiant poate reduce frecarea și, implicit, zgomotul în transmisii;
- **Izolarea vibrațiilor:** Montarea transmisiilor pe suporturi elastice sau utilizarea amortizoarelor de vibrații poate reduce transferul de vibrații către structura generală;
- **Controlul turației:** Turația de funcționare a angrenajului poate afecta nivelul de zgomot. Uneori, ajustarea turației poate ajuta la minimizarea zgomotului;

Respectarea tuturor aspectelor la etapa proiectării, o prelucrare precisă și o selecție adecvată a materialelor sunt esențiale pentru a reduce nivelul de zgomot și vibrații în transmisii cu angrenare [1].

Soluții constructiv-tehnologice care conduc la minimizarea factorului vibro-acustic în transmisiile mecanice:

- **Utilizarea danturilor elicoidale:** Danturile elicoidale au o suprafață de contact mai mare și o distribuție uniformă a forțelor, ceea ce reduce zgomotul și vibrațiile;

O altă soluție tehnică este transmisia planetară precesională de tipul 2K-H [5], centrul de precesie al căreia este suprapus cu punctul de intersecție a axelor și generatoarelor roților conice, dinților roților dințate centrale, a axei arborelui-manivelă și a axei sectorului înclinat, echilibrat sub aspect dinamic, fapt ce conduce la o reducere parțială a sarcinilor dinamice. Însă existența inevitabilă a erorilor de execuție și asamblare a blocului satelit pe sectorul înclinat al arborelui-manivelă conduce la apariția sarcinilor dinamice generate de abaterile punctului de intersecție a generatoarelor dinților de punctul de intersecție al axelor arborelui conducător și sectorului înclinat.

Pentru funcționarea corectă a transmisiei planetare precesionale și reducerea sarcinilor dinamice în angrenaj este necesară respectarea condiției de bază la fabricarea componentelor principale (a arborelui manivelă, blocului satelit și a roții centrale mobile) și asamblarea transmisiei – asigurarea coincidenței punctelor de intersecție ale axei drepte și înclinate a arborelui-manivelă cu punctul de intersecție a generatoarelor dinților coroanelor danturate ale blocului satelit și roților centrale fixă și conducătoare (centrul de precesie). Apariția unei necoinidențe între aceste puncte duce la generarea unor sarcini dinamice, care conduc la creșterea nivelului de zgomot și vibrații.

3. Procedeu de reducere a nivelului de zgomot și vibrații în transmisiile planetare precesionale cinematice și de putere

Una din soluțiile constructiv-tehnologice a problemei reducerii nivelului de zgomot și vibrații în transmisiile planetare precesionale ar fi executarea blocului satelit cu un anumit grad de flotabilitate în direcție axială în timpul funcționării. În Fig. 1 este prezentată o transmisie precesională cinematică cu bloc satelit instalat fix, nu este flotant în direcție axială, fapt ce nu permite compensarea erorilor de execuție și asamblare. În soluția tehnică [6] blocul satelit este executat cu posibilitatea realizării unor microdeplasări axiale în procesul de funcționare, care va conduce la compensarea acțiunii unor erori posibile (de execuție sau montare). Transmisia precesională conform fig.2,a,b,c include carcasa (1), în care sunt amplasate blocul satelit (2) cu coroanele danturate (3) și (4), roțile dințate centrale fixă (5), legată rigid cu capacul transmisiei (6), și mobilă (7), legată rigid cu arborele condus (8). Blocul satelit (2) este instalat pe bucșa înclinată (9), legată prin intermediul știftului (10) cu arborele conducător (11).

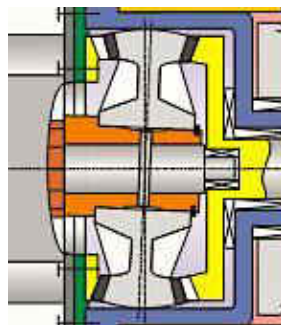


Figura 1. Transmisie precesională cu bloc satelit fixat în direcție axială

Centrul de precesie O (12) este punctul de intersecție a axelor generatoarelor coroanelor danturate (3) și (4) cu axa suprafeței exterioare a bucșei înclinate (9) și axa arborelui conducător (11). Știftul (10) este amplasat în canelul (13) (Fig. 2,b), executat în bucșa înclinată (9), asigurând microdeplasări axiale longitudinale nodului bucșei înclinate (9) cu blocul satelit (2).

Totodată bucșa înclinată (9) este executată din material cu autolubrifiere. Transmisia precesională (Fig. 2) funcționează în modul următor. La rotirea arborelui conducător (11) cu viteza unghiulară de intrare ω_I , blocul satelit (2), instalat pe bucșa înclinată (9), efectuează mișcare de precesie regulată în jurul centrului de precesie O (12) (punctul de intersecție a axelor generatoarelor dinților coroanelor danturate (3) și (4) ale blocului satelit (2) și dinții roților centrale conducătoare (5) și condusă (6). Datorită faptului că bucșa înclinată (9) este executată din material

cu coeficient de frecare redus nu mai este nevoie de utilizat lagăre de alunecare sau rulmenți, ceea ce simplifică construcția.

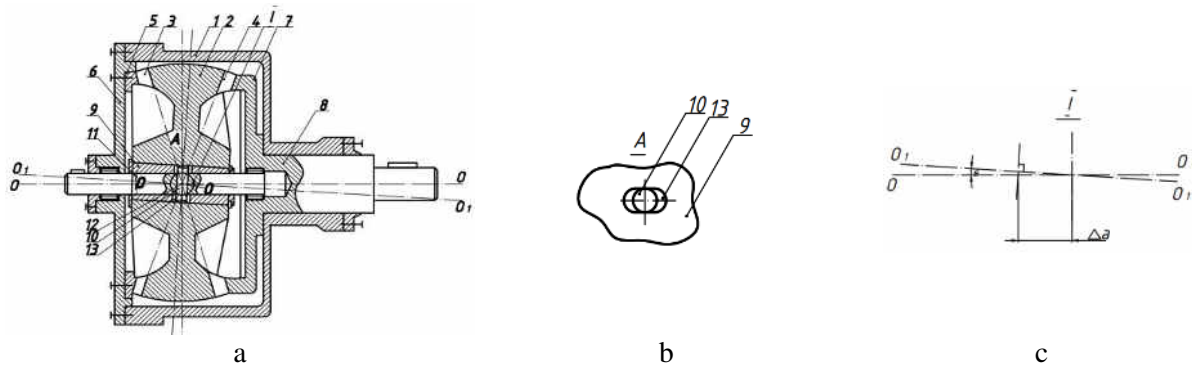


Figura 2. a. Transmisie precesională cu satelit flotant în direcție axială; b. vederea I din fig. a; c, schema necoincidenței axelor Δa .

În procesul de fabricare și montare a blocului satelit (2) pe bușa înclinată (9) și arborele conducător (11) este inevitabilă apariția unor erori de execuție și montare, care conduc la apariția unei necoincidențe Δa (fig. 2,c) între punctul de intersecție a axelor bușei înclinate (9) și arborelui conducător (11) și punctul de intersecție a generatoarelor dinților coroanelor danturate (3) și (4) ale blocului satelit (2) și dinților roților centrale (5) și (6). Amplasarea știftului de legătură a arborelui conducător (11) și bușei înclinate (9) în canalul longitudinal (13) permite nodului „bucșă înclinată (9) – bloc satelit (2)” să efectueze microdeplasări axiale longitudinale, fapt ce asigură compensarea acestei posibile erori Δa . În transmisia precesională conform Fig. 3 blocul satelit (2) este executat din două coroane cu role conice (14) și (15), legate între ele rigid și instalate pe bușa înclinată (9) prin intermediul rulmenților axial-radiali (16), totodată bușa înclinată are executat pe partea din stânga un umăr de sprijin pentru inelul interior al rulmentului radial-axial (16), iar pe capătul din partea dreaptă este executat filet, pe care se montează piulița (17) de reglare a jocului în rulmenții (16).

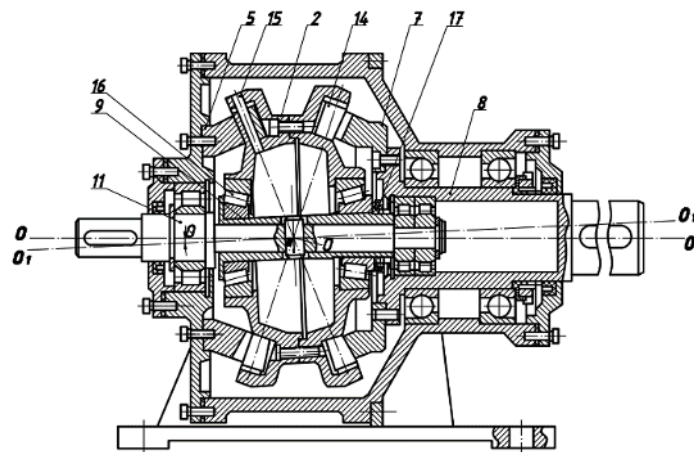


Figura 3. Transmisie precesională cu angrenaj cu role conice cu bloc satelit flotant

În reductorul precesional (fig. 3) de putere blocul satelit este instalat pe rulmenți radiali axiali (16) pe bușa înclinată (9) executată din oțel. Execuția umărului de sprijin pe capătul din stânga al bușei înclinate (9) asigură sprijinul în el a inelului interior al rulmentului radial-axial (16), iar reglarea jocului în rulmenții radial axiali (16) se efectuează cu ajutorul piuliței de reglare (17).

Concluzii:

Soluția tehnică propusă asigură construcție relativ simplă (în special în transmisiile precesionale de putere mică (fig. 2)), majorarea fiabilității reductorului prin reducerea sarcinii dinamice și reducerea nivelului de zgomot și vibrații. Instalarea blocului satelit flotant în direcție axială asigură compensarea relativă a erorilor de execuție și asamblare, fapt ce reduce sarcinile dinamice în transmisiile precesionale de putere și, implicit, nivelul de zgomot și vibrații.

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ASPECTE PRACTICE PRIVIND UTILIZAREA LINIILOR CURBE STUDIAȚE LA OBIECTUL „GEOMETRIE DESCRIPTIVĂ”

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Rezumat. *Obiectul Geometrie Descriptivă este prima disciplină grafică studiată de către studenții U.T.M. ce au ales să îmbrățișeze o specialitate de profil tehnic. Cursul dat pregătește studenții către studierea desenului tehnic, formează imaginația spațială și deprinderi de precizie și acuratețe ale viitorilor ingineri și tehnicieni. Funcție de specificul specialității concrete se atrage o atenție sporită anumitor teme: „linii curbe”, „suprafețe de rotație”, „secțiuni plane”, „desfășurarea suprafețelor”. În procesul studiilor o mare atenție i se acordă motivării spre învățare, trezirii interesului față de obiectul studiat. O influență pozitivă în acest sens o are conexiunea materialului studiat cu diverse probleme din lumea reală. Aici este important de dus o paralelă dintre problemele rezolvate la orele practice și problemele din lumea reală, adică formalizarea problemelor reale până la probleme elementare din geometrie. Drept exemplu în articol este adusă parabola, studiată în tema “Linii Curbe”. Datorită proprietăților sale aceasta este folosită în balistică, optică, radiolocație, arhitectură etc. La studierea subiectului sunt prezentate proprietățile parabolei, definirea în proiecții și metodele de construire ale acesteia.*

Cuvinte cheie: *conexiune cu realitatea, motivare, interes*

Introducere

Planurile de învățământ ale specialităților FIMIT prevăd studierea obiectului Geometrie Descriptivă- prima disciplină grafică general-inginerească, ce pregătește studenții către studierea obiectului Desen Tehnic.

Curricula prevede atât frecventarea prelegerilor cât și participarea la lucrări practice cu îndeplinirea unor sarcini grafice.

În scopul motivării studenților spre studierea obiectului, o mare atenție i se acordă conexiunii problemelor studiate cu problemele din lumea reală [1, 2].

Drept exemplu poate fi adusă parabola, studiată în tema “Linii Curbe”.

Ca și alte linii curbe aceasta este interpretată ca traiectoria mișcării unui punct în plan. Curba este cunoscută din sec. IV î.Hr., fiind studiată de așa savanți ca Menaechmus, Euclid, Apollonius, Galilei, Newton ș.a.

Conținutul prelegerii

Conform variantei clasice prelegerea conține temă, plan și introducere.

Sunt aduse exemple de utilizare a liniilor curbe în viața cotidiană.

Se aduc definițiile necesare și metodele de construire ale liniilor curbe.

Parabola, spre exemplu este construită prin conturarea unei serii de puncte, obținute prin substituirea variabilelor în ecuația parabolei, prin secționarea unui con cu un plan paralel uneia dintre generatoarele acestui con (fig. 1).

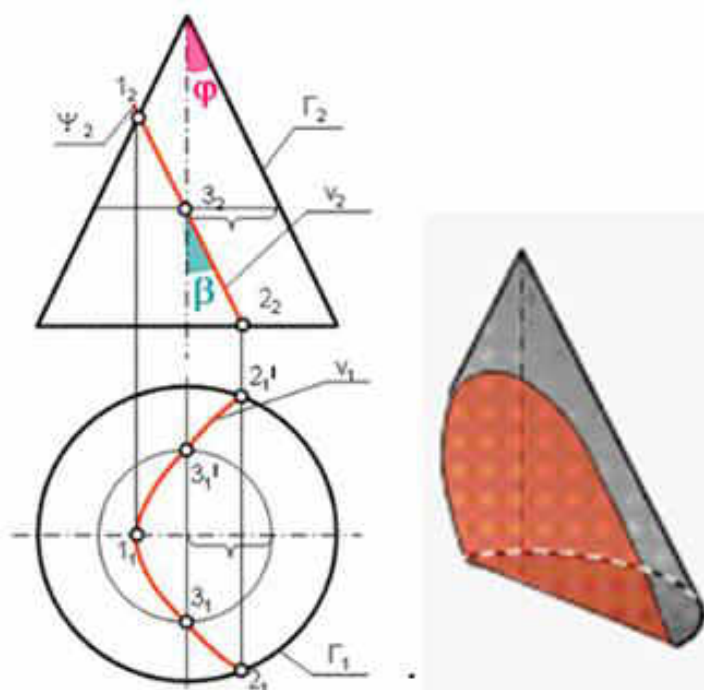


Figura 1. Construirea parabolei ca secțiune plană a conului

Putem de asemenea construi o parabolă prin construcții geometrice (fig. 2): directoare DD_1 și focar F (a), axă vârf A și punct intermediar M (b), tangent dreptelor OA și OB (c).

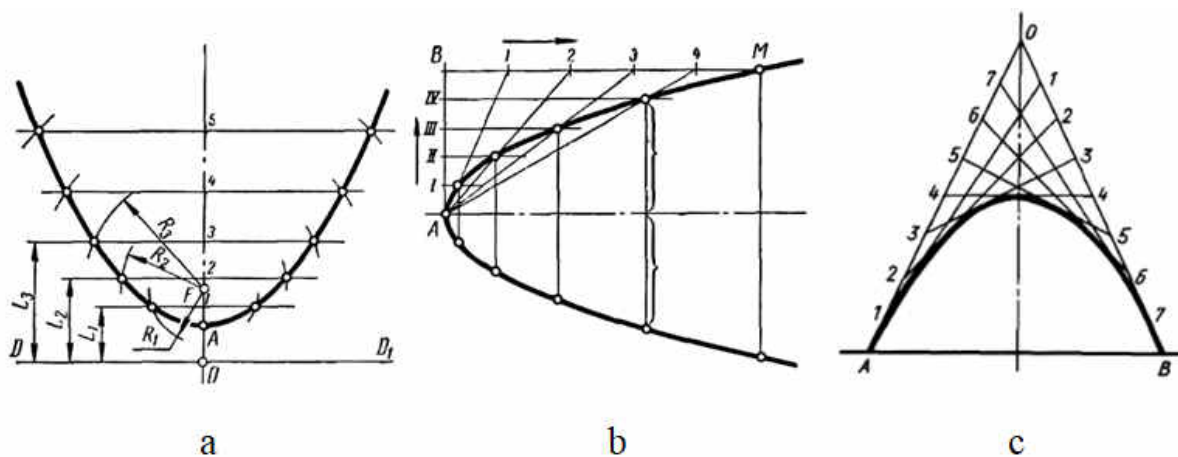


Figura 2. Variante de construire a parabolei prin construcții geometrice

În practică parabola și suprafețele parabolice (paraboloidele) sunt utilizate în balistică, optică, radiolocație, arhitectură etc.

Traectoria mișcării unui proiectil sau a unui jet de apă este o parabolă.

O suprafață parabolică are proprietatea de a concentra undele paralele ce nimeresc pe ea într-un punct, și invers, fiind astfel utilizată în radiolocație și optică.

Arcele de formă parabolică permit uniformizarea sarcinii aplicate, forma parabolică fiind utilizată în arhitectură și construcții.

Parabola mai poate fi trasată și cu ajutorul parabolografului [3] (fig. 3).

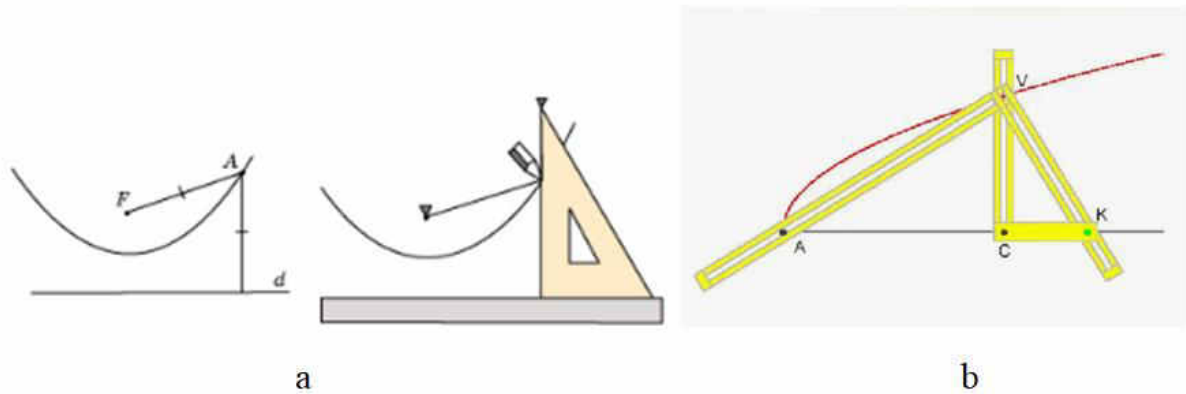


Figura 3 Parabolgrafele Isidor (a) și Cavalieri (b)

Conținutul lucrării practice

În scopul eficientizării ocupațiilor practice profesorii departamentului IM au elaborat un caiet de lucrări practice în care se prezintă succint partea teoretică și sunt reprezentate șabloanele problemelor propuse pre rezolvare. Studenții asistați de profesori rezolvă direct în caiet problemele propuse.

Se aduc de asemenea exemple de formalizare a problemelor din lumea reală până la probleme geometrice [4].

Rezultate și discuții

Utilizarea problemelor aplicate la lucrările practice a dus la sporirea interesului față de obiectul studiat, ameliorarea rezultatelor evaluărilor și a creat posibilitatea depistării studenților cu înclinări spre gândire spațială.

Concluzii

Problemele aplicate sporesc interesul studenților spre disciplina studiată, le largesc orizontul cunoștințelor, duc la ameliorarea reușitei studenților, le creează studenților deprinderi de formalizare a problemelor practice și de utilizare în practică a cunoștințelor teoretice obținute.

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MODELUL TRANSFERULUI INTERCONEXAT DE CĂLDURĂ ȘI MASĂ LA USCAREA MATERIALELOR UMEDE ÎN CÂMP ELECTROMAGNETIC

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Rezumat: *Procesele de încălzire și de uscare a materialelor umede în câmp de microunde electromagnetice pot fi analizate folosind un sistem ce include ecuațiile lui Maxwell pentru descrierea fenomenelor electromagnetice și ecuațiile de conducție termică și masică pentru descrierea transferului de căldură și masă. În situațiile în care avem de-a face cu regimuri intense, este necesar să completăm acest sistem cu ecuațiile care descriu aspectele termomecanice ale problemei analizate. În lucrarea dată este prezentat modelul matematic al procesului de încălzire și uscare în câmp electromagnetic a materialelor umede, la fel și soluționarea ecuațiilor diferențiale pentru calculul câmpurilor de temperatură, umiditate și presiuni în exces la termoprosesarea acestor cu microunde. Modelul matematic al procesului de încălzire și de uscare va fi compus și analizat în această lucrare. Pentru modelul matematic materialele umede sunt considerate ca dielectrici imperfecti, a căror neomogenități structurale au dimensiuni cu mult mai mici decât lungimea de undă în mediul lor.*

Cuvinte cheie: *Căldură, uscare, electromagnetism, materiale, microunde*

Introducere

Analizarea proceselor de încălzire și uscare a materialelor umede în câmpul electromagnetic al microundelor poate fi realizată printr-un sistem care utilizează ecuațiile lui Maxwell pentru explicarea fenomenelor electromagnetice și ecuațiile de conducție termică și de masă pentru a descrie transferul de căldură și de masă. În cazul în care condițiile implică regimuri intense, este necesar să adăugăm la acest sistem ecuațiile care acoperă aspectele termomecanice ale problemei examinate.

1. Modelul matematic al procesului de încălzire și de uscare a materialelor umede în camp electromagnetic

1.1 Ipoteze simplificatoare

În lucrarea data considerăm materialele care sunt încălzite în câmp electromagnetic ca materiale cu pierderi dielectrice (adică dielectrici imperfecti) a căror dimensiuni a neomogenităților structurale sunt cu mult mai mici decât lungimea de undă în mediul lor. În cazul în care permitivitatea dielectrică relativă ϵ' și tangenta unghiului de pierderi dielectrice $\tan \delta$ ale substanței tratate depind de temperatură, la fel de coordonate și de timp.

Cunoscând că din punct de vedere tehnic nu este complicat de a asigura încălzirea omogenă a materialului în tot volumul lui spre exemplu ,prin amestecarea mecanică ,în unele clcule se poate admite că ϵ' și $\tan \delta$ sunt doar funcții de timp.

Într-un interval limitat de temperatură , parametrii termofizici, care sunt implicați în ecuațiile și condițiile de unicitate care descriu transferul de căldură și masă, pot fi considerați constanți. Acest lucru înseamnă că putem opera cu valorile lor medii în acest interval.

1.2. Sistemul de ecuații al transferului interconexat de căldură și masă în câmp electromagnetic

$$\text{rot } H = j + \frac{\partial}{\partial \tau} (D); \quad (1)$$

$$\text{rot } E = -\frac{\partial}{\partial \tau} (B); \quad (2)$$

$$\text{div } D = 0; \quad (3)$$

$$\text{div } B = 0; \quad (4)$$

$$\frac{\partial T}{\partial \tau} = (a_T + a_m \varepsilon \frac{r \delta}{c_M}) \nabla^2 T + \varepsilon \frac{a_m r}{c_M} \nabla^2 U + \varepsilon \frac{a_p c_p r}{c_M} \nabla^2 P + \frac{Q_v}{c_M \rho_M} \quad (5)$$

$$\frac{\partial U}{\partial \tau} = a_m \cdot \delta \cdot \nabla^2 T + a_m \nabla^2 U + a_p c_p \nabla^2 P \quad (6)$$

$$\frac{\partial P}{\partial \tau} = -a_m \frac{\delta \cdot \varepsilon}{c_p} \nabla^2 T - a_m \frac{\varepsilon}{c_p} \nabla^2 U + a_p (1 - \varepsilon) \nabla^2 P \quad (7)$$

unde: E este vectorul intensității (V/m) și D - vectorul inducției (C/m) componentei electrice a unei electromagnetice. H și B - vectorii intensității (A/m) și inducției (V·s/m²) componentei magnetice a unei electromagnetice, j este vectorul densității curentului electric (A/m²). T , U și P sunt respectiv temperatura (K), umiditatea (kg de umezeală/kg de material uscat) și presiunea excedentară a aburului (Pa) în materialul umed; τ -timpul (s); a_T , a_m și a_p - coeficienții de difuzie termică (m²/s), masică (m²/s) și de barodifuzie (m²/s). δ - coeficientul relativ de termodifuzie (K⁻¹);

c_M și c_p - căldură masică a aerului umed și caldura materialului (J/(kg·K)); ε - criteriul schimbării de fază; r - căldura latentă de vaporizare (J/(kg)); ρ_M - densitatea materialului (kg/m³), Q_v - puterea sursei interioare de energie (W/m³).

$$Q_v = 0.5 \cdot \omega \varepsilon_0 \varepsilon' t g \delta |E|^2 \quad (8)$$

unde ω este frecvența ciclică (rad/s); ε_0 - constanta electrică (F/m); ε' - permitivitatea dielectrică relativă a materialului umed; $t g \delta$ - tangenta unghiului de pierderi dielectrice în material.

1.3. Condiții de unicitate

La suprafața de separație dintre mediile considerate (amestecului de abur cu aer 1 și materialul capilar-poros 2) câmpurile electromagnetice se cuplează cu ajutorul condițiilor la limită de tipul:

$$[H_2 - H_1, \mathbf{n}] = 0; [\mathbf{n}, E_2 - E_1] = 0; \mathbf{n}(D_2 - D_1) = 0; \mathbf{n}(B_2 - B_1) = 0 \quad (9)$$

în care \mathbf{n} este un vector unitar, orientat din mediul 2 în mediul 1.

Se scriu condițiile la limita de tip Fourier pentru ecuațiile transferului de căldură și masă:

$$\lambda_M (\nabla T)_n + j_q |n + r j_m |n = 0; \quad (10)$$

$$\lambda_M [\nabla U]_n + \frac{\delta}{c_m} \nabla T |n + \delta \cdot \nabla P |n + j_m |n = 0; \quad (11)$$

$$P_n = 0, \quad (12)$$

în care c_m este capacitatea masică specifică ($kg/(kg \cdot K)$); prin indicele n sunt notate valorile mărimilor respective la suprafața de separație a mediilor.

2 .Analiza modelului matematic

Procesele termice (încălzirea și uscarea) sunt descrise de ecuațiile (5) - (7) și (10) - (12) în aproximația câmpului electromagnetic dat, care, la rândul său, se determină prin integrarea ecuațiilor electrodinamicii (1)-(4) și (9). Ambele probleme ,chiar și în urma adoptării ipotezelor simplificatoare de mai sus, sunt destul de complicate. Algoritmul soluționării lor poate fi următorul: după determinarea dependențelor parametrilor electro și termofizici ai materialului considerat de temperatură și umiditate (de regulă ,pe cale experimentală), timpul de termoprocesare se divide în perioade, în care acești parametri rămân constanți. În așa caz, integrarea sistemului de ecuații (1)-(4) și (9) va determina funcția sursei interioare de energie, ce va permite trecerea la soluționarea problemei transferului interconexat de căldură și masă. Integrarea ecuațiilor transferului de căldură și masă permite la rândul lor de a determina parametrii electro și termofizici ai materialului termoprocesat, care se substituiesc în intervalul de timp ulterior ,repetând această procedură pentru noi intervale de timp, până la atingerea valprilor prestabilite ale temperaturii sau a umidității materialului.

2.1.Calculul procesului de încălzire a materialelor în câmp de microunde

Analiza ecuațiilor (1)-(4) și (9) a arăat, că pentru asigurarea unui randament mai înalt al uscătorului cu microunde este necesară concordanța lui bună cu generatorul de microunde.

Aparatele de procesare a materialelor umede în câmpuri electromagnetice (de frecvență înaltă și supraînaltă) prezintă linii de transmisie a microundelor, umplute parțial cu dielectric imperfect (cu pierderi). În acest caz se ține cont de influența mediului respectiv asupra condiției de propagare a undei electromagnetice.

În conductorul de undă cu secțiune dreptunghiulară, umplut cu dielectric, undele normale sunt cele longitudinale de tipul LM_{min} și LE_{min}

$$E_{X12} = -j \frac{K_X K_{Y12}}{\omega \varepsilon_{12}} \cos(K_X X) \cdot \sin K_{Y1,2} (b_{1,2} \mp Y) \cdot \exp[j(K_Z Z + \omega \cdot t)] \quad (13)$$

$$E_{Y1,2} = \mp j A_{1,2} \frac{K_X^2 + K_{Y1,2}^2}{\omega \varepsilon_{1,2}} \sin(K_X X) \cdot \cos K_{Y1,2} (b_{1,2} \mp Y) \cdot \exp[j(K_Z Z + \omega \cdot t)] \quad (14)$$

$$E_{Z1,2} = A \frac{K_Z + K_{1,2}}{\omega \varepsilon_{1,2}} \sin(K_X X) \cdot \cos K_{Y1,2} (b_{1,2} \mp Y) \cdot \exp[j(K_Z Z + \omega \cdot t)] \quad (15)$$

$$H_{Y1,2} = \mp j A_{1,2} K_Z \sin(K_X X) \cdot \cos K_{Y1,2} (b_{1,2} \mp Y) \cdot \exp[j(K_Z Z + \omega \cdot t)] \quad (16)$$

$$H_{Y1,2} = 0 \quad (17)$$

$$H_{Y1,2} = \mp j A_{1,2} K_X \cdot \cos K_{Y1,2} (b_{1,2} \mp Y) \cdot \cos K_{Y1,2} (b_{1,2} \mp Y) \cdot \exp[j(K_Z Z + \omega \cdot t)] \quad (17)$$

în care $K_{12}^2 = K_X^2 + K_{Y12}^2 + K_Z^2$; $K_{12} = \omega \sqrt{\varepsilon_{12} \mu_{12}}$; $K_X = m \frac{\pi}{\alpha}$; λ – lungime de undă a liniei de transmisie; ε , μ – permitivitatea electrică și magnetică.

Constantele K_Z a undei LM se determină din ecuația de dispersie

$$\frac{K_{Y1} \varepsilon_2}{K_{Y2} \varepsilon_1} \operatorname{tg} K_{Y1} b_1 + \operatorname{tg} K_{Y2} b_2 = 0 \quad (19)$$

Dificultatea principală la soluționarea ecuațiilor transcendente prin metode numerice este apariția rădăcinii izolate și alegerea corectă a aproximației inițiale care să asigure convergența procesului iterativ. Ca aproximație inițială este rațional de ales rădăcinile ecuației (19) pentru $tgK_{Y2}b_2 = 0$. Însă trebuie de avut în vedere că rădăcinile ecuației de dispersie în cazul pierderilor arbitrare au valori apropiate, când $tgK_{Y2}b_2 = 0$ pentru valori determinate ale mărimii b_2 (spre exemplu, pentru $LM_{1,0}$ când $b_2 \rightarrow 0$).

Mult mai simplu problema concordării generatorului de microunde cu conductorul de unde cu secțiune dreptunghiulară, în care se introduce material stratificat subțire, se rezolvă în cazul propagării cvaziunde $H_{1,0}$. Această condiție este respectată, de regulă, când $\epsilon' \leq 80$, $d/a < 0.1$.

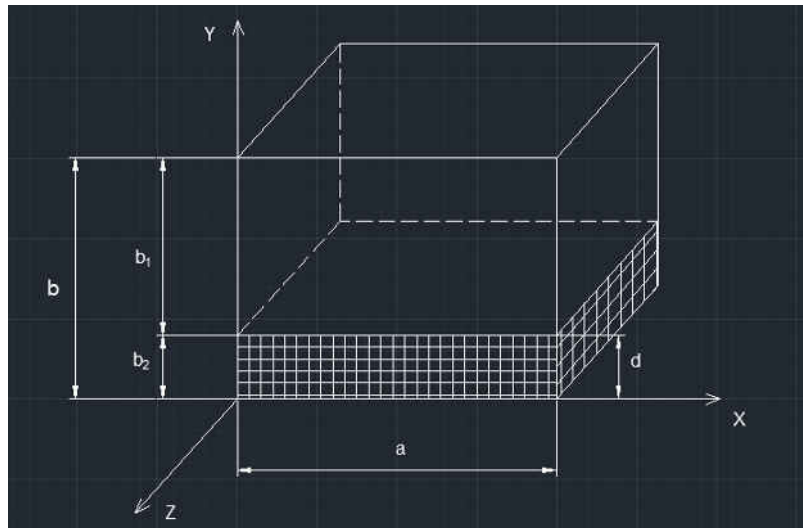


Figura 1. Schema conductorului de unde cu secțiune dreptunghiulară

În acest caz puterea sursei interioare de energie se scrie sub forma :

$$Q_v = \frac{2\alpha P_{int}}{bd} \exp(-2\alpha \cdot X) = B \cdot e^{-KX} \quad (20)$$

în care: α este coeficientul de atenuare (m^{-1}); P_{int} – puterea de intrare (W), a și b – dimensiunile conductorului; d – grosimea materialului procesat.

2.2. Calculul procesului de uscare

Sistemul de ecuații al transferului de căldură și masă descriu procesul de termoprosesare a materialelor și atunci, când se ține cont de schimbarea de fază [4]. Procesul de uscare a materialelor umede poate fi divizat în trei faze: faza stabilirii parametrilor de regim ai procesului, în care temperatura materialului variază esențial, umiditatea lui rămânând practic constantă; faza regimului cu viteză constantă de uscare, în care temperatura practic nu se schimbă, însă se micșorează intens umiditatea materialului; faza regimului cu viteză decadentă de uscare, în care variază atât temperatura, cât și umiditatea. În faza a treia se înlătură preponderent umezeala legată (doar în momentul inițial al acestei perioade are loc înlăturarea focarelor de umezeală liberă, prezența căreia este condiționată de diverse neomogenități, cum ar fi polidispersia structurală și grosimea variabilă a materialului, anizotropia proprietăților lui fizice etc.). În mod convențional această fază poate fi denumită uscare tehnologică finală.

Pentru calcul procesului în prima fază vom admite următoarele ipoteze: umiditatea materialului variază lent în timp și are loc încălzirea materialului, adică $\frac{r\epsilon}{c} \cdot \frac{\partial U}{\partial \tau} \approx 0$; influența procesului de termodifuzie se neglijează.

În acest caz, soluțiile sistemului de ecuații (5)-(7) sunt obținute sub forma:

a) pentru câmpul de temperatură

$$T = \frac{B}{c\rho \cdot k^2 \alpha} \left\{ \frac{1-kx}{2} \left[1 - \phi \left(\frac{x}{2\sqrt{\alpha\tau}} \right) \right] \cdot \exp(-kx) + \frac{1}{2} \left[1 - \phi \left(-\frac{x}{2\sqrt{\alpha\tau}} \right) + k \cdot \sqrt{\alpha\tau} \right] \exp(\alpha k^2 \tau - kx) + \frac{k\sqrt{\alpha\tau}}{\sqrt{\pi}} \exp\left(-\frac{x^2}{4\alpha\tau}\right) \right\} \quad (22)$$

b) pentru câmpul de umiditate

$$U(x, \tau) = \frac{U_0}{2} \left[1 + \phi \left(\frac{x}{\sqrt{\alpha'_m \tau}} \right) \right] \quad (23)$$

$$\text{în care } \alpha'_m = \frac{\alpha_m}{1-\varepsilon}$$

c) pentru câmpul de presiune excedentară

$$P(x, \tau) = \frac{P_0}{2} \left[1 + \phi \left(\frac{x}{\sqrt{\alpha'_p \tau}} \right) \right] \quad (24)$$

Vom analiza câmpul de temperatură (21). Pentru valori mari ale lui x din relația obținută poate fi scrisă sub forma

$$T(x, \tau) = \frac{B}{c\rho \cdot k^2 \alpha} [\exp(\alpha k^2 \tau) - 1] \cdot \exp(-kx) \quad (25)$$

Pentru valori mici ale lui τ obținem:

$$T(x, \tau) = A\tau \cdot \exp(-kx) \quad (27)$$

Relațiile obținute permit de a determina cota puterii introduse în material pentru a evita supraîncălzirea excesivă a lui.

În faza regimului cu viteză constantă de uscare, când temperatura materialului rămâne practic neschimbată, iar mărimea $\partial U / \partial \tau$ este de asemenea constantă, cinetica procesului se descrie cu relațiile lui Lâkov [5]. Pentru această fază soluțiile sistemului (5)-(7) sunt următoarele:

a) pentru câmpul de temperatură

$$T = T_C + \frac{B}{\lambda \cdot k^2} [1 - kx - \exp(-kx)] - \frac{r\varepsilon}{\lambda} \cdot \frac{\partial U}{\partial \tau} \cdot \frac{x^2}{2} \quad (28)$$

transferul de masă efectuându-se doar din contul gradientului de umiditate.

b) transferul de masă la sublimare are loc din contul procesului de termodifuzie, când $\alpha_{m2} \nabla^2 \approx 0$; soluția pentru câmpul de umiditate are în acest caz forma:

$$U = U_0 - \frac{\alpha_{m2} \delta \cdot \varepsilon \cdot B \tau}{\lambda \cdot \left(1 - \varepsilon + \frac{\alpha_{m2} \delta \cdot r \cdot \varepsilon}{\lambda} \right)} \cdot \exp(-kx); \quad (29)$$

c) repartiția câmpului de presiuni excedentare pentru materiale subțiri și $\alpha_p \nabla^2 P \approx 0$ se calculează cu relația

$$P(x, \tau) = \frac{U_0 \varepsilon}{2c_M} \cdot \left[1 - \phi \left(\frac{x}{2\sqrt{\alpha'_m \tau}} \right) \right] \quad (30)$$

3. Concluzii

A fost dezvoltat un set de ecuații diferențiale pentru a descrie cinetica procesului de termoprocesare a materialelor umede în câmp electromagnetic. Prin rezolvarea acestor ecuații, s-au obținut soluții pentru cazurile încălzirii și uscării materialelor în faza de stabilire a parametrilor tehnologici ai procesului, care permit calculul câmpurilor de temperatură, umiditate și presiune excedentară.

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STUDIUL PROCESULUI DE DISTILARE CU AJUTORUL INSTRUMENTELOR DIGITALE

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Rezumat. În contextul reformării învățământului superior din țară și facilitării procesului de învățare-predare a disciplinelor inginerești au fost identificate oportunități de utilizare a instrumentelor digitale în acest scop. În cadrul unei platforme de resurse educaționale cu acces public la simulări și laboratoare virtuale, elaborată la Universitatea din Colorado, a fost analizat procesul de distilare. În lucrare se prezintă etapele și schema de principiu a procesului de distilare periodică, modelul matematic și operarea unor experimente în instalația de laborator virtuală. Experimentele au fost făcute pe instalația de distilare dotată cu coloană de rectificare cu talere. Au fost colectate probe de distilat obținute din coloana dotată cu un singur taler și cu mai multe talere. Au fost analizate diagramele de echilibru vapori-lichid și concentrația esenței din probe și, ulterior rezultatele obținute au fost comparate și formulate concluzii.

Cuvinte cheie: proces de distilare, coloană de rectificare cu talere, laborator virtual, model matematic.

Introducere

În prezent, modelul și procesul educațional al învățământului superior se schimbă. Universitățile cu profil tehnic formează programe educaționale de bază axate pe aplicarea activă a cunoștințelor de bază în inginerie de către absolvenți în activități practice. Un inginer trebuie să fie capabil să planifice și să proiecteze obiecte tehnice, procese și sisteme și să gestioneze procesul de creare și funcționare a acestora. Studenții nu trebuie doar să memoreze fapte, definiții și principii, ci trebuie să învețe să-și folosească propriile cunoștințe atunci când rezolvă probleme practice specifice, să aleagă în mod activ metodele de proiectare și calcul, să evalueze rezultatele calculului lor, să interacționeze și să colaboreze în echipă.

Utilizarea instrumentelor digitale a fost mult timp recunoscută ca fiind importantă în educația matematică, iar progresele în domeniul tehnologiei computerelor poziționează manipulatorii virtuale și simulările interactive ca noi instrumente puternice pentru predarea și învățarea matematicii. Consiliul Național al Profesorilor de Matematică (din SUA) [1] afirmă că studenții pot învăța matematica mai profund cu utilizarea adecvată a tehnologiei, deoarece le permite elevilor să-și schimbe atenția de la calcul la reflecție, luare de decizii, raționament și rezolvarea problemelor. Autoarea lucrării [2] susține că calitatea tehnologiei educaționale – ce și cum este utilizată – este mai predictivă pentru rezultatele elevilor decât cantitatea de tehnologie cu care interacționează studenții.

Una dintre cele mai reușite platforme interactive de învățare-predare a fost realizată la Universitatea din Colorado Boulder, SUA. Platforma cuprinde subiecte la disciplinele fizica, chimia, matematica, biologia și geografia. Aplicațiile sunt concepute astfel pentru a crea experiențe de învățare captivante și eficiente, pentru a sprijini dificultățile și provocările cursanților pe măsură ce învață. Majoritatea aplicațiilor sunt traduse în toate limbile țărilor europene și sunt disponibile cu acces deschis.

În lucrare se prezintă analiza procesului de distilare periodică cu ajutorul unei aplicații de simulare a distilatorului cu coloană de rectificare cu talere. Aplicația este disponibilă în biblioteca electronică cu acces deschis a Universității din Colorado Boulder, SUA [3].

Aspecte generale privind procesul de distilare

Distilarea este o metodă de separare și purificare a unui component lichid dintr-un amestec de lichide cu puncte de fierbere diferite. Metoda constă în aducerea unui lichid la fierbere, condensarea vaporilor, și separarea distilatului într-un recipient diferit de cel în care are loc fierberea.

Aplicațiile distilării sunt următoarele: distilarea plantelor pentru parfumerie și medicamente, industria băuturilor alcoolice tari, industria chimică și petrolieră.

În industria băuturilor alcoolice tari instalațiile de distilare se deosebesc după modul regimului de lucru. Acestea pot fi cu funcționare periodică sau continuă. Procesul de distilare periodică se petrece în instalații care conțin o cantitate fixă de materie primă (borhot). Iar distilarea continuă are loc în instalațiile care sunt alimentate constant cu materie primă.

Distilarea periodică poate fi efectuată ca și proces într-o singură etapă sau în mai multe etape. Dacă în timpul distilării se colectează mai multe fracțiuni de distilat, operația poartă denumirea de *distilare fracționată*. Primele fracțiuni, bogate în component ușor volatil sunt frunți de distilare, iar ultimele fracțiuni, sărace în component ușor volatil sunt *cozi de distilare*.

Gradul de separare se îmbunătățește dacă o parte din distilat se reintroduce în blaza de distilare sub forma de *reflux*. Cu cât cantitatea refluxată este mai mare, cu atât distilatul este mai bogat în component ușor volatil. Refluxul se introduce prin intermediul unui deflegmator (condensator de reflux).

Distilarea repetată se mai numește rectificare și se utilizează cu scopul obținerii unor produse cât mai pure și mai concentrate. Schema de principiu a unei instalații de distilare dotată cu coloană de rectificare este ilustrată în Fig. 1. Materia primă fermentată (borhotul) este introdusă într-un rezervor numit *blază* care este dotat cu sistem de încălzire. La atingerea temperaturii de vaporizare, componentul care urmează a fi separat trece prin coloana de distilare. Aceasta are formă de cilindru în care sunt montate o serie de talere (tăvi) dispuse la o anumită distanță una de alta. Talerele conțin lichid în fierbere (extract din borhot) alimentat din conducta de reflux sau din conducta de alimentare a instalației.

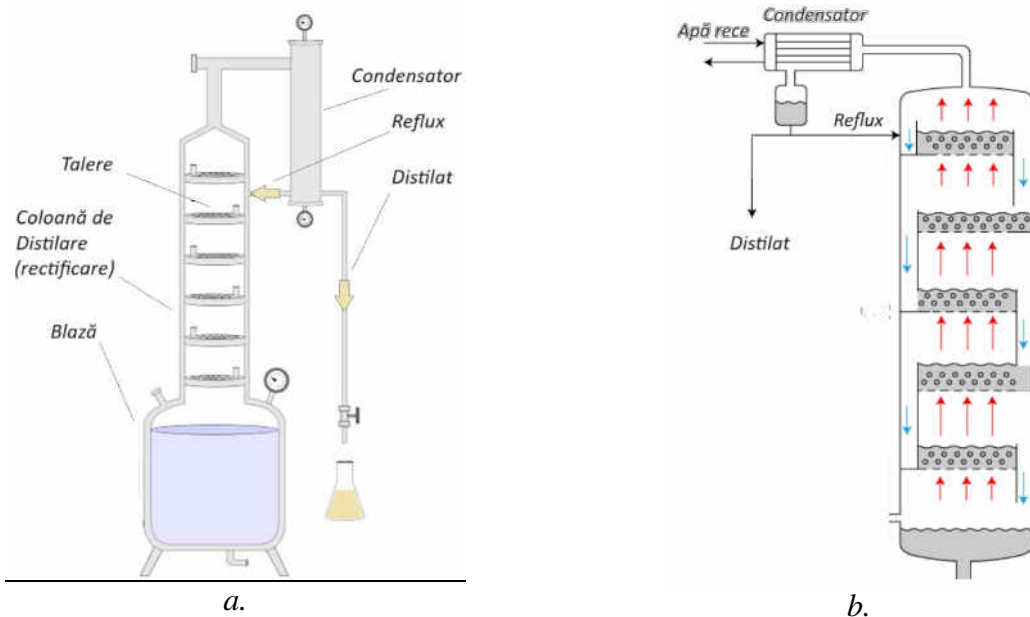


Figura 1. Schema de principiu a instalației de distilare:
a) vedere generală; b) procesul de rectificare în coloana cu talere.

Săgețile roșii îndreptate în sus spre baza fiecărei tăvi reprezintă vaporii care curg în sus. Iar săgețile albastre orientate spre jos reprezintă lichidul care se scurge gravitațional. Vaporii care ajung în partea superioară a coloanei sunt direcționați în condensator, după care condensul obținut

(distilatul) este redirecționat în coloana de rectificare (reflux) și parțial colectat. Cantitatea de reflux este reglată în funcție de calitatea necesară a distilatului. Condensatorul reprezintă un schimbător de căldură în care are loc condensarea distilatului cu ajutorul apei reci.

Modelul matematic al procesului de distilare

După cum s-a menționat, distilarea periodică în mai multe etape asigură obținerea unui produs de o puritate mai mare decât distilarea discontinuă simplă. Considerăm materia primă fermentată, introdusă în instalația de distilare, un amestec din două componente A și B (apă și etanol) dintre care B (etanolul) este componentul mai ușor volatil. Bilanțul total de materie este exprimat cu relația [4]:

$$F = W_{fin} + D_{tot} \quad (1)$$

în care F este cantitatea molară totală a materiei prime din instalație (borhotul);

W_{fin} – cantitatea molară de reziduu (care rămâne în blază);

D_{tot} – cantitatea molară totală a distilatului colectat.

Bilanțul componentului ușor volatil pe întreaga coloană este exprimat cu relația:

$$F \cdot x_f = W_{fin} \cdot x_{W,fin} + D_{tot} \cdot x_{D,med} \quad (2)$$

în care x_f este fracția molară inițială a componentului B ;

$x_{W,fin}$ - fracția molară finală de reziduu;

$x_{D,med}$ - fracția molară medie a componentului B în distilatul colectat.

Se consideră că în fiecare taler din coloana de rectificare este un echilibru lichid-vapori:

$$y = f(x) \quad (3)$$

Funcția $y=f(x)$ reprezintă curba de echilibru ilustrată în diagrama x - y , Fig. 2. Compoziția la o anumită etapă se află undeva pe această curbă (punctul de pe curba albastră).

O linie de operare indică compoziția unei etape raportată la compoziția etapei adiacente. Ecuația liniei de operare este:

$$y_n = \frac{R}{R+1} \cdot x_{n+1} + \left(1 - \frac{R}{R+1}\right) x_D \quad (4)$$

în care y_n este fracția molară de vapori a componentului B la etapa n ;

R – cifra de reflux; x_{n+1} - fracția molară de lichid a componentului B la etapa $n + 1$.

Cifra de reflux se determină cu relația:

$$R = \frac{L}{D} \quad (5)$$

În care L este debitul de lichid care se întoarce în coloană din condensator, iar D este debitul de distilat colectat.

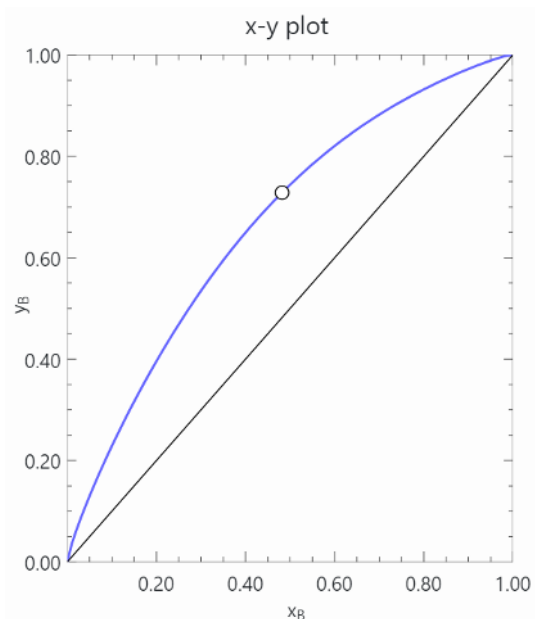


Figura 2. Diagrama de echilibru x - y .

Pentru determinarea compoziției finale a distilatului și a reziduuului este utilizată ecuația Rayleigh [4]:

$$\ln \left(\frac{W_{fin}}{F} \right) = \int_{x_F}^{x_{W,fin}} \frac{1}{x_D - x_W} dx_W \quad (6)$$

relația dintre compoziția distilatului și a rezidului ($x_W = x_D$) este complicată pentru instalațiile dotate cu coloane cu talere, prin urmare fracțiile molare se obțin numeric.

Simularea procesului de distilare

Procesul de distilare periodică în mai multe etape a fost simulat într-o aplicație de pe platforma *LearnChemE* a Universității din Colorado Boulder. Interfața grafică a aplicației este prezentată în Fig. 3. Aceasta constă din schema instalației de distilare, diagramele cu parametrii de proces și panoul de reglare a parametrilor operare.

Pentru a înțelege mai bine distilare periodică în mai multe etape au fost efectuate experimente virtuale la diferiți parametri de operare cum ar fi numărul de talere și cifra de reflux.

Condițiile inițiale sunt următoarele: se consideră un amestec binar din componentele A și B în cantitate de 10 kmoli care se află în blaza distilatorului; fracția molară a componentului B a fost selectată la 0,2; temperatura inițială din blază nu poate fi modificată și este 97°C.

Primul experiment a fost efectuat la instalația dotată cu un taler și cifra de reflux 3. Următorul experiment a fost efectuat la instalația dotată cu trei talere la aceeași cifră de reflux. Ulterior, au fost efectuate aceleași experimente la cifra de reflux 6. La fiecare experiment au fost colectate câte trei probe de distilat în cantitate de 0,5 kmoli fiecare. Rezultatele simulărilor sunt prezentate în Tabelul 1.

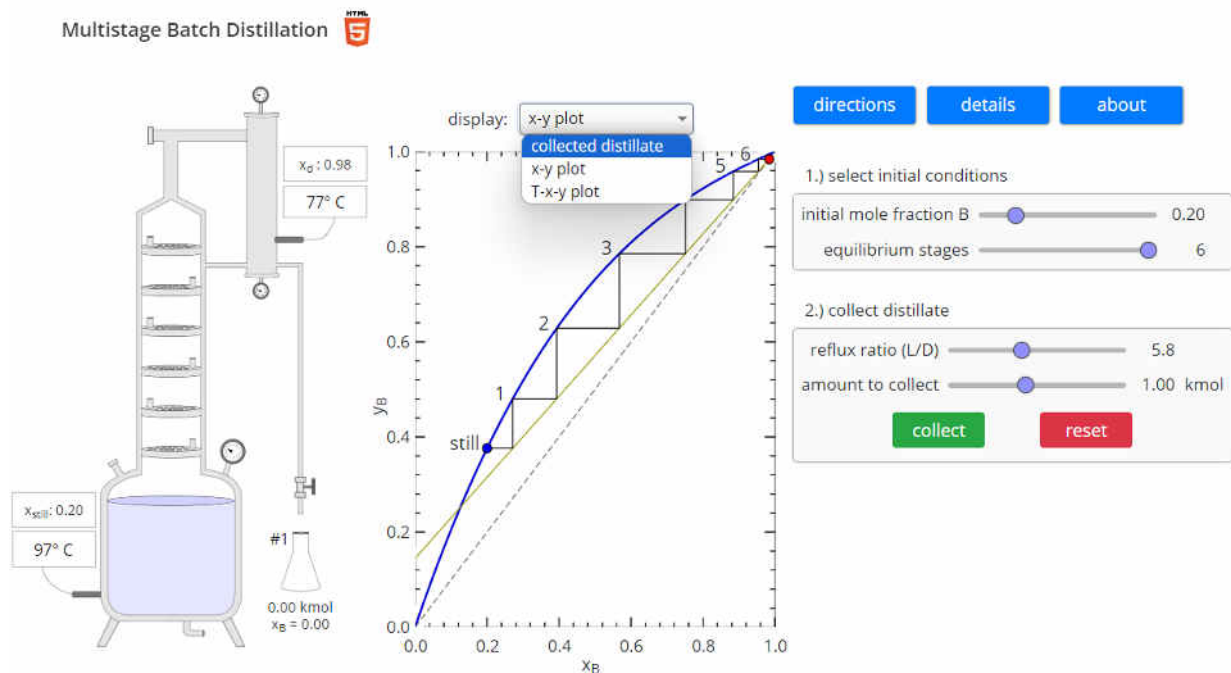
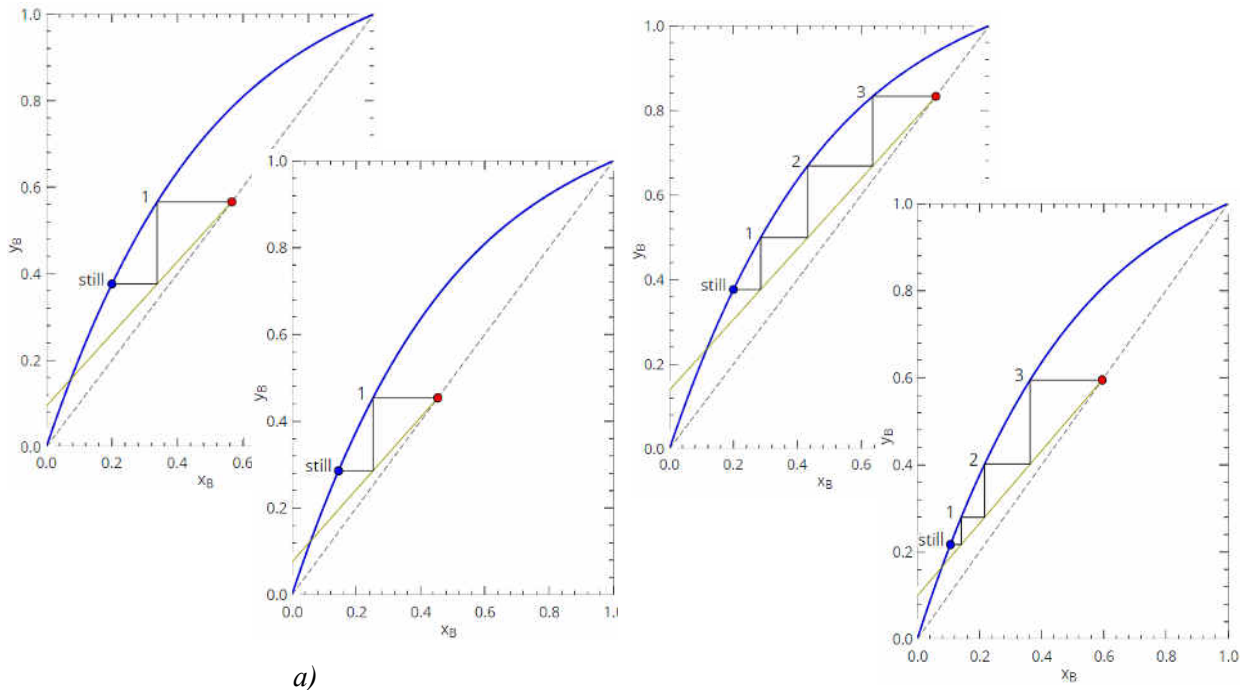
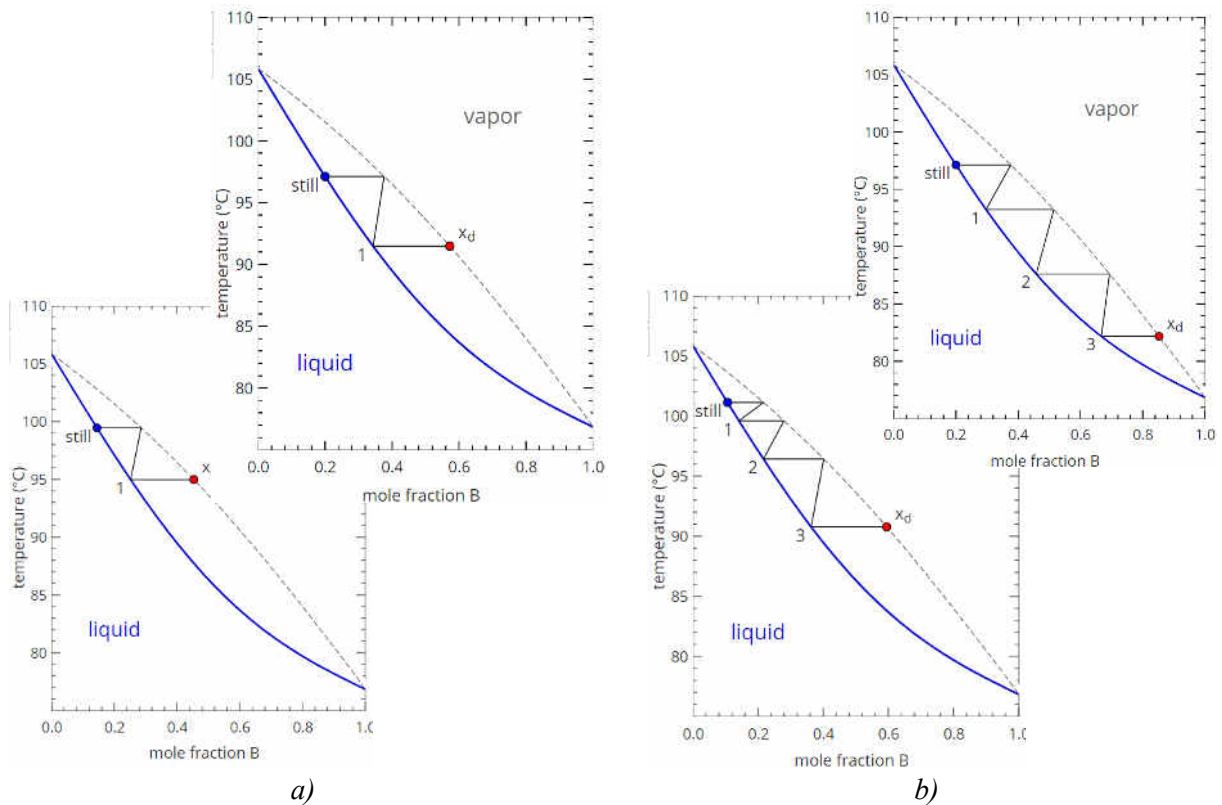


Figura 3. Interfața grafică a simulatorului „Distilare periodică în mai multe etape”.

În figura 4 sunt ilustrate diagramele de echilibru $x - y$ ale procesului de distilare prin coloana dotată cu un taler și cu trei talere. Dependența fracției molare a componentului B de temperatură este ilustrată în Fig. 5 pentru ambele cazuri. După cum se observă creșterea concentrației distilatului are loc cu fiecare etapă parcursă, iar scăderea concentrației componentului B în blază are loc în timp după colectarea probelor de distilat.



a)
**Figura 4. Diagrama de echilibru vapori-lichid (stare inițială și finală):
a) cu un taler; b) cu trei talere.**



a) b)
**Figura 5. Diagrama de echilibru vapori-lichid-temperatură (stare inițială și finală):
a) cu un taler; b) cu trei talere.**

Rezultatele simulării procesului de distilare

Proba	Concentrația borhotului din aparat		Concentrația esenței X_B		Cifra de reflux (L/D)	Cantitate colectată, (kmol)
	1 taler	3 talere	1 taler	3 talere		
1	0,18	0,17	0,53	0,72	3	0,5
2	0,16	0,14	0,49	0,65		
3	0,15	0,12	0,46	0,58		
1	0,18	0,17	0,56	0,83	6	0,5
2	0,16	0,13	0,52	0,76		
3	0,14	0,10	0,5	0,67		

Concluzii

În procesul de simulare (animație) a distilării periodice a unui amestec binar s-au observat următoarele aspecte:

- Temperatura crește în timpul distilării;
- Concentrația de distilat a componentei mai volatile scade cu timpul;
- Creșterea numărului de etape (talere) în coloană mărește concentrația componentei mai volatile din distilat;
- Creșterea cifrei de reflux mărește concentrația componentei mai volatile din distilat.

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STUDIUL VALORIFICĂRII SEMINTELOR DE CĂTINĂ ALBĂ ÎN CONTEXTUL ECONOMIEI CIRCULARE

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Rezumat. Cătina albă este o plantă ce poate fi găsită în toată Europa și Asia. Frunzele, florile, semințele și fructele se folosesc în industria alimentară și farmaceutică. Uleiul din aceste semințe este bogat în diferite carotenoide și vitamine, conține niveluri de ridicate de acizi oleici, linoleici și linolenici. Fructul de cătină conține de două ori mai multă vitamina C decât măceșul și de 10 ori mai mult decât citricele. În economia circulară semințele de cătină albă nu sunt folosite deoarece industriile folosesc cel mai des fructul acestei plante în scopul dorit, semințele fiind un material adesea aruncat și neutilizat. În Republica Moldova semințele de cătină albă nu sunt valorificate deplin, chiar dacă acestea reprezintă un potențial valoros pentru industrii. Lipsa echipamentelor și tehnologiilor eficiente pentru prelucrarea primară stagnează valorificarea acestor semințe, care de fapt reprezintă o materie primă valoroasă pentru a fi utilizată la obținerea altor produse finite.

Cuvinte cheie: semințe, cătină albă, valorificare, economie circulară.

Introducere

Cătina albă este o plantă ce poate fi găsită în toată Europa și Asia. Frunzele, florile, semințele și fructele se folosesc în industria alimentară și farmaceutică. Prezența componentelor sănătoase în semințele de cătină fac ca această plantă să fie importantă în aceste două industrii.

Semințele de cătină albă sunt bogate în uleiuri nesaturate și conține materii saponificabile și nesaponificabile. Uleiul din aceste semințe este bogat în diferite carotenoide și vitamine, conține niveluri de ridicate de acizi oleici, linoleici și linolenici [2]. Fructul de cătină conține de două ori mai multă vitamina C decât măceșul și de 10 ori mai mult decât citricele. În fructele coapte conținutul depășește 400–800 mg la 100 g suc proaspăt. Alte vitamine prezente în fruct sunt A, B1, B2, B6, B9, E.

Uleiurile rezultate sunt folosite în suplimente alimentare, nutraceutice, cosmetice și produse de îngrijire a pielii [1]. În economia circulară semințele de cătină albă nu sunt folosite la justa valoare, deoarece industriile folosesc cel mai des fructul acestei plante în scopul dorit, semințele fiind un material adesea aruncat și neutilizat. În Republica Moldova semințele de cătină albă nu sunt valorificate deplin, chiar dacă acestea reprezintă un potențial valoros pentru industrii. Lipsa echipamentelor și tehnologiilor eficiente pentru prelucrarea primară încurcă valorificarea acestor semințe. Cantitatea de ulei ce poate fi obținută din semințele de cătină este de 2-3 kg de ulei din 50 kg de semințe. Un exemplu este că în RM există o fermă ce cultivă aproximativ 34 hectare de cătină albă de proprietar autohton. În acest context întreprinderile de prelucrare a semințelor de cătină albă ar putea încheia un contract pentru a le fi furnizate fructe și semințe pentru a fi utilizate ca materie primă la extragerea uleiului, dar și obținerea unor produse cosmetice și medicinale.

Cu toate acestea există un șir de neajunsuri specifice a tehnologiilor existente, care stagnează utilizarea ulterioară a semințelor de cătină albă pentru obținerea unor produse sau

subproduse ce pot fi utilizate în alimentația publică. Printre aceste neajunsuri se numără următoarele:

- Viteza mică de prelucrare;
- Timpul îndelungat de procesare;
- Consum sporit de energie;
- Costuri esențiale de procesare.

Prelucrarea semințelor de cătină albă. Pulpa din straturile superioare și inferioare are o umiditate ridicată 75-79 % și este instabilă microbiologic în concordanță cu tehnologia propusă, pulpa de cătină se propune a fi uscată la temperaturi ușoare: temperaturi de (55-60) °C la umiditatea de (140,5 %). În urma cercetării experimentale s-a demonstrat că există o pierdere de carotenoide până la 30 %, bioflavonoide până la 32 % și taceferoli până la 12 % la uscarea unui conținut de umiditate de 6 %. În plus, necesită costuri mari de energie la uscarea în profunzime.

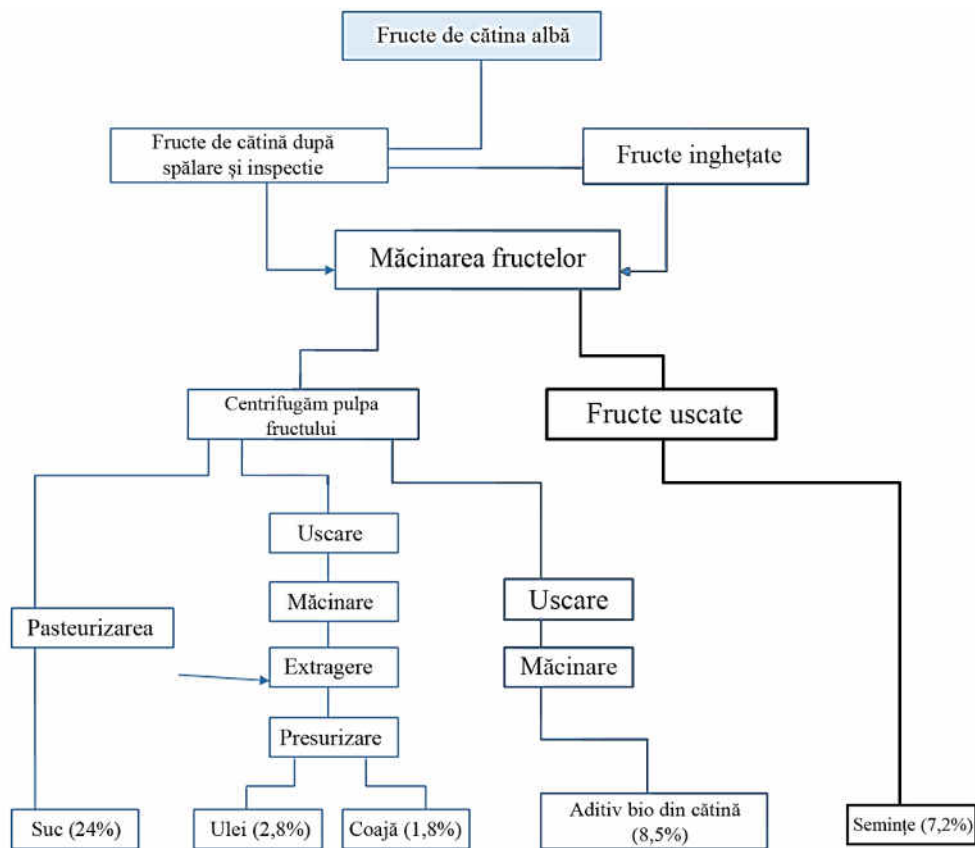


Figura 1. Schema tehnologică de prelucrare a fructelor de cătină albă.

La aflarea indicatorilor microbiologici s-a definit stabilitatea garantată a pulpei de cătină albă uscată timp de 12 luni. Se recomandă ca, după uscare, pulpa de cătină albă să fie strivită pentru o distrugere mai profundă a structurilor celulare, ceea ce va duce la eficientizarea procesului de extracție a uleiului prin utilizarea unui solvent cu greutate moleculară mare, care este uleiul vegetal.

Pentru obținerea uleiului de cătină albă din pulpă uscată strivită s-a propus o metodă de difuzare, care constă în încălzirea uleiului vegetal localizat în structura pulpei și extragerea sa.

Utilizând metoda analizei corelației, am cercetat influența factorilor precum raportul pulpă-ulei, cantitatea de extracție, timpul și temperatura de extracție pentru criteriile rezultate: eficiența produsului, cantitatea de carotenoizi și valoarea acidității uleiului. Tot în acest studiu s-a constatat că temperatura perfectă de extracție este între 55 și 60°C, cantitatea de extracție – 4, raportul ulei-pulpă – 1,4, iar timpul de extracție variază de la 4 până la 5 ore.

Produsele obținute în urma prelucrării cătinii albe, mai ales uleiul obținut de pulpa straturilor superioare și inferioare bogate în tocoferoli și carotenoizi sunt utilizate în aditivul alimentar care acționează ca antioxidant și emulgator (Tabelul. 1). Alegerea compușilor se explică prin funcțiile lor fiziologice și eficiența antioxidantă a acestora [3].

Tabelul 1

Caracteristici organoleptice și fizico-chimice ale probelor de ulei obținute

Caracteristici	Ulei de cătină obținut din pulpă din stratul superior	Ulei de cătină obținut din pulpă din stratul superior	Ulei de semințe de cătină
Transparență	Lichid limpede		
Miros și gust	Aromatic, caracteristic uleiului de cătină		
Aspect, consistență la 20°C	Lichid uleios		
Culoare	Maro deschis		
Conținutul de umiditate, %	10,0	12,1	14,3
Carotenoizi totale, mg/100 g	160,5	329,4	20,62
Tocoferoli totale, mg/100 g	160,0	160,0	90,0
Valoarea acidității uleiului, mgKOH/g, max 6,0 mg KOH/g	4,6	4,4	6,0
Valoarea peroxidului, 10 meq/kg, max.	2,3	2,1	3,5
Densitate la 20°C, g/cm ³	0,915	0,915	0,914
Indicele de refracție, 20°C	1,474	1,472	1,473

Analizând datele de mai sus putem ajunge la concluzia că uleiul din stratul inferior de pulpă de cătină albă este mai stabil la oxidare față de cel din stratul superior de pulpă. Uleiul obținut din pulpa stratului inferior conține o cantitate mai mare de carotenoizi.

Cercetările efectuate ne-au permis să ajungem la concluzia că există mai multe proteine, vitamine și elemente minerale în stratul inferior al pulpei de cătină albă decât în nivelul superior. Deci pulpa de cătină albă uscată și măcinată din nivelul inferior dispune de o compoziție echilibrată de proteine-lipide, minerale și vitamine.

Astfel, s-a constatat că prelucrarea fructelor de cătină albă, permite obținerea mai multor tipuri de produse – ulei, aditivi pentru pudra de fructe, semințe și suc. Permite de asemenea creșterea gradului de conservare a substanțelor active utilizând parametrii tehnologici a proceselor. Totodată procesul de extracție a uleiului din semințele de cătină albă poate implica presarea la rece sau extracția cu solvenți. După extracție, uleiul poate fi rafinat pentru a îndepărta impuritățile și a îmbunătăți calitatea. Semințele de cătină albă pot fi folosite pentru a crea noi produse alimentare, sucuri, gemuri, prăjituri, uleiuri. Uleiul de cătină albă este deseori folosit ca supliment alimentar datorită conținutului bogat de vitamine și alte substanțe nutritive benefice, de asemenea este utilizat în diverse produse cosmetice datorită proprietăților sale hidratante și regenerante pentru piele și păr.

Cătina albă este apreciată pentru proprietățile sale medicinale și este utilizată în diverse produse farmaceutice și suplimente alimentare datorită conținutului său ridicat de substanțe nutritive și antioxidanți.

Au fost obținuți aditivi funcționali cu conținut de fază uleioasă de 95%. Calitatea aditivului funcțional cu efecte antioxidante și emulsionante pe baza uleiului de cătină albă și a fosfolipidelor, ce sunt rezumați în Tabelul 2.

Tabelul 2

Indicatori organoleptici și fizico-chimici ai aditivilor funcționali

Caracteristici	Ulei de cătină obținut din pulpă din stratul superior	Ulei de cătină obținut din pulpă de strat inferior
Miros și gust	Slab, caracteristic tipului de ulei vegetal.	
Culoare	Portocaliu-galben	
Conținut de umiditate și substanțe volatile, % max.	5.0	5.0
Raport de greutate ulei de cătină, %, min.	10	5
Aciditatea uleiului, mg KOH/g, max.	3.5	2.5
Valoarea peroxidului, mmol de oxigen activ/kg, max.	10.0	10.0
Densitate (15 °C) g/cm ³	0,924	0,922
Indicele de refracție (20 °C)	1.474	1.476
Viscozitate(20 °C), cP	55.1	58.4

Aditivul funcțional obținut se distinge printr-un conținut mărit de carotenoizi (67-69 mg/100g) și tocoferoli (43-46 mg/100g), în timp ce calculele caracterizate prin activitate oxidantă (β și γ - tocoferoli) se ridică la 23-25 mg/100g (Tabelul 3).

Tabelul 3

Conținutul cantității de carotenoizi și tocoferol în aditivi funcționali

Substanță	Folosind ulei de cătină obținut din pulpă din stratul superior	Folosind ulei de cătină obținut din pulpă de strat inferior
Vitamina E, mg/100 g	43	46
α -tocoferol	20	21
δ -tocoferol	18	19
Carotenoizi, mg/100 g	67	69
β -caroten	21	23

Utilajele folosite la extragerea uleiului din semințe de cătină albă dispun de o varietate foarte largă a productivității lor și randamentului de extracție. Principiul de lucru al acestor mașini este bazat pe aplicarea presiunii asupra materiei prime încărcate preventiv în camera de lucru și separarea uleiului din întregul amestec solid al semințelor de cătină albă.

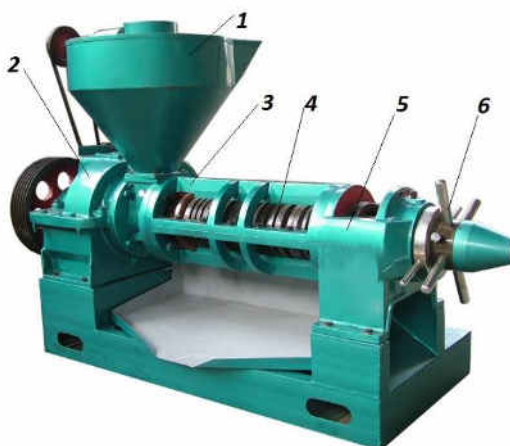


Figura 2. Mașină pentru extragerea uleiului prin presare la rece.

Elemente constructive: 1-buncăr de alimentare cu produs; 2-reductor; 3-camera de presare; 4-tambur perforat; 5-corp; 6-manetă de fixare.

În figura 2 și figura 3 sunt reprezentate două mașini al căror principiu de lucru se bazează pe cele spuse anterior, doar că ele diferă prin posibilitatea de aplicare a sursei de căldură în procesul de extragere a uleiului la mașina prezentată în figura 3.

O mașină automată pentru extragerea uleiului poate fi și cu temperatură controlată în mod automat. În comparație cu o mașină simplă de extras ulei, acest tip de mașină folosește bobine încălzite electric pentru a încălzi și controla temperatura automat. Acestea reduc timpul de preîncălzire, eficientizând astfel funcționarea mașinii. În plus, ajută la reducerea consumului de energie și diminuează uzura în timp a subsansamblurilor de piese din construcția sa [4].

Tabelul 4

Caracteristicile tehnice ale mașinilor de extras ulei prin presare la rece

Model	Capacitate	Putere	Dimensiuni Exterioare	Greutate
YZS-85 Small Oil Press	60-80kg/h	5.5Kw-7.5P	120*400*900mm ³	260KG
YZS-95 Small Oil Press	150-200kg/h	(7.5-11)Kw-(10-15)P	1600*700*1350mm ³	530KG
YZS-105 Small Oil Press	210-300kg/h	15Kw-20P	1850*700*1350mm ³	580KG
YZS-128 Small Oil Press	300-375 kg/h	15Kw-20P	2000*800*1170mm ³	720KG
YZS-130 Small Oil Press	450-500 kg/h	18.5Kw-25P	2010*800*1380mm ³	820KG
YZS-150 Small Oil Press	750-850 kg/h	30Kw-41P	2180*790*1790mm ³	1060KG

Caracteristicile tehnice ale mașinilor de extras ulei la rece sunt prezentate în tabelul 4 de mai jos, unde se observă că capacitatea lor variază de la 60 kg/h până la 850 kg/h, independența de puterea motorului electric instalat, ce poate fi de la 5,5 kw până la 30 kw [5].

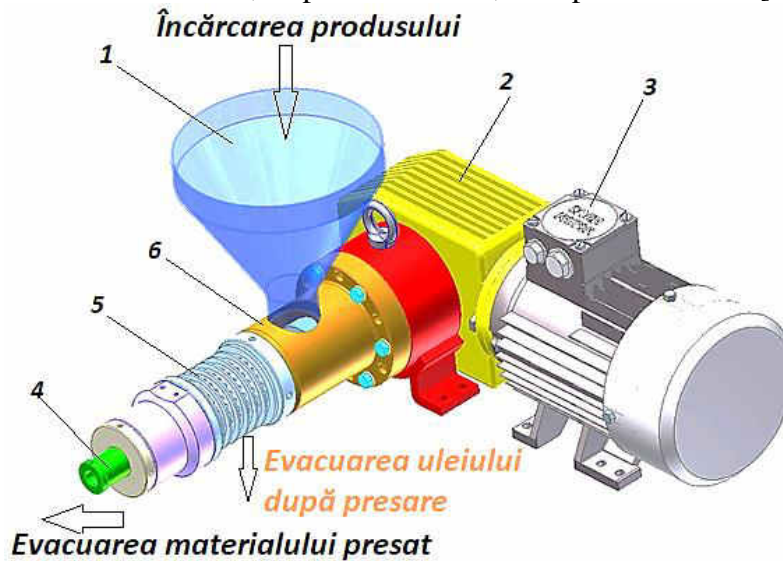


Figura 3. Model 3D al mașinii pentru extragerea uleiului prin presare la rece, cu posibilitate de instalare a elementului de încălzire.

Elemente constructive: 1-buncăr de alimentare cu produs; 2-reductor melcat; 3-motor electric; 4-racord de evacuare a materialului presat; 5-tambur perforat; 6-camera de lucru;

Principiul de funcționare: Încărcarea produsului are loc prin intermediul buncărului de alimentare 1, ulterior el nimereste gravitațional în camera de lucru 6 în care se rotește melcul de presare prin intermediul motorului electric 3 și reductorului melcat 2. Datorită rotației melcului de presare materia primă, este antrenată în mișcare liniară către tamburul perforat 5 unde are loc procesul de separare și extragere a uleiului prin presare. Uleiul presat este evacuat din camera de presare prin orificiile tamburului perforat 5 iar materialul presat, rămas după procesul tehnologic este evacuat prin racordul 4.

Inovația mașinii prezentate în figura 3, constă în posibilitatea instalării unui modul adăugător, ce poate fi montat pe tamburul perforat 5. Destinația acestui modul constă în posibilitatea interschimbabilității sale și eficientizarea procesului de extracție a uleiului prin

încălzirea sa până la o temperatură de 70 °C. Acest modul de încălzire poate fi instalat în dependență de necesitățile consumatorului referitoare la indicii de calitate ai produsului finit. Sporirea indicilor de calitate ai uleiului extras din semințe de cătină alba este asigurată de metoda de extragere la rece prin presare, astfel noi obținem calitate de produs – nu și cantitate.

Concluzii

În urma studiului efectuat s-a constatat că valorificarea semințelor de cătină albă ar avea impact pozitiv în contextul economiei circulare a RM promovând economia sustenabilă prin implementarea unor metode inovative și abordări strategice în recuperarea produselor cu valoare adăugată din deșeurile agro-alimentare în scopul obținerii alimentelor funcționale ce au efecte benefice asupra populației RM și situației ecologice din zonă.

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THE ART OF ACCELERATION: EXPLORING THE PAST, PRESENT AND FUTURE OF STAGE TUNING

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Abstract. *It is obvious that for a modern engineer in the automotive industry today it is important not only to have basic knowledge, it is necessary to constantly learn and develop as well. A modern driver strives to get the maximum power and performance from his car, not causing significant harm to nature and the environment in general, and therefore he must have a notion of how to do it in the right way. In this issue the engineers and the workers of tuning companies will help him, however, it is quite important for the car owner to understand at least the basis of what he wants from his car and how to achieve this and not to be deceived. The purpose of this article is to convey to the reader what is Stage Tuning and what is its essence, how to improve the car to get the best of it, while leaving it safe for nature and people.*

Keywords: *automobile, performance, stage tuning, improvement*

Introduction

Each car owner aims to achieve maximum power and speed from it. However, the factory settings of the car do not allow the driver to achieve more results than those indicated in the vehicle passport. Nevertheless, there is the opportunity to improve the performance of the car using various engineering machinations. It is about stage tuning packages that can significantly improve the characteristics of your favorite car.

Every year the idea of car staging is becoming more and more popular, the automotive tuning industry is rapidly developing and engineers are finding more and more ways to improve the customer's cars. It is important to note that the so-called stage tuning package for one car cannot always be suitable for another. This is the art of stage tuning - to find the best way to improve a car's performance. In this article I'm going to introduce you to the art of car tuning and tell you more about its past, present and near future.

Tuning And Staging – A Quick Look at The History:

To start with, to know more about stage tuning it is necessary to define these terms. Car tuning [1] is the modification of a car to optimize it for a different set of performance requirements from those that was originally designed to meet. Most commonly this is a higher engine performance and dynamic handling characteristics but cars may also be altered to provide better fuel economy or smoother response. The goal of tuning is the improvement of a vehicle's overall performance in response to the user's needs.

Stage tuning [2] describes how various upgrades and enhancements are made to the vehicle. Each stage depicts a different level of upgrades that are fitted as a set. For instance, stage 1 represents the most basic level of performance upgrades, while stage 3 represents the most tuning you can do to your engine.

Now we can move on to the history of Stage Tuning [3]. The history of stage tuning is closely tied to the evolution of the automotive industry, dating back to the earliest days of the automobile. Tuning has essentially been an intrinsic aspect of automobile ownership, driven by two motivations: to adapt the automobile to individual needs and to satisfy the aesthetic desires of the owner.

In the early automotive industry, its customization focused on the practical needs of owners, namely the modification of engines, suspension and transmission to improve performance. As the automotive industry developed, tuning became more influenced by aesthetic desires. The Hot Rod, which was created during the Prohibition Era, exemplifies this shift by combining a modified appearance of the cars with improved performance.

To avoid detection during prohibition, alcohol smugglers altered vehicles by improving their engines and maneuverability. These modifications, eventually, established a unique car customization style that combines savage and performance.

Prohibition-era hot rods had a significant impact on automotive customization, leading to a tuning culture that focused on horsepower, suspension, and unique aesthetics. These modified vehicles have had a lasting impact on this style remaining popular.

Racing has been influenced by modified smuggled cars leading to organized events such as NASCAR. A lasting impact has been made by the history of stage tuning, which is rooted in practical modifications and driven by aesthetic desires.

Hence, the history of tuning is full of interesting facts. From alcohol smuggling to innovative technology and, finally, chip tuning. Car drivers have always been improving their cars and there are certainly many interesting modifications ahead.

What Includes Certain Stages?

Now, being aware of the origins of Stage Car Tuning, we can move on to the main topic, namely, the definition and description of each of the tuning stages - from a stock car to an infinite number of modifications [4-6].

- **Stage 0 – Zero Tuning**

Although this level is not included in the classic list of stages, nevertheless, it is important to talk about it in a few words. Stage 0 indicates that no modifications were made to the vehicle which is exactly what was identified from the factory, in other words, the stock car.

- **Stage 1 – Chip Tuning / Tuning box**

Stage 1 is a stage of minimal car performance upgrade, best known as chip tuning. It consists of optimizing the ECU (Electronic Control Unit) of the engine using special software adapted to the engine and customer preferences. The result is a significant increase in engine power and torque: turbocharged engines from 20% to 40%, and atmospheric engines from 7% to 10%.



Figure 3. ECU Chip Tuning

Stage 1 is based on the fact that any engine with electronic control of fuel supply and ignition (injector gasoline or modern diesel) works according to a certain program. In simple words, at every moment of operation of the engine, it should receive a metered portion of fuel and a time-precisely normalized spark on the spark plugs (in petrol engines). Using several sensors, the ECU takes into account information on speed, load, temperature and the like, and accordingly determines the moment and time of the ignition of fuel injectors.

The plant ECU has a program that is the result of a compromise between guaranteed engine power, its environmental friendliness, economy and durability. But most engine models can adjust the program towards more power and torque - but at the expense of other mentioned indicators.

Of course, the new program for Stage 1 changes valve debugging in the boost system, but structurally the engine remains the same, with no parts replaced.

Note that only the control programs of ECU change, but it is strictly forbidden to touch «iron».

It is also important to mention here that the owner of the tuned-up car often gets problems with the reliability and durability of the powertrain: premature failure of the turbine, the valves are nailed down, the pistons are destroyed and burned. But usually, these risks for each engine and each program are known, so the owner should ask them in advance.

The most interesting thing for car owners is that for tuning the first stage there is ready-made software, written for specific models of engines and repeatedly tested on them. In Moldova, there are certain car tuning companies, that are specific to the stage improvement of car characteristics, many of them focus on Stage 1. Among the most popular tuning studios in Moldova can be identified Dieselok, Seven Force, CarDream, TopTuning, Rivals and so on. Besides, everyone knows international tuning companies: ABT, BRABUS, Hennesy Performance, Mansory, MTM and so forth.



Figure 4. Audi TTRS Rivals Tuning

Thus, to increase car performance, it is often enough to rewrite the ECU program to gain more power and torque. The programs of this stage are quite standard, they have been tested and laminated hundreds of times already. Hence, Stage 1 is great for daily use.

- **Stage 2 - downpipe, intercooler, sports air filter, possibly upgrade turbocharger/ upgrade compressor kit**

Stage 2 is an addition to the first stage of tuning. It consists of optimizing some parts of the car: a less restrictive exhaust system, sports filter, large intercooler. The second stage involves further increase of the engine efficiency by extending the range of maximum torque and power. For this purpose, the inlet and outlet systems are modified by increasing the diameter.

In terms of intake, air ducts with a larger diameter and a minimum number of turns for airflow are installed. The intercooler is replaced by a more productive intercooler, a low-resistance filter is installed and air is provided from the cold area outside the bonnet.

No less work on the outlet. Additionally, extend the diameter of pipelines for exhaust gas removal, they make as much as possible direct. The catalyst is removed or, instead, a special sports catalyst is installed.



Figure 5. Stage 2 Package for Volkswagen Golf, Audi A3 TT 2.0 TFSI

The ECUs are also listed, but unlike Stage 1, there are no finished programs at this level - there are too many options for combinations of input and output parts of different types. True, the tuners have certain blanks, which after replacing "iron" are customized for each specific engine.

So, on the second level, the car owner gets high performance, the car becomes more aggressive and sportier, although it becomes more capricious - increased fuel consumption, faster wear parts, which cost expensive repairs or complete replacement of the details, and even the engine itself. Anyway, the car still can use public roads.

Stage 3 - engine reinforcement, complete exhaust system, modified intake/airflow

Stage 3 involves significant changes to the engine and the replacement of more components. The new turbine and an even more efficient intercooler are installed, providing a more efficient engine cooling system. Not uncommon - the exhaust manifold of a more advanced design. Accordingly, the performance of the fuel system is added - through a new fuel pump and injectors that can feed more fuel into the cylinders.

Tuning "third level" allows you to shoot from a fully civilian 1.5-liter engine up to 300 horsepower. For the realization of the obtained power and torque, the clutch and gearbox, drive shafts of wheels and the like are strengthened. Performance will be close to the physical limits of the engine.



Figure 6. Stage 3 Package - VAG

For Stage 3 as well as for the previous one there is no finished software (chip tuning), everything is handpicked depending on the car, parts and desired characteristics, but sets of parts - it is not uncommon. However, it is much more rational and more profitable to pick up the necessary parts, rather than buy the finished parts.

The tuning on the third-state car is still suitable for daily use, but the fuel consumption will be huge. These vehicles are often used on a racing track or participate in motorsport competitions.

- **Stage 4 - custom ECU, nitrous oxide injection, methanol conversion, displacement increase, crate engine**

Opinions on how many Stage Tuning Packages there are vary in different sources. I suggest that there are 4 stages. Stage 4 is the last stage of tuning, which has no final point - the ability to improve performance and modify the car is infinite. Fantasy has no limits; in this case, the owner can change everything.

Most often, such highly modified cars are used for driving on a race track and for participation in automobile sports competitions, they are not designed for use on public roads - it is prohibited. Cars are transported by tow trucks to the race track.

The Future Trends of Stage Tuning

The world is constantly changing, this also applies to the automobile world. Nowadays electric cars are becoming increasingly popular, so there is a reasonable question - what will happen with stage tuning soon? Of course, a classic car with an internal combustion engine will not soon be lost, but tuning companies already need to adapt to modern realities and find ways to increase the performance of electric cars. Shortly, there will be tuning studios, specific to electric vehicles, there will be new stages of tuning, but this is a question that needs to be thought about now, and for new engineers - this is the space for experiments.

Conclusion

Taking everything into consideration, looking at the history of the appearance and development of car tuning can be concluded that for the modern driver, Stage Tuning Packages play an important role. For many car owners it is important to get the best results from their car, the best performance. Although previously only those who participated in sporting events could tune cars, now this phenomenon has become very popular. Even for daily use state tuning has many advantages.

However, both drivers and automotive engineers need to be prepared for the upcoming changes associated with the spread of electric cars, and thus need to adapt to changes in the near future.

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DESIGNUL PARAMETRIZAT – CATIA VERSUS INVENTOR

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Rezumat. Designul parametrizat reprezintă modalitatea prin care proiectantul poate construi un model CAD controlat complet/parțial prin intermediul unor parametri, formule și reguli. Modelul final trebuie să fie ușor de modificat de către un alt utilizator al modelului. Designul parametrizat este necesar atunci când avem de a face cu produse din aceeași familie, de diferite configurații, dar și atunci când se dorește integrarea mai multor designuri într-un singur model. Lucrarea de față abordează designul parametrizat în Catia și Inventor, fiecare având propriile avantaje/dezavantaje. Catia oferă o bună organizare în construirea atât a modelului 3D cât și a controlului pe care parametrii și relațiile îl pot avea asupra întregului model. Acesta oferă avantajul că, atunci când o legătură este ruptă, designerul este înștiințat. Inventor oferă aproximativ aceleași funcționalități, cu o organizare limitată și posibilități de rupere a legăturilor fără înștiințare, însă oferă în plus controlul asupra desenului 2D. Astfel, pentru proiectele mai complexe designul în Catia este ideal, în timp ce pentru produsele cu un grad mediu de complexitate care se dorește a fi construite sub mai multe configurații, Inventor poate fi folosit.

Cuvinte cheie: design, model, parametri, reguli, software, cod.

Introducere

Designul parametrizat se poate defini ca procesul de proiectare a unui model 3D configurabil, care poate fi controlat parțial sau în totalitate de către o serie de parametri declarați de proiectantul modelului.

Conform [3], designul reprezintă pașii de urmat pentru a pune la un loc informațiile necesare pentru fabricarea unui produs. Practic designul conține ideile și informațiile care vor fi folosite pentru realizarea produsului. Produsul poate fi finalizat doar atunci când toate informațiile necesare sunt puse cap la cap într-un model.

Un model parametrizat este util atunci când sunt așteptate o serie de modificări pe parcursul procesului de dezvoltare a produsului, atunci când se dorește obținerea ușoară a unui model complicat cu geometrii de dimensiuni configurabile sau atunci când se dorește folosirea unui singur model pentru o familie de produse.

De fapt, dacă luăm în calcul modul în care sunt construite softurile CAD (Computer-Aided Design) actuale, orice model care conține istoricul de proiectare ar putea fi considerat ca un model controlat prin parametri și, în funcție de cât de bine este construit, poate fi și modificabil. Cu toate acestea, designul parametrizat definește acel model care poate fi modificat fără necesitatea accesării caracteristicilor 3D (pad/extrude, pocket, hole, etc) din structura modelului, ci doar prin modificarea acelor parametri definiți în scopul posibilității configurării modelului 3D.

De obicei, configurarea modelului este posibilă direct din fișierul CAD (parametrii fiind declarați într-un set în arborele modelului - "tree") sau printr-un tabel excel atașat modelului.

Un model de parametrizare prin intermediul tabelului excel este prezentat în [1], unde este construit un dispozitiv modular ale cărui dimensiuni sunt declarate ca parametri modificabili cu ajutorul funcției „design table” din Catia.

În [2], designul parametrizat este descris ca fiind folosit pentru crearea unor familii de produse/modele prin declararea parametrilor necesari controlați direct sau prin intermediul relațiilor.

În general, un model parametrizat este controlat prin parametri direct sau cu ajutorul relațiilor: formule și reguli. Regulele sunt mici bucăți de cod care controlează parametrii, activitatea caracteristicilor 3D /geometriilor, materialul, instrucțiunile pentru utilizator, etc.

Catia

Catia este un software de proiectare extrem de utilizat, ce permite proiectarea parametrizată alături de un istoric al piesei organizat după bunul plac și care se poate modifica în orice moment al dezvoltării produsului. Acest software oferă posibilitatea de a utiliza formule și, prin intermediul modulelor KWA (Knowledge Advisor) și KWE (Knowledge Expert), oferă posibilitatea introducerii unor reguli prin intermediul unor mici bucăți de cod.

Inventor

Inventor este un software de proiectare destul de intuitiv care permite de asemenea proiectarea parametrizată alături de crearea unui istoric al construcției piesei, care poate fi vizualizat etapizat de la un punct al istoricului la altul. Acest software oferă de asemenea posibilitatea de a utiliza formule și, prin intermediul interfeței de programare iLogic, oferă posibilitatea introducerii unor reguli prin intermediul unor mici bucăți de cod.

Catia versus Inventor

Aparent, ambele software-uri oferă aceleași funcționalități care ajută la crearea unui model complet/parțial parametrizat.

Catia oferă posibilitatea organizării modelului prin separarea caracteristicilor 3D solide de geometriile ajutătoare (suprafețe, plane linii, puncte). Este posibilă vizualizarea modelului în orice etapă a creării acestuia (prin funcția „Define în work”) și de asemenea este permisă reorganizarea istoricului (prin funcția „Reorder”). Se pot introduce mai multe corpuri solide ce pot fi organizate prin intermediul operațiilor booleene și mai multe seturi de geometrii pentru facilitarea creării și modificării oricărui design complex.

Inventor permite de asemenea organizarea separată a caracteristicilor 3D solide de geometriile ajutătoare, fără însă a exista posibilitatea organizării acestora pe corpuri solide și seturi geometrice. O geometrie ajutătoare își poate schimba locul în istoric, însă o caracteristică 3D solidă nu. Deci este imposibil să schimbi ordinea efectuării acestora. În schimb, este posibilă vizualizarea fiecărui pas din istoric doar mutând iconița „End of part” în locul dorit.

Introducerea parametrilor în Catia este posibilă fără necesitatea utilizării modulelor KWA sau KWE. Se poate alege între mai multe tipuri de parametri: boolean (adevărat/fals), nr. întreg, lungime (nr. real), unghi, text, masă, forță, densitate, volum, etc.

Pentru facilitarea modificării parametrilor în Catia, aceștia pot fi introduși fie într-un fișier CatPart separat numit Skeleton (metoda utilizată de obicei în cadrul ansamblurilor pentru a controla mai multe piese și, eventual, constrângerile de asamblare ale acestora), fie în seturi de parametri plasați la începutul istoricului.

Modificarea parametrilor în Inventor se face accesând funcția „Parameters”.

În Inventor, parametrii pot fi introduși inițial doar sub tipurile: boolean, numeric sau text.

Ambele software-uri permit importul și exportul parametrilor într-un fișier Excel, parametrii putând fi modificați direct din acest fișier.

Crearea regulilor în Catia se face în modulul KWA prin accesarea funcției “Rules”. Codarea se limitează la instrucțiuni de bază. Funcția nu oferă sugestii automate în momentul utilizării instrucțiunilor, ci doar oferă ajutor în selectarea diferitor tipuri de funcții sau a diferitor tipuri de parametri. În momentul utilizării, parametrii și funcțiile se pot selecta direct din istoric.

În Inventor, crearea regulilor se face utilizând funcția “Add rules”. Codarea este de asemenea limitată la instrucțiuni de bază. În momentul introducerii instrucțiunilor, software-ul oferă sugestii, ceea ce reprezintă un mare avantaj față de Catia. Un alt avantaj este faptul că Inventor oferă indicii cu privire la erorile găsite în cod în momentul validării. La unele erori minore (de exemplu utilizarea literei mari în loc de cea mică), software-ul poate corecta automat.

Pentru a transforma modelul într-unul ușor modificabil de către un alt utilizator, în ambele software-uri se pot utiliza mesaje ajutatoare în care acesta să primească indicații cu privire la pașii următori, sau cu privire la unele limitări ale modelului.

Ambele software-uri permit activarea sau dezactivarea anumitor caracteristici 3D prin intermediul regulilor. În Catia, dacă acea caracteristică 3D este legată de alte caracteristici 3D/geometrii, utilizatorul primește o eroare, putând gestiona situația tot prin intermediul regulilor. În Inventor însă, la dezactivarea automată a unei caracteristici 3D, tot ce se afla în istoric după acea caracteristică 3D va fi dezactivat. Catia nu va permite activarea/dezactivarea directă a caracteristicii 3D din istoric, atât timp cât există o regulă care controlează această activitate (figura1). În schimb, în Inventor, se permite activarea ulterioară, fiind necesară rularea regulii din nou în cazul în care se dorește aplicarea acesteia (figura 2). Acesta este un dezavantaj pentru Inventor din punctul de vedere al controlului automat asupra modelului. Ideal ar fi ca utilizatorul să fie măcar anunțat de existența acelei reguli.

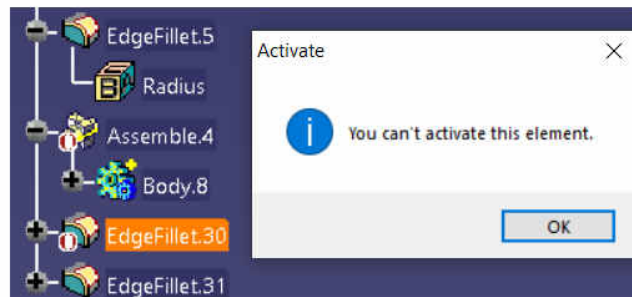


Figura 1. Încercarea activării unui unei caracteristici 3D controlată printr-o regulă în Catia

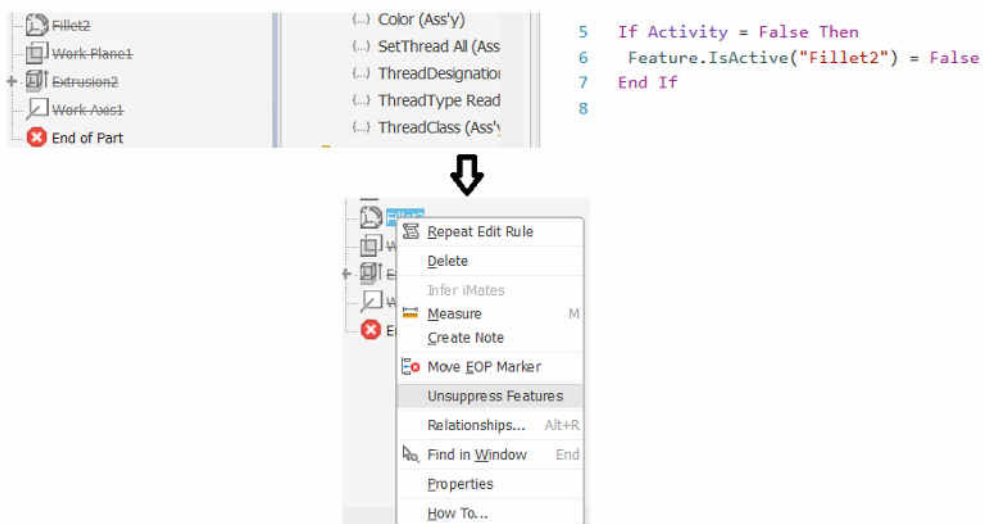


Figura 2. Încercarea activării unei caracteristici 3D controlată printr-o regulă în Inventor

În momentul creării unei noi reguli este bine să se obișnuiească adăugarea unor scurte descrieri sub formă de “comment” acolo unde se consideră necesar. Acest lucru este posibil atât în Catia cât și în Inventor. Inventor are avantajul că poate comenta automat mai multe rânduri doar prin apăsarea unui buton destinat acestui lucru. În Catia, în schimb, este necesară adăugarea “de mână” a textului “/*” înainte și “*/” la final.

Spre deosebire de Catia, unde designul parametrizat poate fi utilizat în doar modelele 3D, în Inventor parametrizarea poate fi extinsă și în desen. Nu vorbim aici despre modificările unor vederi, pentru că oricum, în momentul unui update în 3D, modificările se cascadează în vederile din desen, ci discutăm despre întregul desen care poate fi controlat prin parametrizare, inclusiv reatribuirea dimensiunilor, notelor, etc. De asemenea, tot prin intermediul unor reguli introduse în iLogic Inventor, pot fi configurate indicatorul și formatul foii; acestea ar putea fi folosite în momentul în care dimensiunile se modifică atât de mult încât să fie necesară schimbarea dimensiunii foii.

Tabelul 1 prezintă caracteristicile pe care le îndeplinește fiecare dintre cele 2 software-uri:

Tabelul 1

Catia versus Inventor - caracteristici

	Catia	Inventor
Organizare caracteristici 3D solide separate de geometriile ajutoare	x	x
Organizare în corpuri solide și seturi geometrice și reorganizare ulterioară a istoricului	x	
Serie largă de tipuri de parametri	x	
Exportul parametrilor în fișier Excel	x	x
Sugestii în momentul definirii codului și indicii legate de erorile din cod		x
	Catia	Inventor
Posibilitatea introducerii mesajelor ajutoare pentru utilizator	x	x
Activare/dezactivare caracteristici	x	x
Notificarea la încercarea activării/dezactivării unei caracteristici controlate prin reguli	x	
Posibilitatea introducerii unei descrieri a codului	x	x
Posibilitatea transformării automate a mai multor rânduri de cod în comentariu		x
Desen 2D configurabil		x

Concluzii

Catia este un software CAD care se pretează la designuri complexe ce au nevoie de o construcție foarte organizată. Din punctul de vedere al modelării 3D, Catia oferă un control deosebit asupra geometriilor și relațiilor în ansamblu. Un model bine construit va fi foarte ușor de modificat oricând, chiar și după finalizarea designului, fără a relua întregul proces pentru un pas făcut undeva la începutul modelului. Legăturile dintre parametri/relații (reguli și formule) sunt stabile atât timp cât sunt bine definite.

Inventor este un software CAD intuitiv cu multe funcții disponibile, dar puțin limitat când vine vorba de organizare. Pentru designuri medii din punct de vedere al complexității și mai ales pentru familii de produse, acest software este unul foarte folositor datorită posibilității configurării automate a desenului odată cu modelul 3D. Acesta este un avantaj deosebit care ar putea fi dezvoltat pe viitor.

Mulțumiri

Mulțumiri îndrumătorului de doctorat prof. univ. dr. ing Oana Dodun pentru implicare.

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TESTAREA LA EROZIUNE ABRAZIVĂ

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Rezumat. În acest articol se realizează o analiză succintă a procesului de eroziune abrazivă și a unor scheme de lucru utilizabile pentru testarea la eroziune abrazivă. Utilizând metoda analizei sistemice, au fost evidențiate grupele de factori capabili să exercite influență asupra intensității procesului de îndepărtare de material prin eroziune abrazivă, din epruvete realizate din materiale polimerice compozite. Analiza unor modalități de testare la eroziune abrazivă a conturat treptat posibilitățile de construire a unui echipament relativ simplu de testare a rezistenței la eroziune prin abrazare. S-a conturat treptat o schemă de testare la eroziune abrazivă bazată pe apăsarea unei epruvete de formă cilindrică pe suprafața activă a unei benzi abrazive aflate în mișcare. A fost conceput un echipament relativ simplu, care să poată fi utilizat pentru testarea la eroziune prin abrazare și care are la bază utilizarea unei benzi abrazive.

Cuvinte cheie: eroziune abrazivă, scheme de testare, analiză sistemică, echipament.

Introducere

Eroziunea este termenul utilizat pentru a descrie ce se întâmplă atunci când un obiect sau o suprafață intră în contact cu acțiunea unor factori exteriori și apare un proces de îndepărtare treptată de material din obiect, efectul fiind influențat de gradul de coliziune dintre obiect și factorul exterior, considerat ca fiind agentul eroziv.

În domeniul procedurilor de fabricație, conceptul de eroziune ia în considerare un proces de prelevare de material de la suprafața unei piese. Controlul și gestionarea impactului dintre agentul eroziv și obiect sau piesă pot asigura o mai bună calitate și durabilitatea a pieselor, fie că acestea sunt doar epruvete sau sunt produse finite. Printre cele mai comune tipuri de eroziune se enumeră eroziunea mecanică, eroziunea chimică, eroziunea electronică. Eroziunea abrazivă reprezintă un proces de degradare de natura mecanică a unui obiect ce intră într-un contact continuu cu unele particule abrazive. În urma impactului cu particulele abrazive, pe obiect sau pe piesa urmărită sunt generate micro-zgârieturi sau micro-găuri ce pot conduce treptat la eliminarea unui strat din material din obiectul afectat de acțiunea abrazivă [1-5].

Procese de eroziune abrazivă intenționată sunt utilizate la finisarea suprafețelor unei piese în industria prelucrării materialelor. Din punctul de vedere al exploatării echipamentelor mecanice, prezintă interes testarea unor piese la eroziune abrazivă. În acest sens, se poate menționa utilizarea unor diverse procedee de testare la uzare prin eroziune abrazivă [2-4]. Apariția de noi materiale a condus la inițierea și dezvoltarea unor scheme diferite de testare a lor din punctul de vedere al rezistenței la eroziune abrazivă.

În lucrare sunt prezentate rezultatele unei analize referitoare la diferitele scheme de testare la eroziune abrazivă, intenționându-se ca, în viitor, să fie conceput și realizat un echipament destinat unei asemenea testări.

Scheme de testare la eroziunea abrazivă

Așa cum s-a menționat anterior, procesul de uzare a organelor de mașini poate avea loc prin abrazare, deformare plastică, coroziune, oboseală etc.

Testarea la eroziune abrazivă poate fi utilizată ca o modalitate de obținere a unor informații referitoare la modul în care se va comporta un material la uzarea prin abrazare. Cunoașterea comportării materialului la uzura abrazivă sau la eroziune prin abrazare poate conduce la o selectare mai bună a materialului unei piese care va fi supusă unor asemenea solicitări.

Atunci când se efectuează o clasificare a schemelor de testare a comportării unui material la eroziune abrazivă, este necesar să fie luate în considerare mai multe aspecte, care vor permite, ulterior, o evaluare cuprinzătoare și relevantă a performanței unui material din punctul de vedere al rezistenței la eroziune abrazivă. În prezent, se cunosc trei scheme de lucru ce pot fi utilizate în cadrul echipamentelor de testare la eroziune abrazivă.

O primă asemenea schemă este cea bazată pe apăsarea unei epruvete din materialul de testat pe un cilindru aflat în mișcare de rotație și a cărui suprafață exterioară prezintă caracteristici abrazive (fig. 1) [2]. Variația în timp a lungimii epruvetei sau a masei acesteia vor permite caracterizarea rezistenței la eroziune abrazivă a materialului epruvetei. Pentru a evita situația în care menținerea epruvetei într-o poziție unică în raport cu cilindrul antrenat în mișcare de rotație ar conduce la o posibilă uzare prematură a acelei zone în care este apăsată epruveta, se poate recurge la o deplasare lentă a epruvetei în lungul axei cilindrului rotitor.

O a doua schemă de testare la eroziune abrazivă poate lua în considerare apăsarea epruvetei din materialul de încercat pe suprafața plană abrazivă a unui disc aflat în mișcare de rotație, fără ca epruveta să fie implicată în efectuarea unei mișcări suplimentare (fig. 2) [3, 4]. O asemenea schemă de lucru va genera o suprafață plană pe epruvetă, dar procesul de eroziune abrazivă ar putea fi mai intens spre acea zonă a epruvetei mai îndepărtate de axa de rotație a discului, unde viteza mișcării relative dintre disc și epruvetă este mai mare.

O a treia schemă de testare la eroziune abrazivă identificată are la bază apăsarea epruvetei pe suprafața în mișcare a unei benzi abrazive, fiind utilizată, de fapt, o așa-numită bandă continuă, rezultată prin îmbinarea capetelor benzii și antrenarea benzii la un capăt cu ajutorul unui cilindru rotitor, în timp ce un al doilea cilindru permite sprijinirea benzii la celălalt capăt și respectiv întinderea benzii (fig. 3) [4]. Faptul că banda abrazivă prezintă o anumită flexibilitate poate conduce la necesitatea includerii unui suport plan rigid, aflat sub bandă, în zona în care banda este apăsată de epruvetă.

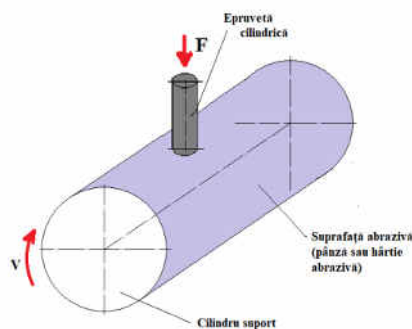


Figura 1. Cilindru abraziv

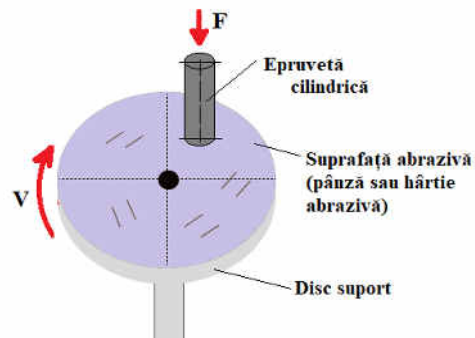


Figura 2. Disc abraziv

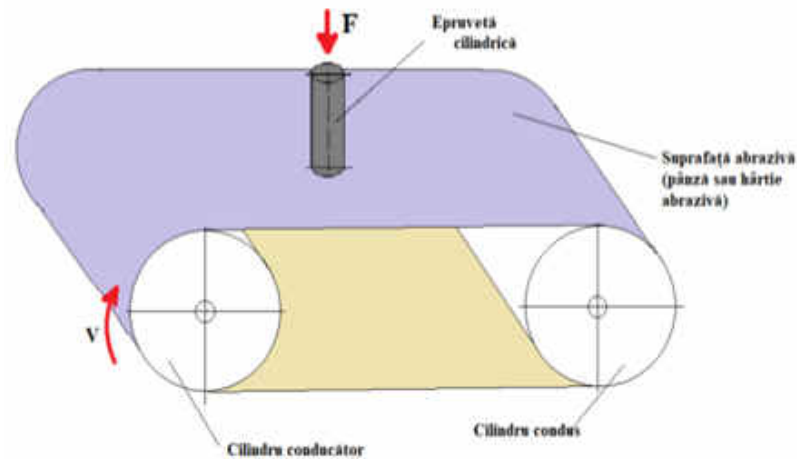


Figura 3. Bandă abrazivă

Analiza sistemică a procesului de eroziune abrazivă

În vederea dezvoltării ulterioare a unui echipament care să permită studiul comportării la eroziune abrazivă a unor epruvete de formă cilindrică, din materiale polimerice compozite, a fost realizată o analiză sistemică a unui proces de testare la eroziune abrazivă. Rezultatul acestei analize este prezentat sub formă grafică în figura 4.

Se poate astfel constata că în calitate de parametri de ieșire ai procesului, au fost luate în considerare variația lungimii și/sau a masei epruvetei, intensitatea acestei variații, forma așchiilor detașate din epruvetă prin abrazare. Ca factori de intrare în procesul de eroziune abrazivă, pot fi avuți în vedere natura și proprietățile materialului epruvetei, natura și proprietățile materialului benzii abrazive, posibilitățile de modificare a valorilor ce caracterizează regimul de testare.



Figura 4. Analiza sistemică a procesului de eroziune abrazivă

Soluție propusă pentru testarea comportării unor materiale la eroziune abrazivă

Prin utilizarea rezultatelor analizei sistematice prezentate anterior, s-a optat pentru o schemă de testare al comportamentului materialului polimeric compozit al unei epruvete de formă cilindrică, la eroziune abrazivă, bazată pe utilizarea unei benzii abrazive (fig. 5). Astfel, epruvete de dimensiuni și materiale diferite vor fi supuse contactului cu suprafața abrazivă a benzii.

Apăsarea epruvetei pe suprafața benzii abrazive în mișcare va putea lua valori diferite, datorită greutateilor de mărimi distincte amplasate pe un platan solidarizat cu subsistemul de orientare și fixare a epruvetei. Reglarea poziției epruvetei în lungul unei direcții verticale este posibilă prin folosirea unei bușe ce poate fi deplasată și fixată cu ajutorul unor piulițe pe o coloană filetată.

Un subsistem cu arc ar putea fi folosit pentru întinderea benzii abrazive. Modificarea poziției epruvetei pe bandă, pentru a evita utilizarea unei aceleași zone a benzii în procesul de eroziune, va fi posibilă cu ajutorul unei sănii pe care se află subsistemul portbandă.

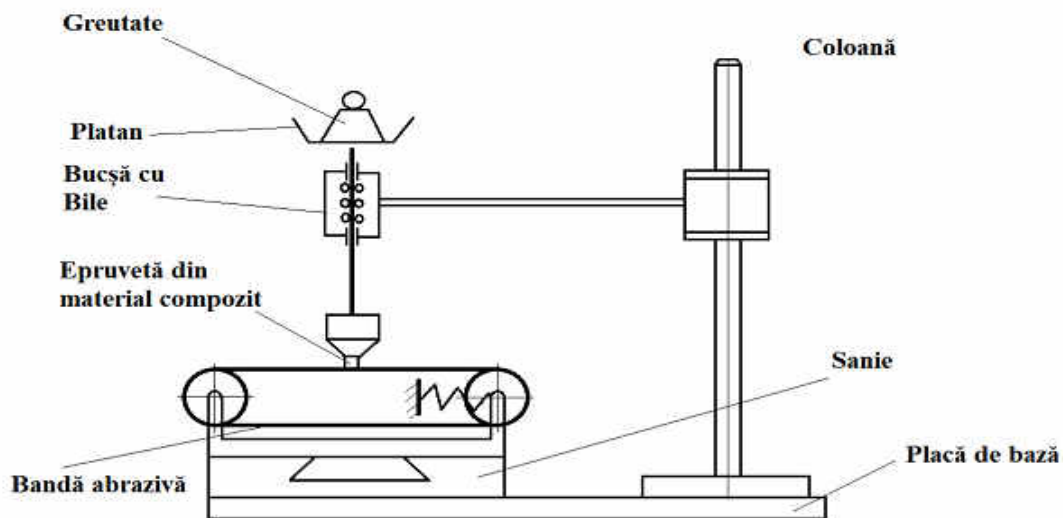


Figura 5. Reprezentare simplificată a unui echipament de testare la eroziune abrazivă ce folosește o așa-numită bandă continuă

Concluzii

Procesul de eroziune abrazivă este un proces complex și rezultatele sale pot fi afectate de către mai mulți factori luați în considerare în calitate de factori de intrare într-un asemenea proces. Utilizarea metodei analizei sistemice a permis evidențierea unor grupe de astfel de factori de intrare în procesul de testare la eroziune abrazivă. A fost luată în considerare o schemă a unui echipament relativ simplu de testare la uzare abrazivă ce folosește o bandă abrazivă așa-numită continuă. Se intenționează ca, în viitor, un asemenea dispozitiv să fie construit și utilizat pentru testarea la eroziune abrazivă a unor epruvete de formă cilindrică din materiale polimerice compozite.

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DESPRE MĂSURĂTORILE COEFICIENTULUI DE FRECARÉ ÎN CONTACTUL PNEU-PISTĂ

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Rezumat: Coeficientul de frecare dintre pista de aterizare și pneurile aeronavelor este un element esențial în siguranța operațiunilor de aterizare. Pentru ca aceste operațiuni să se desfășoare în siguranță, aeroporturile au obligația de a verifica valoarea coeficientului de frecare utilizând echipamente speciale. Acest lucru se face periodic și ori de câte ori există premise, că aderența la pistă a pneurilor să se fi modificat (prin modificarea condițiilor meteo sau din alte cauze), cu echipamente omologate destinate acestui scop, așa cum este și echipamentul ASFT T5. În cadrul acestui articol se realizează o analiză și o interpretare a unor rezultate ale măsurătorilor coeficientului de frecare pe o pistă de aeroport, cu un echipament de măsurare de tip ASFT T5. Măsurarea valorilor acestui coeficient, făcută pe porțiuni prestabilite ale zonei de rulare și interpretarea coeficienților de frecare, bazată pe aspecte fenomenologice și observații directe pe pistă, conduc la concluzii practice, privind posibilitatea de estimare a momentului când trebuie preconizate lucrări de mentenanță ale suprafeței de rulare a pistei, fiind în același timp și un bun indicator al gradului de degradare locală a stării suprafeței.

Cuvinte cheie: frecare pneu-pistă, măsurători, contaminare pistă

Introducere

Frecarea pneu-pistă contribuie direct la stabilitatea aeronavei pe pistă și este un factor crucial care, atunci când este prea mică, poate determina producerea de accidente la aterizare sau decolare. Aeronava care rulează pe pistă se bazează pe frecarea generată între anvelope și suprafața pistei, ceea ce permite aeronavei să păstreze direcția, să vireze, să ruleze și, în cele din urmă, să oprească.

Frecarea este un fenomen care se manifestă printr-o forță care se opune mișcării relative între anvelope și pistă. Forța de frecare de alunecare se caracterizează prin coeficientul de frecare, μ , definit ca raportul dintre forța tangențială de frecare dintre banda de rulare a pneului și suprafața pistei și reacțiunea normală.

La contactul inițial al pneurilor cu pista, acestea întâi patinează, apoi încep să se rotească sub efectul interacțiunii cu pista și, după un anumit timp, capătă o anumită viteză de rotație, denumită ca "spin up speed" [1].

Valorile măsurate ale coeficientului de frecare sunt singurele informații obiective privind starea suprafeței pistei, celelalte aspecte sunt subiective (apreciere, estimare contaminare de către personalul ce realizează inspectarea stării suprafeței pistei).

Astfel, măsurătorile coeficienților de frecare sunt informații valoroase, în special în situațiile de cumul a contaminanților pe pistă, atunci când se monitorizează degradarea aderenței pe suprafață, fiind un indicator al stării suprafeței portante a pistei și a siguranței desfășurării operațiunilor.

Prezentarea echipamentului de măsurare de tip ASFT T5 [2]

Pentru efectuarea măsurătorilor s-a folosit un echipament de tip ASFT T5 (figura 1). Suprafața de contact este de tip covor asfaltic. ASFT este un echipament de sol, integrat electromecanic-hidraulic de înaltă tehnologie, compus dintr-un sistem de transmisie mecanică, sistem hidraulic, sistem computerizat de măsurare și control și sistem de control electric.



Figura 1. Echipament măsurare coeficient frecare- ASFT T5

Principiul general de funcționare al ASFT T5 se bazează pe măsurarea forței care antrenează în mișcare de rotație, o roată de măsurare, apăsată pe pistă cu o sarcină constantă, prestabilă. Mișcarea și efortul sunt culese de la roata de măsurare prin intermediul unei transmisii prin lanț, de la care sistemul de măsurare evaluează forța de frecare și calculează coeficientul de frecare. Concomitent sistemul monitorizează ceilalți parametri respectiv forța de apăsare a roții de măsurare pe pistă, viteza de deplasare, condițiile meteo, etc.

Se pot efectua două tipuri de măsurători:

8. Primul tip de măsurători care se poate realiza este cu frecare continuă, când roata de măsurare este acționată permanent cu o sarcină de 140 kgf pe suprafață, fiind în contact cu pista, pe întreaga lungime de măsurare.
9. Cel de al doilea tip presupune setarea de intervale predefinite de măsurare, când, la atingerea distanței setate roata de măsurare, care este în rulare liberă pe suprafață, este acționată cu o sarcină de 140 kgf pe suprafață și se măsoară coeficientul de frecare. Există 2 moduri de a face acest lucru, fie prin pornirea manuală a măsurătorii, fie automat prin definirea unui autostart după o distanță predefinită. Coeficientul de frecare de alunecare este coeficientul obținut într-o condiție de blocare a roții de măsurare, similar cu ceea ce se întâmplă atunci când pneurile aeronavei ating pista, la aterizare.

În cadrul măsurătorilor roata de măsurare folosită a fost de tip T520, cu presiune interioară de 7 bari și confecționată să se comporte asemănător unui pneu de aeronavă, acționarea /coborârea acesteia realizându-se cu ajutorul sistemului hidraulic integrat, figura 2.



Figura 2. Roata de măsurare- T520

Desfășurarea măsurătorilor

În cadrul acestui studiu s-a folosit funcția de autostart pentru a efectua măsurători ale coeficientului de frecare la distanțe de măsurare de 150 metri, pe o distanță totală de 1800 metri.

Măsurătorile s-au efectuat în lungul pistei, pe două linii paralele cu axa/linia centrală a acesteia și situate la distanțe de 6 metri stânga și 6 metri dreapta. Viteza medie de măsurare utilizată a fost de 65 km/oră. Distanța față de axă s-a adoptat având ca referință aeronavele care operează frecvent, aeronave de tip Airbus 321, respectiv locul cu probabilitatea de rulare cea mai mare, deoarece pilotul ghidează aeronava după linia de axă a pistei iar distanța între grupurile de roți din trenul de aterizare este 12 metri.

Prelucrarea și interpretarea rezultatelor

În figura 3 se prezintă un mod de afișare a unui rezultat al măsurării coeficienților medii de frecare pe zone de măsurare, în formă tabelară. Măsurătorile au fost centralizate în vederea interpretării.

Measure	Config	Tools	Settings	Summary
Summary all				
Speed Avg	76	Km/h		
Max	0.90	μ		
Min	0.46	μ		
Zone A Avg	0.73	μ		
Zone B Avg	0.72	μ		
Zone C Avg	0.68	μ		
TOT Avg	0.71	μ		

Figura 3. Model de afișare a sintezei rezultatelor coeficienților medii de frecare pe zone de măsurare

Au fost efectuate un număr de 6 treceri (câte 3 pe fiecare parte a axului pistei) cu echipamentul de măsurare de-a lungul pistei. Reprezentarea grafică a valorii medii a coeficienților de frecare măsurați este evidențiată în figura 4.

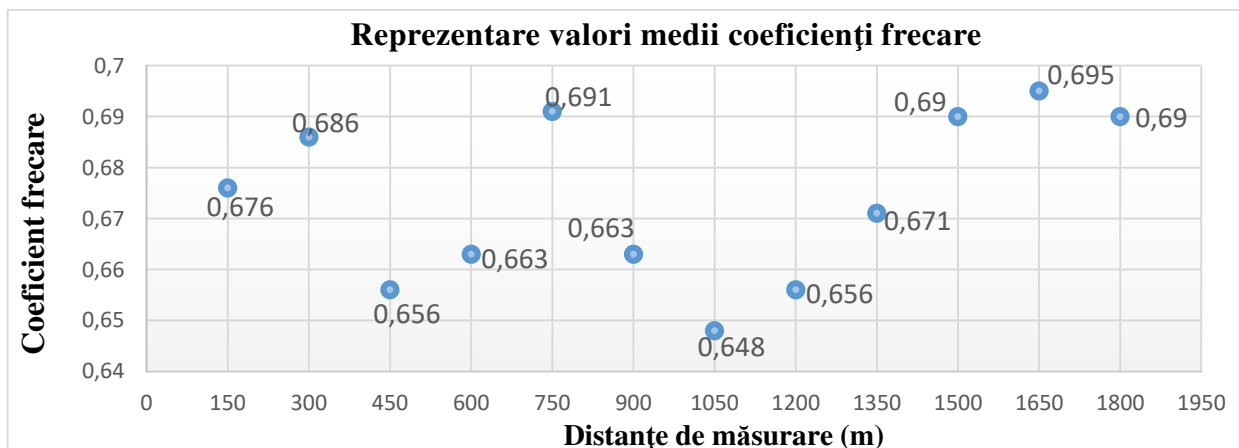


Figura 4. Reprezentare valori medii coeficienți de frecare corespunzător distanțelor de măsurare

Coeficientul de frecare mediu a fost calculat ca o valoare medie aritmetică a coeficienților obținuți din măsurători, pentru fiecare distanță de măsurare, pentru cele 6 seturi.

Graficul evidențiază o distribuție relativ neuniformă. Astfel, se apreciază că distribuția valorilor discrete poate fi influențată și de faptul că roata de măsurare nu măsoară/calcă exact în același loc, deci nu rulează pe același tip de suprafață sau pe aceeași tip/grad de contaminare a suprafeței (uscată, cu urme de cauciuc etc.).

Pe porțiunile unde roata de măsurare a întâlnit depuneri de cauciuc, valorile coeficientului de frecare sunt mai scăzute, ele depinzând de situația existentă în locul respectiv. De aceea, pentru siguranța aterizării se apreciază că sunt mai importante măsurătorile continue ale coeficientului de frecare pe suprafața pistei decât cele la distanțe prestabilite.

Se apreciază că o micșorare a distanței de măsurare sau chiar o măsurare continuă ar conduce la o creștere a acurateții de estimare a valorilor locale ale coeficientului de frecare pe lungimea pistei, identificând mai precis zonele unde aceasta este afectată de factori externi ca: uzura suprafeței de rulare (lustruire, faianțare), gradul de acoperire cu contaminanți (urme de cauciuc, apă, zăpadă, gheață) precum și grosimea depozitelor de cauciuc.

În figura 5 este prezentat un exemplu de rezultate, ales aleatoriu, obținut în cadrul măsurătorilor, respectiv setul 5 de măsurători.

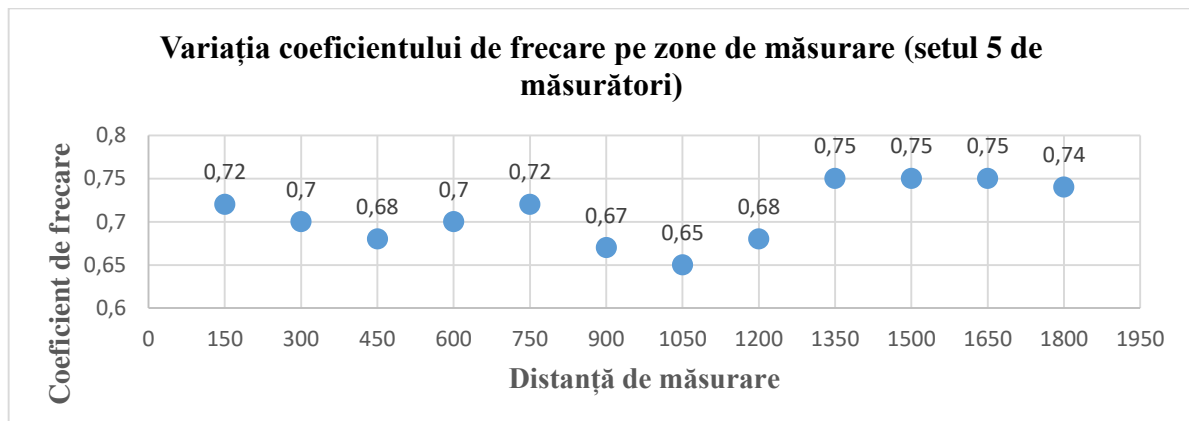


Figura 5. Variația coeficientului de frecare pe distanțe măsurate (setul 5 de măsurători)

Variația coeficientului de frecare este de la 0,65 la 0,75. Această diferență se apreciază că este datorată rugozității covorului asfaltic, uzurii suprafeței portante (lustruire, faianțare) și contaminării (depuneri de cauciuc).

Valorile cele mai scăzute ale coeficientului de frecare, intervalul 0,65-0,68, corespund zonelor celor mai utilizate, care prezintă gradul de contaminare mai mare cu urme de cauciuc provenite din pneurile aeronavei, respectiv 450 metri și 900-1200 metri.

Valorile obținute pe zona de la 450 metri se explică prin faptul că această zonă corespunde locului unde roțile aeronavei ating preponderent pista, pneurile intră în patinare și apoi trec în mișcare preponderentă de rostogolire. La trecerea cu echipamentul, roata de măsurare a efectuat măsurători pe aceste urme.

Pe distanța 900-1200 metri valorile scăzute ale coeficientului de frecare se datorează faptului că aterizarea predominantă este pe această pistă într-un singur sens, astfel această zonă fiind mai contaminată cu urme de cauciuc decât alte zone din pistă și corespunde zonei de rulare cu frânare a aeronavei.

Valorile corespunzătoare intervalului 0,7-0,75, sunt măsurate pe zonele care nu sunt contaminate cu urme de cauciuc.

Tipul acesta de măsurători reflectă coeficientul de frecare local, efectiv, care este puternic dependent de situația în locul respectiv, unde roata de măsurare întâlnește sau nu o depunere de cauciuc, provenită dintr-un contact inițial pneu- pistă.

Este posibil ca un avion care aterizează și atinge pista puțin lateral față de ax și la aceeași distanță de capăt, să atingă într-o zonă cu un alt coeficient de frecare, deci să nu atingă zona contaminată pe care s-au efectuat măsurători. De aceea pentru siguranța aterizării sunt mai importante măsurătorile continue decât cele la distanțe prestabilite, efectuate longitudinal, la mai multe distanțe față de axul pistei.

Concluzii

În urma analizei efectuate se constată că valorile coeficientului de frecare în contactul pneu-pistă nu au o distribuție uniformă pe suprafața măsurată, împrăștierea poate fi datorată rugozității covorului asfaltic, uzurii suprafeței portante (lustruire, faianțare) și contaminării (depunerii de cauciuc).

Măsurătorile au fost realizate pe intervale predefinite în scopul analizării gradului de obiectivitate în a reflecta condițiile de pe suprafața pistei. Micșorarea distanței de măsurare poate oferi mai multe date despre variația coeficientului de frecare, astfel acurațetea cu care se va realiza estimarea coeficienților medii de frecare va fi îmbunătățită.

Valorile medii ale coeficientului de frecare, obținute la distanțele prestabilite, ce variază între 0,648 și 0,695, semnifică o stare a suprafeței diferită pe lungimea pistei, care nu asigură un coeficient de frecare constant.

Valorile coeficienților de frecare se pot lua ca referință în vederea stabilirii caracteristicilor de frecare pe suprafață, fiind un bun indicator în preconizarea lucrărilor de mentenanță. Acest lucru se poate realiza prin compararea valorilor coeficienților de frecare obținuți cu valorile de referință, reglementate ale coeficientului de frecare: 0,6 pentru planificarea mentenanței și 0,5 pentru valoarea minimă acceptată de operare [3].

Pentru o imagine precisă a distribuției valorilor coeficientului de frecare pe întreaga pistă, ar trebui analizate cumulativ mai multe valori măsurate, precum și evoluția lor în timp deoarece mărimea valorilor măsurate depinde esențial de starea locului pe unde trece roata de măsurare și această stare poate să difere atât pe lungimea cât și pe lățimea zonei posibile de contact pneu-pistă.

Gradul de degradare al suprafeței poate astfel fi determinat prin monitorizarea variațiilor coeficientului de frecare obținut prin măsurători în timp.

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EXAMINAREA MACARALEI POD DE REAZEM PE PERIOADA DE EXPLOATARE

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Rezumat. Pe parcursul exploatării macaraua, calea de rulare precum și clădirea cu construcția suport se afla sub influența multor factori și sarcini care duc la schimbarea stării lor și influențează starea tehnică a macaralei. Astfel modificarea stării acestora pot duce la majorarea timpului de staționare în reparații, micșorarea termenului de exploatare, creșterea riscului de incidente, respectiv a cheltuielilor de întreținere. Din această cauză pe parcursul efectuării lucrărilor de verificare tehnică completă, a încercărilor statice și dinamice, măsurării alinierii căilor de rulare și uzurii șinei de rulare macara, inclusiv a roților de deplasare macara (impuse de regulamentul tehnic în vigoare) se execută măsurări de deformare, aliniere, uzură. Se propune combinarea studiului prin măsurări de scanare a macaralei, căii de rulare, roților deplasare macara, construcției de suport, pentru vizualizarea detaliată, construirea graficelor de monitorizare și a evoluției stării mecanismului de ridicare și suport macara în ansamblu.

Cuvinte cheie: macarale, măsurări, geometrice, geodezice, aliniere, cale de rulare, uzură, roți, scanare.

Introducere

Macaralele pod, conform normativelor tehnice, sunt supuse examinării, care constă din control vizual, dimensional, nedistructiv a construcției metalice, elementelor portante și a îmbinărilor prin sudură precum și verificarea frânelor, sistemelor de siguranță a macaralei (limitatori, opritori etc). Efectuarea măsurărilor respective și analiza datelor preluate sunt dificile, pentru a face o concluzie finală reală pentru a emite permisiunea de exploatare. Mai mult ca atât, în cadrul examinării macaralei anumite componente ca exemplu calea de rulare, construcția suport cale de rulare și macaraua în sine, cu componentele sale (grinzi, transversale, grinzi de capăt, roți deplasare) sunt tratate și analizate separat, ceea ce duce la emiterea unor concluzii incomplete, uneori chiar eronate referitor la exploatarea de mai departe a macaralei respective.

În cazul ”metodelor clasice” de examinare a componentelor macaralei sunt necesare un șir de instrumente și echipamente de măsurat, ce implică competențe tehnice speciale, uneori din diferite domenii, ca exemplu în cazul măsurărilor de aliniere în geodezie sau control nedistructiv în utilizarea echipamentului specializat ș.a. Metoda 3D SCAN permite înglobarea anumitor măsurări astfel micșorând durata de preluare a datelor și simplificând procesul de examinare, fără a pierde din precizia și veridicitate datelor, sau chiar în unele cazuri depășind volumul informației obținute față de ”metoda clasică”.

Metoda 3D SCAN, cuprinde: control vizual, măsurări de aliniere cale de rulare, construcției de suport macara, uzuri și deformări a roților, grinzilor, care ar alcătui aproximativ 65% din volumul măsurărilor în cadrul examinării macaralei și componentelor sale, Fig. 1.



Fig. 1. Volumul examinării componentelor de macara

Procesul include în sine patru etape de bază descrise în Fig. 2. Prima etapă reprezintă studiul proiectului sau modelului grafic al macaralei, în cazul lipsei acestora măsurările și concluziile nu vor influența semnificativ rezultatele, dar informația finală obținută nu va fi una reprezentativă. A doua etapă este procesul de scanare și citire date. Etapa trei include procesul de suprapunere a datelor inițiale cu cele preluate și comparația lor, analiza valorilor obținute în raport cu cele admisibile și gradul de evoluție a acestora. Etapa a patra, finală, a procesului de examinare este procesul de creare/generare a raportului care conține concluzii aferente referitoare la starea tehnică a macaralei și a componentelor, precum și recomandările privind înlăturarea deficiențelor tehnice depistate.

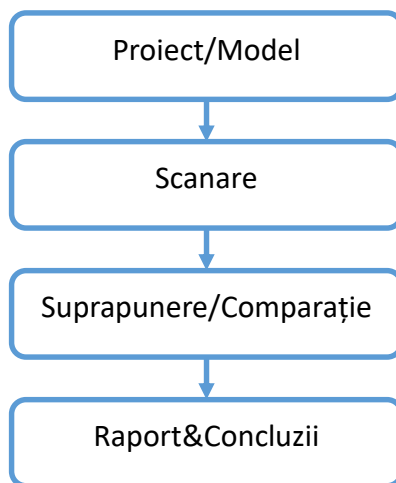


Fig. 2. Etapele procesului de examinare 3D SCAN

Resursele de baza utilizate pentru realizarea procesului de examinare 3D SCAN sunt enumerate în Fig. 3, care includ: echipamentul de scanare, și anume echipament SHINING 3D FreeScan trak Pro2, care permite efectuarea procesului de scanare fără aplicarea de marchere. A doua resursă este softul de FreeScan Trak, prin intermediul căruia se execută procesul de suprapunere a datelor inițiale cu cele preluate prin intermediul echipamentului de scanare. A treia resursă, de bază, este un softul Geomagic Control X, prin intermediul căruia se execută procesul de analiză a datelor. Datele obținute sunt documentate într-un raport care conține concluziile/recomandările aferente.

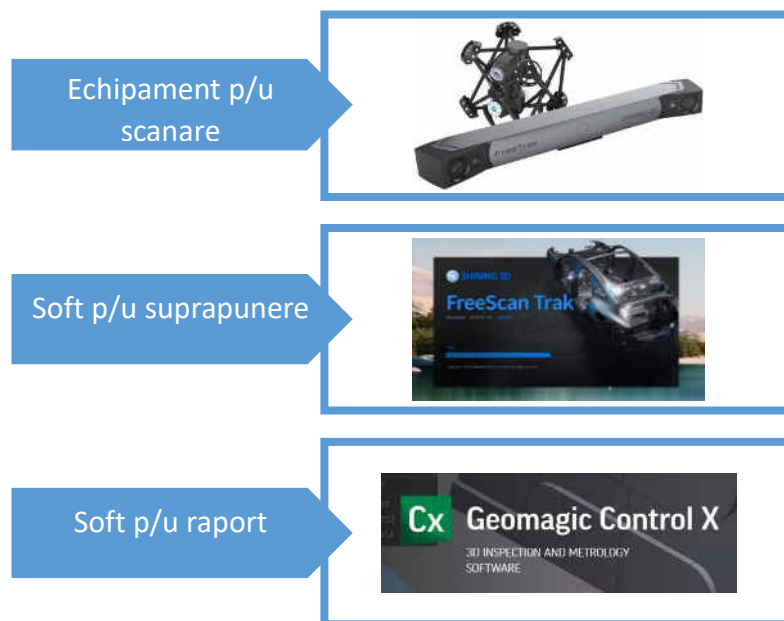


Fig. 3. Resursele de bază pentru 3D SCAN

Caracteristicile de bază a echipamentului prezentat (cu densitatea punctelor de măsurare 0,005-10mm și erorile măsurărilor 0,03 mm), ca model de utilizare, satisface pe deplin cerințele normelor de măsurare impuse în cadrul examinării macaralelor. Formatele fișierelor sunt compatibile cu softurile de proiectare 3D și printare 3D.

Vizualizarea interfețelor softurilor de preluare și prelucrare a datelor 3D SCAN sunt reprezentare în Fig. 4.

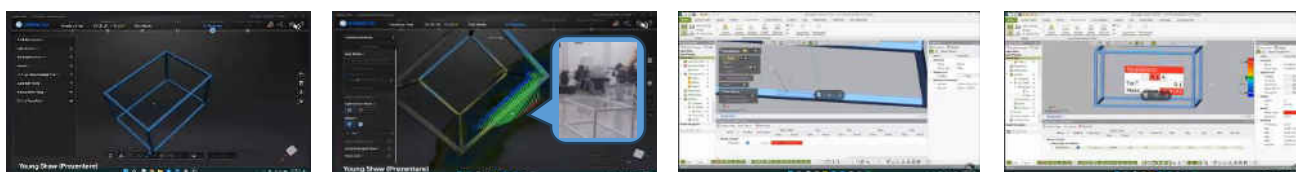


Fig. 4. Interfețele softurilor de preluare și prelucrare a datelor 3D SCAN

Concluzie

Studiul efectuat, arată că prin metoda 3D SCAN se pot efectua măsurări în cadrul examinării macaralei cu o precizie înaltă, se obține un volum mai mare de date și o informație mult mai complexă asupra obiectului studiat. Totodată, aceasta metodă poate substitui anumite măsurări, ce pot fi efectuate prin alte metode clasice. Iar rapoartele generate, au o formă de prezentare mai intuitivă și ușor de analizat, ceea ce duce la emiterea unor concluzii și recomandări reale, care vor facilita și spori exploatarea în siguranță macaralelor.

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MORE THAN JUST VIRAL VIDEOS: THE ENGINEERING LEGACY OF BOSTON DYNAMICS AND THEIR IMPACT ON MANUFACTURING

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Abstract: *Get ready to embark on an extraordinary voyage into the captivating world of Boston Dynamics, where the boundaries of robotics are continually pushed to new frontiers, reshaping the very fabric of the manufacturing industry! From the graceful movements of Spot to the remarkable agility of Atlas, these machines epitomize the pinnacle of technological achievement. Gone are the days when they were confined to the realms of science fiction; today, they're indispensable assets on factory floors, optimizing processes, enhancing security measures, and ensuring unparalleled quality control. Yet, amid the excitement of their capabilities, we must also confront the inherent challenges of integrating these robots into existing workflows. Ethical quandaries, workforce dynamics, and societal implications loom large as we navigate this uncharted terrain. Nevertheless, amidst these complexities, Boston Dynamics offers a bold and visionary outlook for the future of manufacturing, one that promises to revolutionize the industry as we know it. So, prepare yourself for an immersive journey into innovation and possibility, where every turn reveals a new dimension of what's achievable when human creativity meets cutting-edge technology!*

Key Words: *Automation, efficiency, future, manufacturing, robots.*

Introduction

Imagine a factory floor where robots, like Spot, elegantly navigate obstacles and perform tasks. Boston Dynamics pioneers advanced robotics, shaping reality. Gone are old, pre-programmed robots; Boston Dynamics' designs learn, adapt, and push boundaries. Spot, with its agile legs, opens doors, scales stairs, and explores tight spaces. Atlas, a humanoid, executes backflips, moves objects, and handles tools. Boston Dynamics redefines manufacturing. Their robots, production partners, boost productivity, security, and quality. They work alongside humans, enhancing workplace safety and efficiency. Picture an orchestrated ensemble; each robot serves a distinct function, collaborating with humans to ensure a harmonious production process. This manufacturing evolution promises better products and a more gratifying work environment. Remember, a robot isn't merely a machine; it symbolizes a future where humans and robots unite to create something extraordinary.

Boston Dynamics: An Arsenal of Robots Reshaping Manufacturing, A Symphony of Efficiency and Quality

In manufacturing, a blend of human ingenuity and robotic precision, sculpted by Boston Dynamics' advancements, transforms processes. Spot, a nimble four-legged robot, navigates tight spaces, ensuring precise equipment inspections. Atlas, a versatile humanoid, handles assembly, freeing humans for complex tasks. Stretch, a modular robot arm, adapts to various tasks, from palletizing to delicate packing. These robots redefine productivity and safety, reshaping manufacturing. Boston Dynamics' robots address safety concerns in hazardous environments. Spot's agility enables data collection in tight spaces, reducing risks. Integrated sensors ensure high-quality products. Challenges like job displacement and workflow integration require ethical

consideration. Yet, guided by Boston Dynamics' innovation, manufacturing evolves. The collaboration between humans and robots promises limitless manufacturing excellence.

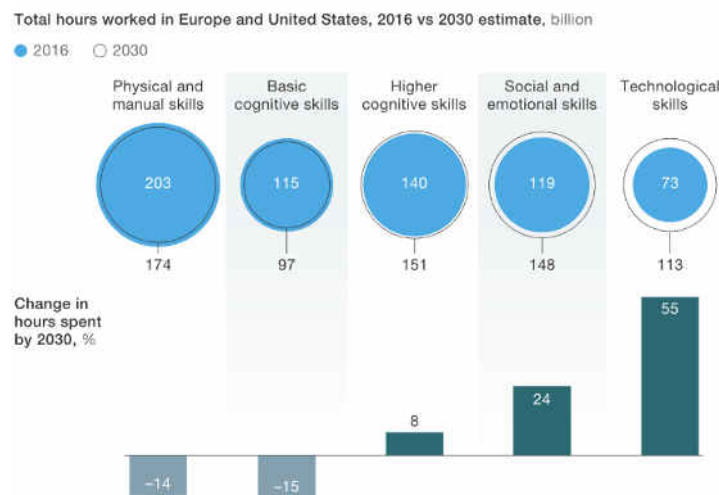
Boston Dynamics' robots revolutionize manufacturing processes, boosting productivity and quality:

- **Enhanced Efficiency:** Robots handle monotonous tasks like welding, packing, and palletizing, freeing humans for strategic roles. They operate 24/7, maximizing uptime and meeting tight deadlines without fatigue. Programmed for precision, they ensure consistent product quality on assembly lines.
- **Elevated Quality Standards:** Equipped with advanced sensors, robots detect defects with superhuman accuracy, safeguarding product quality. They conduct predictive maintenance, avoiding costly breakdowns and ensuring smooth operations. Robots collect vast production data, enabling informed decisions for continuous improvement.
- **Challenges and Considerations:** Integrating robots into existing infrastructure requires careful planning and adaptation. Ethical considerations of robot integration must be addressed.

Paving the path: Challenges and Future Prospects of Boston Dynamics in Manufacturing

While Boston Dynamics' robotic marvels paint a compelling picture of a revolutionized manufacturing landscape, integrating these machines presents a complex crossroads. Challenges may come around every corner, demanding careful consideration and proactive solutions. Let's delve into the heart of these intricacies:

- **The Adaptation Dilemma:** Transforming existing factories into robot-friendly havens is no small feat. Adapting infrastructure to accommodate these technological giants requires significant financial investments and can disrupt production schedules, potentially inflicting temporary pain for long-term gain. Moreover, the lack of standardized interfaces and communication protocols between robots and existing systems throws a wrench into the integration process, further complicating the matter.
- **Automation's Double-Edged Sword, Job Displacement and Reskilling:** The specter of robots snatching jobs from human hands is a legitimate concern. Automation can undoubtedly displace some workers, sparking anxieties and fueling social unrest. To navigate this delicate terrain, proactive reskilling and upskilling programs become indispensable. Equipping the workforce with the skills needed to thrive in a robot-augmented future is crucial, ensuring a smooth transition from displacement to adaptation. Next will be presented a graph created by McKinsey Global Institute analysis illustrating the needed shift in time for developing the new skills:



- **Ethical Crossroads, Data Privacy and Algorithmic Bias:** As robots grow in number, the data they generate becomes a treasure trove. However, this data also poses ethical concerns. Ensuring its secure collection, storage, and use is paramount to protect worker privacy and prevent misuse. Furthermore, the algorithms powering robots must be meticulously scrutinized and guarded against potential biases. Unchecked algorithmic biases can lead to discriminatory practices, exacerbating existing inequalities within the workforce.
- **Embracing the Inevitable, A Future Shaped by Learning and Adaptation:** As AI and machine learning continue their relentless march forward, robots will become increasingly sophisticated. They will learn, adapt, and evolve, pushing the boundaries of what's possible. To stay ahead of the curve, both manufacturers and workers need to embrace a culture of continuous learning and adaptation. Upskilling and reskilling need to become ingrained in the fabric of the workplace, ensuring a future where humans and robots dance in perfect harmony.

By tackling these challenges head-on and shaping a future where humans and robots collaborate, Boston Dynamics can usher in a new era of manufacturing – one where efficiency and productivity flourish alongside ethical considerations and human well-being. The crossroads may seem daunting, but by embracing the inevitable and navigating it with wisdom and foresight, the future of manufacturing holds immense promise, powered by the transformative potential of robots like those from Boston Dynamics.

From Imagination to Reality: Engineering and Fabrication with Boston Dynamics Robots

As previously discussed, Boston Dynamics' robots have significant real-world impact in factories, potentially altering human work dynamics. These machines, with their futuristic designs and precise movements, defy science fiction stereotypes, already revolutionizing multiple industries with their efficiency and accuracy.

- **Spot (Image [1]):** The Inspection and Data Acquisition Ace:

Spot is a versatile quadruped robot equipped with sensors and three motors in each leg, enabling it to traverse various terrains indoors and outdoors while maintaining balance and executing different postures. It can be operated remotely or autonomously, customized for specific tasks with a variety of sensors and payloads. In construction, Spot can scale scaffolding and inspect welds with data-gathering cameras, while in oil and gas industries, it navigates hazardous areas to collect pipeline data. In mining, Spot maps tunnels, identifies hazards, and provides real-time ore data. Its main body consists of four legs, housing cameras and computers, each leg featuring ball joints at the hip and hinged knees. Additional features include payload mounting rails, payload ports, stereo cameras, and LED strips for status indication

- **Atlas (Image [2]):** The Dexterous Master of Manipulation:

Atlas, the world's most agile humanoid robot, serves as a research platform enabling us to explore the boundaries of full-body movement and two-handed manipulation. Equipped with cutting-edge hardware and an advanced control system, this robot possesses the strength and stability to showcase advanced feats of athleticism and nimbleness. Now that we're talking about sports and agility, I suppose it's time to address the first part of the article's title - "more than just viral videos". Nonetheless, Atlas was featured in a YouTube video from roughly two years ago, dancing to the song "Do You Love Me" by The Contours alongside other robots like Spot and Handle. Even though it seems strange to hear, watching them dance with real grace is something else entirely, which is why it obviously sparked some discussion online.

Atlas, equipped with 28 hydraulic actuators, is optimized for rough terrain walking, ladder climbing, and precise manipulation. Quintic splines dictate high-level motions like foot trajectories, leveraging designated footstep locations. Its versatility extends to assembly lines, where it excels in complex tasks with human-like finesse. In warehousing and logistics, Atlas

automates repetitive tasks, optimizing coordination and productivity. In aerospace and automotive industries, Atlas aids in intricate assembly, ensuring precision and consistency.

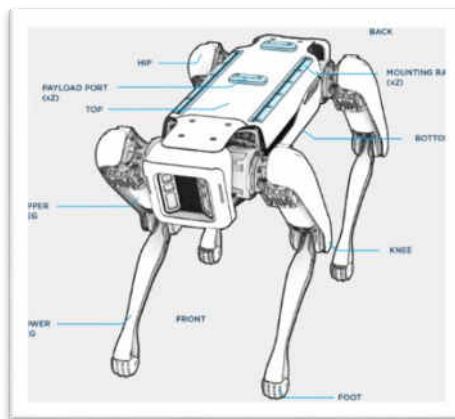
- **Stretch (Image [3]):** The Modular Maestro of Material Handling:

Stretch continuously maintains the flow of goods and gives warehouse operations consistency. Stretch's ability to process hundreds of cases per hour ensures that daily goals are met even in the face of increasing order fulfillment demands. Stretch is a multipurpose mobile robot that can carry out a range of material handling duties, including unloading trucks and containers. Its lack of tethering and pallet-sized footprint make it easy to integrate into the existing warehouse system. Manufacturing: Stretch's modular design allows for customization, enabling it to tackle diverse tasks like lifting heavy objects, moving materials through production lines, or even packaging finished products. Distribution Centers: In high-volume environments, Stretch can automate loading and unloading tasks, optimizing the flow of goods and minimizing manual labor. Waste Management: Imagine robots like Stretch sorting and handling waste efficiently, contributing to a cleaner and more sustainable future.

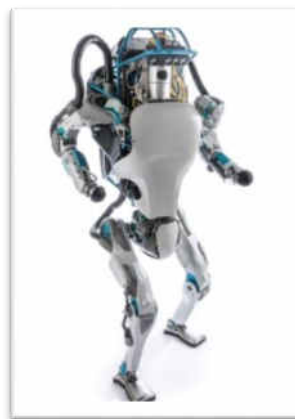
- **Handle (Image [4]):** The Wheeled Workforce Revolutionizing Logistics:

Though Spot and Atlas command attention for their agility, Handle, the one-legged centaur from Boston Dynamics, quietly transforms logistics. Envision a warehouse where robots can move heavy boxes, reach high shelves, and maneuver through tight spaces with ease – that's Handle's world. Agility Meets Power: Nimble climbs stairs and navigates uneven terrain on a single wheel. Extends its arm over 6 feet to reach high shelves and palletize with precision. Lifts to 33 lbs. (15kg), tackling heavy boxes and packages. Uses advanced vision to identify and sort boxes, streamlining workflows. Transforming Logistics: Automates palletizing and depalletizing, saving time and labor. Sorts and distributes boxes with accuracy, minimizing errors. Manages inventory in real-time, preventing stockouts.

These are just a few glimpses into the diverse engineering and fabrication capabilities of Boston Dynamics' robots. As technology evolves and these machines become even more sophisticated, the possibilities for real-world applications are virtually limitless.



Spot [1]



Atlas [2]



Stretch [3]



Handle [4]

Conclusions

Boston Dynamics, once the stuff of fiction, now offers game-changing robots like Spot for agile inspections, Atlas for precision assembly, Handle for warehouse efficiency, and Stretch for versatile tasks, redefining manufacturing. But it is not just about robots; it is about humans and machines working together. Imagine workplaces where humans focus on high-level tasks, construction sites with safe and efficient collaboration, and optimized warehouse logistics. Challenges exist in integrating robots, addressing job displacement, and navigating ethics, but these are opportunities for progress. Together, humans and robots can shape a future where technology empowers, not replaces. The journey has begun, join Boston Dynamics in crafting this future. Embrace the possibilities, let us build a better world, together.

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THE EMOTIONAL IMPACT OF GRAPHIC DESIGN

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Abstract. *This research paper explores the profound influence of graphic design elements on human emotions. Designers are creators who not only generate a new universe, but also must rule it by establishing laws for the harmonious function of its components. The foundational building blocks in "conceiving this world" are the elements of graphic design including point, line, shape, form, texture and color. The core purpose of every designer is to plot how to mix these aspects in a way they achieve consensus. If these elements are combined appropriately, designer's projects will engage with their audience, awakening emotions and creating memorable experiences. This paper delves into how these elements are utilized to stir specific feelings, highlighting the intricate relationship between design and human psychology. The data we used in the given paper relies on various studies conducted by psychologists and also on our personal research. The analysis of effects produced by elements of graphic design on consumers' feelings is important, because it can enhance user experience and feelings which can help businesses develop a loyal client base. Furthermore, it can provide insights on certain design decisions that can be used to create more effective and impactful works.*

Key words: *brand identity, design elements, perception, psychology*

Introduction

Through studies in graphic design, we've encountered multiple times what the profession entails, namely creating drawings, plans or patterns for goods that are going to be produced. Even though the explanations from textbooks provide a short, clear, comprehensive way to convey the essence of this domain, I believe the purpose of our craft can be expanded.

Every designer is foremost a creator who not only generates a new universe through their masterpieces, but also must ensure balance between the components for their realm to function. Like atoms, which are the basic units of matter, the elements of design signify the unique, fundamental constituents forming the visual representation of an idea. These primordial threads of design are combined in the right way by the masterful hands of creators in order to materialize their projects, forming visually pleasing and ingeniously simple results.

By meticulously incorporating these aspects into their designs, creators can attract attention and also interact with their audience by evoking specific emotions and associations, ultimately creating memorable experiences for them. In the sphere of marketing, elements of design can be a powerful tool, which can strategically create a brand association — a mental connection a customer makes between a trademark and an experience, person, concept, interest or activity. Brand association is crucial, because it guides the customer's perception towards a company and its products.

The point

A point is a trace left with just one touch in space, representing the simplest pictorial element.

In painting, the point creates the impression of space and conveys volume. For example, large points painted with warm tones generate the illusion of proximity, while small dots brushed on with cool tones produce the illusion of distance [1]. In neoimpressionist paintings, George

Searut and Paul Signac used pointilism, a technique that includes formation of patterns by applying distinct dots of color to form an image.

In the domain of graphic design, the point aids in creating the main focus of the image. A couple of small dots can make a difficult complex structured and understandable. Readers recognize points as a shortcut to high-priority information [2]. A reference point can help build, orient, align, and drive geometry in a conceptual design, which can influence how consumers perceive the product. They can create a sense of consistency and order, which strengthens the trust of customers, expressing professionalism and reliability. A layout with clear reference points can create a feeling of attention to detail and thus instills trust in shoppers.

The line

Paul Klee, a German and Swiss graphic artist, mentioned that the line is a point gone out for a walk, so we can say that the line is a continuous feature on a flat surface [1].

Lines in design can awaken different emotions through their direction, thickness, length and interactions with other elements. Horizontal lines convey tranquility and lack of movement, while vertical lines communicate greatness. When two of them are combined, they transmit stability by creating a right angle. Unlike the other two mentioned, diagonal lines are dynamic, giving a sense of direction to the viewer [3]. For example, in the Nike logo, the convex line expresses movement, speed and energy, while its simplicity stirs a sensation of agility and grace. Longer lines prompt durability and shorter lines create a feeling of urgency. Thick lines are more dominant and prominent, while thinner ones are more subtle. Also, intersecting or overlapping lines elicit a feeling of conflict, whereas those arranged in a repetitive pattern incite harmony.

The shape

Through shape we understand the exterior aspect of an object limited by a contour in a two-dimensional space. Shapes can be classified into three groups: organic shapes, which are found in nature; geometric shapes, which are consistent and easily measurable; abstract shapes that are distorted or simplified versions of the previous two types [4].

Organic shapes create associations with nature, life and growth [4]. Leaves, a common organic shape, are often seen in logos for organizations promoting ecological awareness and sustainability, for instance, The Nature Conservancy. Also, leaves can be noticed in businesses related with health and wellness, used in designs regarding herbal medicine.

Geometric shapes are associated with order, stability, symmetry and are used to create structure and harmony. Shapes with angles can invoke the sense of authority, reliability, especially rectangles and squares. The triangles suggest energy, movement and action, when diamond shapes are usually used in high-luxury brand logos to convey sophistication. The most flexible shape in design is the circle, which can portray unity, infinity, completeness [4].

Abstract shapes are representations of real things without repeating their exact form. They are favorable in illustrating ideas hardly expressed through realistic depictions and also in simplifying intricate forms in order to make them more understandable for the customers. Typical abstract shapes are alphabet glyphs, which are specific forms of characters or symbols that form the written language [4]. Depending on the design, glyphs can evoke certain emotions. For example, glyphs with bold lines and symmetrical shapes can convey seriousness and importance, while characters with curvy shapes can evoke a playful mood.

The form

Form is the spatial representation of two-dimensional shapes, which basically means that a third dimension is added to the given shape. For example, a 2D shape like a square can be extended in a third dimension, obtaining a 3D form like a cube, pyramid, prism etc. In graphic design, adding a third dimension is usually an illusion, because the work is still done in a bidimensional space [5]. A compelling deception of form can be created by thoughtfully

combining techniques, like adding light and shadow, highlight and reflection, gradient and blending etc.

Form is essential in graphic design, adding visual dimension and volume. It is engaging to the eye, because it makes objects appear more realistic for the viewers, creates a sense of depth, establishes the main focus of the design, thus helps convey a message and evokes emotions. Form adds a 3D quality that generates tactile sensations, such as hard or soft, hot or cold, pointy or round. There are two main types of forms: geometrical and natural. Geometrical forms appear more man-made and produce feelings of control and order, while natural ones occur in nature, producing a feeling of calmness and harmony [6].

The texture

In design, texture refers to the surface quality of a work of art. In order to mimic the texture of materials, graphics are layered upon each other, therefore creating a visual illusion [7]. That way, there are two main types of textures used in the field: actual and implied.

Actual textures contain tactile properties created by material and are useful in designing business cards, flyers, brochures or invitations [7]. Implied textures are generated by layering graphics on shapes so they bring a feeling of texture. The last ones are usually used in print and digital design, where physical touch is not possible [7]. Both kinds of texture add a distinct visual tone to a piece of graphic design, thus stimulating the brain to remember the tactile and visual sensations, respectively, creates a brand association

The color

Color is defined in the Oxford dictionary as "the appearance that things have that results from the way in which they reflect the light". Since most sensory stimuli come from our visual system, color is a key component that defines graphic design.

Warm colors, such as red, orange, yellow usually convey energy, happiness, optimism, anger. For example, Red Bull and Ferrari use red in their designs to attract attention and express energy and excitement. Orange creates a sense of friendliness and joy and is used in the logos of Nickelodeon and Fanta [8]. Cool tones, like blue, green or purple, evoke calmness, relaxation, being associated with the sky, water and snow. Facebook, Samsung and Intel chose blue to represent their brands due to its strong connection with reliability and professionalism [8]. Green is closely linked with nature, leading environmental organizations like Greenpeace to use it in their designs. Although achromatic colors, white and black, are less spectacular, they are heavily used in minimalistic and timeless designs, creating a sense of clarity and sophistication.

Survey

We conducted two surveys among students at our university about primary colors and shapes and what emotions students associate with them.

1. What emotions do the colors blue, red, and yellow evoke in you?
2. What do you associate with such shapes as triangles, squares, and circles?

Results and discussions

After our surveys, the results were as follows:

Red color:

- 48.9% of people associate the red color with "anger, fear, or danger"
- 40% with a sense of love and passion
- 11.1% of people understand red color like the sense of life energy

Blue color:

- 57.8% of people associate the color blue with "calmness"
- 33.3% with "sadness or boredom"
- 8.9% with "severity or seriousness"

Yellow color:

- 73.3% of people associate the color yellow with "happiness and positivity"
- 17.8% with a "sense of energy and movement"
- 8.9% with "anxiety or disgust"

Most common answers were:

Triangle

- Power, sharpness, energy

Square

- Stability, balance, security

Circle

- Unity, perfection, harmony.

Even though the answers vary, we can still trace how people developed certain associations with different colors and shapes. This once again proves the strong emotional influence of design elements on a person.

Conclusions

In conclusion, design elements play a significant role in graphic design, which works closely with marketing and people's perception of said design. It is important, as a designer, to follow along with the brand identity when working with a customer and take into consideration the main points that shall make the finished product successful.

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DE LA PROTOTIP LA PRODUS: PERSPECTIVE ȘI PROVOCĂRI ÎN ERA IMPRIMĂRII 3D

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Rezumat. *Fabricarea aditivă, cunoscută și sub denumirea de imprimare 3D, a devenit o tehnologie inovatoare cu un potențial vast în diferite domenii, de la inginerie și medicină până la design și arhitectură. Acest articol explorează progresele recente în domeniul fabricării aditive, concentrându-se pe procesele, materialele și aplicațiile care se află în proces de dezvoltare. De la imprimarea de prototipuri și componente personalizate până la fabricarea de organisme biologice și structuri complexe, tehnologia 3D oferă o gamă variată de oportunități și provocări. Vom analiza avantajele și impedimentele actuale ale acestei tehnologii, precum și perspectivele sale viitoare, inclusiv potențialul de a revoluționa producția industrială și de a crea soluții inovatoare pentru problemele globale. Prin explorarea acestor aspecte, articolul își propune să furnizeze o perspectivă amplă și detaliată asupra rolului și impactului fabricării aditive în societatea contemporană, evidențiind necesitatea unor reglementări și practici sustenabile pentru a optimiza beneficiile și pentru a reduce potențialele riscuri și consecințe nefavorabile. Adicional, accentuăm importanța continuă a cercetării și colaborării interdisciplinare întru avansarea și integrarea acestei tehnologii în diverse sectoare ale economiei și societății.*

Cuvinte cheie: *Fabricare aditivă, imprimare 3D, inovație, producție industrială.*

Introducere

În era tehnologiilor moderne, procesul de dezvoltare a produselor a suferit transformări semnificative datorită noilor tehnologii avansate care se află în continuă dezvoltare. Printre cele mai revoluționare instrumente se numără fabricarea aditivă, sau imprimarea 3D, care, odată cu scăderea prețurilor unei imprimante 3D, în jur de 300\$, a deschis noi posibilități în prototipare și producție, impunându-se ca puntea dintre concept imaginar și realitate. Articolul dat explorează procesul de transformare a unui prototip în produs final, evidențiind esențialul rol și impact al imprimării 3D. Această tehnologie multifuncțională și capabilă să modeleze o gamă variată de materiale aduce flexibilitate și agilitate în procesul de dezvoltare a producției și a altor domenii ingineresti. În pofida avantajelor, apar și unele provocări, precum: calitatea materialului, complexitatea designului, finisarea și post-procesarea obiectelor printate.

Imprimarea 3D în prototipare și producție

În ultimii ani, imprimarea 3D a devenit un instrument vital în procesul de dezvoltare a modelelor preliminare și producție în diverse industrii. Această tehnologie oferă o gamă largă de avantaje, inclusiv flexibilitatea în design, reducerea timpului de dezvoltare și costurile de producție. Unul dintre principalele beneficii ale imprimării 3D este capacitatea de a realiza rapid prototipuri funcționale și modele de testare fără a fi necesare scule sau matrice costisitoare. Acest lucru permite inginerilor și designerilor să lucreze cu ușurință și rapid asupra designului și să identifice eventualele probleme sau îmbunătățiri necesare înainte de procesul de imprimare. Mai mult decât atât, imprimarea 3D oferă șansa de a personaliza și adapta rapid produsele la nevoile individuale ale clienților sau la cerințele specifice ale diferitelor aplicații. Această flexibilitate este crucială în industrii precum medicina, unde prototipurile personalizate pot fi utilizate pentru a crea dispozitive medicale adaptate la anatomia unui pacient în mod unic sau în industria aeronautică, unde piese complexe pot fi produse cu geometrii optimizate pentru greutate și performanță.

Materialele utilizate în imprimarea 3D sunt diferite și adaptate la diferite necesități. Printre acestea se numără metale precum pulbere de oțel, titan, aluminiu și aliaje de nichel, care sunt folosite în industria aerospațială, automotivă și în alte aplicații unde rezistența și durabilitatea sunt aspecte esențiale. De asemenea, există și rășini speciale utilizate în imprimarea 3D, care oferă o gamă largă de proprietăți, inclusiv transparență, flexibilitate și rezistență la temperaturi ridicate. Rășinile sunt adesea folosite în industria medicală și în prototiparea rapidă a pieselor din diferite domenii ingineresti. Totuși, plasticul rămâne unul dintre cele mai populare materiale în fabricarea aditivă datorită disponibilității sale, costului redus și versatilității. Printre cele mai comune tipuri de plastic folosite se numără PLA (acid polilactic), PC (polycarbonat), ABS (acrilonitril butadien stiren) și altele. Aceste materiale sunt folosite în diverse domenii precum industria de consum, producția componentelor electronice și prototiparea rapidă. În plus, imprimarea 3D oferă posibilitatea utilizării unor materiale inovatoare, cum ar fi cimentul, în construcții, pentru a realiza structuri complexe și detalii arhitecturale. Cu toate acestea, este important de evidențiat faptul că fiecare material are propriile sale caracteristici și limite, iar selecția materialului potrivit este esențială pentru obținerea rezultatelor dorite în procesul de prototipare și producție utilizând imprimarea 3D.

Acest proces tehnologic poate avea loc datorită unor tehnici variate și metode care permit transformarea datelor digitale în obiecte fizice tridimensionale reale. Fiecare metodă de imprimare 3D are propriile sale caracteristici, avantaje și limite, iar selecția metodei potrivite depinde de cerințele specifice ale aplicației și de caracteristicile obiectului imprimat.

- FDM (Modelare prin Extrudare Termoplăstică) (fig. [1]): Această metodă implică extrudarea unui material termoplăstic, cum ar fi PLA sau ABS, printr-un cap de imprimare încălzit care se deplasează într-un model specific. Materialul se solidifică apoi pentru a forma obiectul imprimat.
- DLP (Expunerea Digitală a Luminii) (fig. [2]): Această metodă implică expunerea unui strat subțire de rășină fotosensibilă la un proiector digital care proiectează imaginea stratului de rășină într-un mod precis. Rășina se întărește apoi sub acțiunea luminii ultraviolete.
- LOM (Fabricarea Stratificată prin Laminare) (fig. [3]): Această metodă implică aplicarea și tăierea repetată a straturilor de material, cum ar fi hârtia sau plasticul, pentru a construi obiectul strat cu strat. Fiecare strat este lipit cu ajutorul unui adeziv și apoi tăiat conform conturului obiectului.
- 3DP (Printare Inkjet Tridimensională) (fig. [4]): Această metodă implică aplicarea strat cu strat a unui agent legător pe un strat de pulbere subțire, folosind un cap de imprimare inkjet. Agentul legător unește particulele de pulbere pentru a forma obiectul imprimat.
- SLA (Stereolitografie) (fig. [5]): Această metodă folosește un laser ultraviolet pentru a solidifica rășina fotosensibilă strat cu strat, formând obiectul imprimat.
- SLM (Sintetizarea Laser a Metalelor) (fig. [6]): Această metodă utilizează un laser puternic pentru a topi și a solidifica pulberile metalice, creând obiecte metalice solide.



fig. [1]



fig. [2]

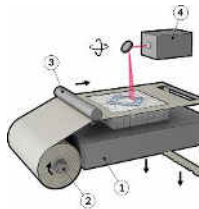


fig. [3]

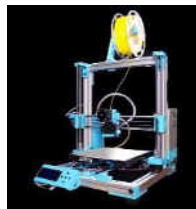


fig. [4]

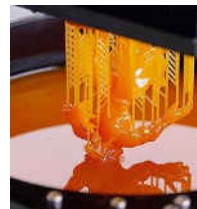


fig. [5]



fig. [6]

Perspective viitoare și impactul imprimării 3D

Imprimarea 3D (fabricare aditivă) a depășit deja stadiul de prototipare tradițională, devenind o forță transformatoare în diverse domenii. Pe măsură ce tehnologia continuă să evolueze, mai ales în aria imprimării cu pulbere metalică, cu cât prețurile continuă să scadă, ne putem aștepta la un impact și mai profund, cu beneficii semnificative pentru fabricație.

1. **Flexibilitate:** În contrast cu fabricarea tradițională, care necesită oameni să proiecteze manual piese, imprimarea 3D oferă o flexibilitate nemaiîntâlnită în producție. Proiectarea asistată de calculator înlocuiește procesul manual, permițând crearea de obiecte personalizate și complexe cu o precizie uimitoare. Acest lucru va permite companiilor să satisfacă nevoile specifice ale clienților și să se adapteze rapid la tendințele pieței.
2. **Varietate:** În timp ce fabricarea tradițională are limite în ceea ce privește materialele și procesele, imprimarea 3D poate fi utilizată cu o gamă largă de materiale, de la plastic și metale la materiale biocompatibile și chiar alimente. Această varietate va deschide noi oportunități pentru inovație și va duce la crearea de produse noi și inedite.
3. **Detectare și remediere din timp:** Factorul uman în fabricarea tradițională aduce adesea cu sine un timp îndelungat de prototipare, precizie joasă și prețuri mari. În contrast, imprimarea 3D permite o mai bună detectare și remediere a defectelor în faza de prototipare. Acest lucru va reduce semnificativ costurile și timpul de producție, ducând la produse de calitate superioară.
4. **Modificare fără pregătire suplimentară:** Procesul manual de prototipare în fabricarea tradițională necesită pregătire suplimentară costisitoare pentru a efectua modificări. În schimb, imprimarea 3D permite modificarea rapidă și ușoară a designului produsului. Acest lucru va accelera ciclul de dezvoltare a produsului și va permite companiilor să lanseze rapid noi produse pe piață.
5. **Testare în faza de prototip:** Imprimarea 3D permite testarea funcționalității produsului în faza de prototipare, eliminând necesitatea de a trece la teste costisitoare și laborioase în faza de producție. Acest lucru va duce la produse mai fiabile și mai performante.

Toate aceste diferențe între fabricarea tradițională și cea aditivă, pot fi vizualizate în fig. [7]. Pe lângă o comoditate, precizie și eficiență ridicată a tehnologiei 3D, aceasta mai este întâlnită și în: industria alimentară (fig. [8]), unde este folosită pentru ornamentarea și crearea unor alimente personalizate; medicină (fig. [9]), prima inimă imprimată din celule umane ce imită cu exactitate anatomia celulară al uneia reale), utilizată pentru printarea organelor și a țesuturilor umane, contribuind la dezvoltarea medicinei personalizate și la îmbunătățirea procedurilor chirurgicale; construcții (fig. [10]), casele printate din ciment devin o soluție rapidă și economică pentru locuințe durabile și eficiente energetic.

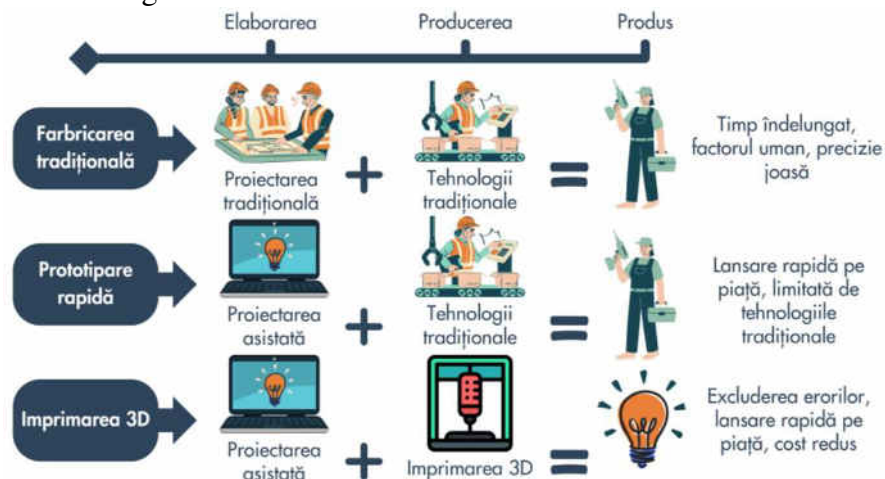


fig. [7] Diferențele în fabricația tradițională și aditivă



fig. [8]



fig. [9]



fig. [10]

Provocările imprimării 3D

Provocările imprimării 3D sunt diverse, unele majore fiind complexitatea modelului, dimensiunile obiectelor și finisarea acestora. Complexitatea modelului poate aduce dificultăți în procesul de printare, deoarece detaliile prea mari pentru imprimarea pe o singură bucată, necesitând împărțirea lor în mai multe părți sau folosirea unor imprimante speciale ducând la piese finale inexacte sau cu defecte, afectând calitatea și funcționalitatea acestora, pe când detaliile mici sunt pierdute datorită rezoluției de printare care este limitată de capul extrudor și filament.

Finisarea și post-procesarea obiectelor printate sunt, de asemenea, aspecte importante ce pot ridica provocări. Piesele imprimate pot prezenta imperfecțiuni, fie din cauza rezoluției prea mari sau chiar al unei erori în executarea sau tăierea modelului în software. Eliminarea acestora necesită lucrări suplimentare de finisare, cum ar fi șlefuirea sau aplicarea de straturi suplimentare de material care în număr mare poate fi considerat ca o risipă de timp și resurse, fie ele umane sau robotizate.

Pentru a înlătura aceste defecte, este esențială dezvoltarea continuă a tehnologiilor de imprimare, îmbunătățind precizia și calitatea procesului. Inovarea în materialele utilizate poate aduce rezistență și flexibilitate necesare pentru a micșora diametrul capului extrudor și, ca și urmare, mărirea rezoluției la imprimare. Metode avansate de design pot optimiza detaliile și dimensiunile obiectelor direct în software-ul de tăiere pe straturi al piesei. Post-procesarea și finisarea obiectelor sunt cruciale pentru eliminarea imperfecțiunilor însă odată cu dezvoltarea unor filamente cu proprietăți mai favorabile imprimării detaliilor mici, toate straturile devin mai fine și este posibilă înlăturarea totală a acestui pas. Astfel, un efort combinat de inovație tehnologică, cercetare în materiale și design avansat, posibil și condus de către o inteligență artificială ce înțelege procesul, poate contribui la îmbunătățirea rezultatelor în prototiparea rapidă.

Concluzii

Este evident că tehnologia imprimării 3D a devenit o comoditate ce este greu de ignorat în aria prototipărilor unor produse finale. Cu avantajele sale remarcabile în accelerarea ciclului de design și producție, imprimarea 3D a deschis noi perspective în diverse industrii, de la medicină și inginerie la design industrial și industria aerospațială precum și în ingineria civilă cu printarea rapidă al unor case de locuit de preț redus însă la fel de utilizabile. Cu toate acestea, este important să recunoaștem și provocările ce vin cu aceasta, precum asigurarea calității și rezistenței materialelor, precizia procesului și scalabilitatea producției. Pe măsură ce tehnologia continuă să evolueze, perspectivele pentru imprimarea 3D sunt promițătoare, iar impactul său în industria de producție va fi din ce în ce mai căutată și apreciată. De la personalizarea produselor la reducerea deșeurilor și creșterea eficienței, imprimarea 3D revoluționează modul în care produsele sunt concepute, fabricate și folosite de industrii cât și persoane fizice (fig. [7]). Cu toate acestea, pentru a atinge întregul său potențial, este încă necesar să continuăm să adresăm punctele sale mai slabe, mai ales reducerea dimensiunii de printare, cu alte cuvinte creșterea rezoluției acesteia pentru a înlătura probleme întâlnite la modelele complexe precum și necesitatea de a retușa prototipul după printare, și să investim în cercetare și dezvoltare pentru a îmbunătăți tehnologiile și procesele asociate cu imprimarea 3D. Medicina ar fi un sector ce ar beneficia enorm de o revoluție radicală în procesele de printare, având potențialul de a salva mii de vieți.

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ИССЛЕДОВАНИЕ ТЕХНОЛОГИЙ И МАШИН ДЛЯ ПОСАДКИ РАССАДЫ

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Реферат. В статье проведен анализ основных технологий и конструкций машин для посадки рассады и представлена классификация рассадопосадочных машин и их основные отличительные признаки. Проведен анализ существующих рассадопосадочных машин и выявлены основные их недостатки и отмечены преимущества, который позволяет определить наиболее перспективные для сельского хозяйства Республики Молдова конструкции рассадопосадочных машин и наиболее рациональные направления их совершенствования, а также дает возможность сформулировать предъявляемые к усовершенствованным конструкциям требования. Выполненная классификация рассадопосадочных машин по основным признакам функционирования наглядно представляет наиболее важные для рассмотрения аспекты конструкции рассадопосадочных машин. В работе выделены наиболее важные и перспективные конструктивные схемы для дальнейшего совершенствования и исследования рассадопосадочных машин карусельного типа, основными признаками функционирования которых являются: горизонтально-плоскостное движение рассады в распределительном механизме усовершенствованной конструкции посадочной машины, самостоятельное падение рассады через направляющую к заделывающим в почву органам машины.

Ключевые слова: анализ технологии, рассадопосадочные машины, рабочие органы.

Rezumat. În articol a fost efectuat un studiu al tehnologiilor și schemelor constructive de bază ale mașinilor de plantat răsaduri cu prezentarea clasificării lor și a principalelor caracteristici distinctive ale acestora. S-a efectuat o analiză a mașinilor de plantat răsaduri existente și au fost identificate principalele dezavantaje ale acestora și evidențiate avantajele. Studiul permite determinarea unei scheme constructive a mașinii de plantat răsaduri mai promițătoare pentru agricultură în Republica Moldova și cele mai raționale direcții de îmbunătățire a acestora și, de asemenea, care face posibilă formularea cerințelor impuse față de mașina de plantat perfecționată. Clasificarea realizată a mașinilor de plantat răsaduri în funcție de principalele caracteristici de funcționare prezintă în mod clar cele mai importante aspecte ale construcției mașinilor studiate. În lucrare au fost identificate schemele constructive esențiale și de perspectivă pentru perfecționarea și cercetarea ulterioară a mașinilor de plantat răsaduri de tip carusel, ale căror caracteristici principale sunt: mișcarea în plan orizontal a răsadurilor în mecanismul de distribuție a mașinii perfecționate de plantat și căderea independentă a răsadurilor prin tubul de conducere către organele de încorporare a răsadurilor în sol.

Cuvinte cheie: analiza tehnologiei, mașini de plantat răsaduri, organe de lucru.

Введение

Овощеводство является важной отраслью сельского хозяйства страны. Рассадный способ возделывания овощных культур является одним из наиболее эффективных агротехнических приемов для получения высоких урожаев в короткие сроки.

В условиях современных технологий выращивания овощей (механизация, автоматизация, высокая цифровизация) процессы овощеводства приобретают все более выраженный индустриальный характер. В результате внедрения в производство современных технологий выращивания рассады и использования более производительных рассадопосадочных машин можно улучшить ситуацию с созданием овощных плантаций. Рассадный способ возделывания овощных культур является одним из наиболее эффективных агротехнических приемов получения высоких урожаев в наиболее короткие сроки [1]. Одной из существующих проблем в технологии выращивания овощей является посадка рассады, которая на небольших площадях до сих пор выполняется вручную с использованием более дешевой рассады с голым корнем. Современные технологии предусматривают использование более качественного посадочного материала (рассады, саженцев), выращенного в кассетах [2]. Этот вид рассады более перспективен и имеет приживаемость в пределах 98-100%.

Выявление конструктивных особенностей посадочных машин различного назначения и их технический уровень, а также прогрессивные решения и возможность их использования в совершенствовании техники для посадки рассады является целью исследований. Обоснование параметров универсальной рассадопосадочной машины создаст возможность разработки новых универсальных комплексов и усовершенствует их применение, что приведет к уменьшению количества машин в технологической цепочке производства овощей и повысит качество работы и использования агрегатов [3].

Материалы и методы

Выявление потребностей в создании новых рассадопосадочных машин и их конструкций позволит выбрать верное перспективное направление. Для этого необходимо провести анализ и выявить классификацию по нескольким основным признакам функционирования рассадопосадочных машин [4].

Для обоснования параметров универсальной рассадопосадочной машины необходим анализ различных видов существующих машин для посадки рассады, для выполнения которого необходимо использование таких научных методов познания как индукция и дедукция, а после выявления преимуществ и недостатков рассмотренных конструкций при помощи сравнительного анализа предложить наиболее приемлемые направления совершенствования конструкций. Причем классификация машин для посадки рассады как метод упорядочения рассматриваемых конструкций дает возможность сгруппирования выявленных преимуществ и недостатков и их совершенствования [3, 5].

Результаты и обсуждения

С каждым годом возрастают объемы машинной посадки рассады овощных культур, клубне- и корнеплодов. Несмотря на многообразие посадочного материала, а также технологий и предъявляемых требований к качеству посадки и технико-экономическим показателям, посадочные машины имеют много общего, что является положительным в разработке универсальных посадочных устройств. Однако, их широкое применение сдерживается как несовершенством конструкций, так и низким качеством посадки. В настоящее время в Молдове используются рассадопосадочные машины широкого спектра производителей, а это означает, что существуют сложности с подготовкой и обслуживанием машин, и как следствие стоимость обслуживания повышается. Низкое качество работы существующих машин определяет большие затраты труда и денежных

средств, вследствие необходимости применения ручного труда при посадке и оправке неправильно высаженных растений.

При разработке универсальной рассадопосадочной машины предлагается учитывать более широкий спектр условий и требований, предъявленных к ней для успешного внедрения в производство (Таб. 1).

Таблица 1

Требования предъявленные к рассадопосадочным машинам	
Параметр	Влияние на рабочий процесс
Регулируемые параметры	
Глубина посадки	Возможность регулировки глубины посадки позволяет адаптировать машину к различным типам почвы и требованиям для оптимального укоренения рассады
Расстояние между растениями	Регулируемое расстояние между растениями дает возможность адаптировать посадку к конкретным требованиям культуры и условиям выращивания.
Многорядность	
Универсальность в использовании	Возможность проводить посадку нескольких рядов рассады одновременно увеличивает производительность и делает машину более универсальной для различных культур.
Экономия времени	Многорядная посадка позволяет существенно сократить время работы, особенно на больших полях
Автоматизация технологии управления	
Системы GPS и автоматизированный контроль	Интеграция современных технологий, таких как GPS и автоматизированные системы управления, повышает точность посадки и снижает вероятность ошибок.
Датчики для адаптации к условиям	Использование датчиков для сбора данных о почвенных и климатических условиях позволяет машине автоматически адаптироваться к окружающей среде
Эргономичность и обслуживание	
Простота обслуживания	Универсальная машина должна быть сконструирована так, чтобы обслуживание было простым и доступным
Удобство использования	Эргономичный дизайн и простой интерфейс обеспечивают удобство использования для оператора.
Гибкость и модульность	
Использование различных рабочих органов	Машина должна быть спроектирована с учетом возможности быстрой замены или настройки рабочих органов для посадки различных видов рассады и на разных почвах.
Модульность	Возможность добавления дополнительных модулей или оборудования для расширения функциональности машины с учетом изменяющихся потребностей сельскохозяйственного производства
Точность и скорость	
Точность	Параметры машины должны обеспечивать точность в посадке рассады, что обеспечивает более здоровый рост
Скорость	Машина должна быть способна работать на высокой скорости, чтобы обеспечить производительность процесса.
Частота использования	
Многоразовое использование	Конструктивные параметры должны позволять машине эффективно использоваться для посадки различных видов рассады.
Срок службы	
Долговечность и надежность	Конструктивные параметры должны обеспечивать прочность и надежность машины, чтобы снизить риски неплановых поломок.

Такие машины подразделяют на специализированные и унифицированные. Специализированные машины менее интересны из-за узкого спектра выполняемых работ и услуг. Унифицированные машины наиболее распространены и подходят для выполнения большего количества операций. Таким образом, проанализировав существующие признаки функционирования и требования к рассадопосадочным машинам, можно сделать вывод, что они делятся на ручные и механизированные.

Для полноты анализа будет представлен обзор начиная с ручных рассадопосадочных машин, т.е. от примитивных к более совершенным конструкциям.

Ручные рассадопосадочные машины (рис. 1) в настоящее время встречаются крайне редко. Примером может быть ручная рассадопосадочная машина РРМ-1 [6]. К плюсам данной конструкции следует отнести ее простоту и долговечность. Учитывая, что машина не будет агрегатироваться с каким-либо трактором, следует иметь в виду минимальное негативное воздействие на почву. Недостатками машины являются высокие требования к подготовке поля, низкая производительность и малая возможность маневрирования, ограниченный запас рассады на самой машине и невозможность его увеличения, высокие трудозатраты и большое влияние человеческого фактора на процесс посадки, что делает машину непривлекательной для использования. Отсюда, ручные посадочные машины не являются перспективными с точки зрения и дальнейшего их совершенствования.

Наиболее распространенные из механизированных это полуавтоматические машины. Примером может быть тип модели МРП-2 (4) (6) [7]. Наиболее интересной частью машины является высаживающий аппарат револьверного типа с приемным устройством овальной формы и двенадцатью стаканчиками (рис. 1).

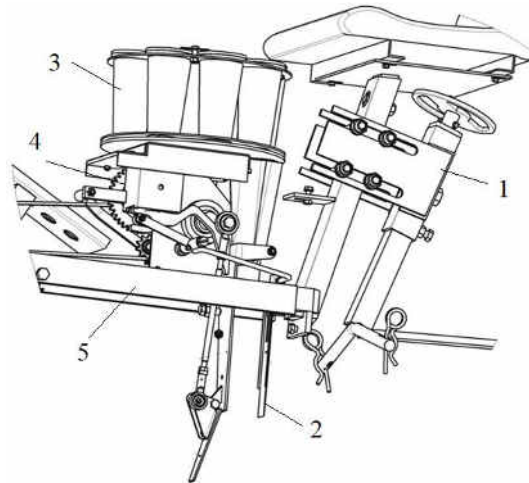


Рисунок 1. Высаживающий аппарат револьверного типа машины МРП:

*1 - регулировочный винт сидения сажальщика; 2 - планка, направляющая рассаду;
3 - барабан; 4 - приводной механизм; 5 - рама посадочной секции.*

Недостатком данного устройства является необходимость в дополнительном трубопроводе для вертикального перемещения рассады от питателя к сошнику. Вертикальное перемещение рассады от стаканов к сошнику происходит за счет неконтролируемого свободного падения рассады. Дополнительная деталь - трубопровод - усложняет конструкцию машины. В приемном устройстве восемь стаканов движутся друг за другом, последовательно доставляя рассаду в сошник [7]. Недостатком машины является низкая скорость машины и соответственно производительность.

Интересной в конструктивном и технологическом плане является рассадопосадочная машина МР-2/-4 [8]. Одной из важнейших частей машины является высаживающий аппарат, представляющий собой корпус, в котором установлены ведомые шестерни (рис. 2) с закрепленными между ними высаживающими сошниками (рис. 3). Корпус секции установлен на параллелограммном механизме, тем самым обеспечивая копирование рельефа почвы при работе машины и постоянство глубины посадки рассады. Машина обладает рядом недостатков. В состав каждого высаживающего блока входит индивидуальный привод и вертикальные высаживающие элементы, что существенно усложняет конструкцию машины и ее настройку на необходимое междурядье. К недостаткам следует отнести вертикальное перемещение стаканов при работе машины, что

повышает требования к точности установки рассады в стакан и приводит к быстрой утомляемости и снижению производительности труда сажальщика.

В конструктивном и в технологическом плане интерес вызывает машина с водяным колесом RAIN-FLO IRRIGATION 1670 для посадки рассады под мульчу [9]. При движении водяное колесо шипом пробивает мульчирующую пленку и подает порцию воды в образующуюся лунку, а затем операция посадки осуществляется вручную.

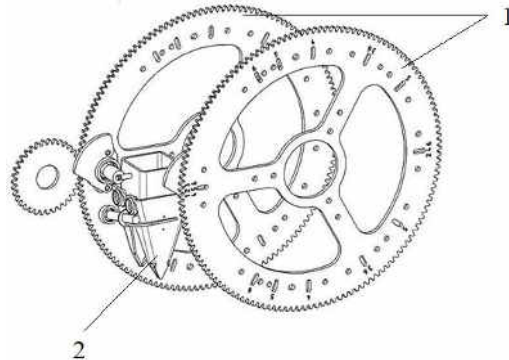


Рисунок 2. Ведомые шестерни с сошником рассадопосадочной машины MP-2/-4:
1 - ведомые шестерни; 2 - сошник.

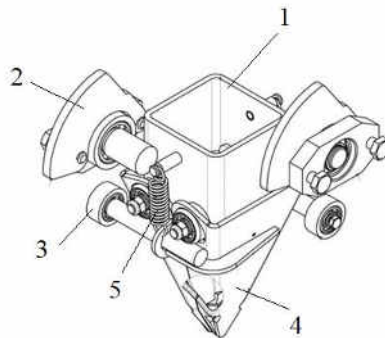


Рисунок 3. Высаживающий сошник, рассадопосадочной машины MP-2/-4:
1 - чашка; 2 - эксцентрик; 3 - толкатель; 4 - сошник; 5 - возвратная пружина.

Подача воды осуществляется через колесо (рис. 4). Основным недостатком машины: ручная высадка приводящая к утомляемости сажальщика и огрехам.

Автоматические рассадопосадочные машины позволяют снизить до минимума простой при ее использовании. Она может изготавливаться в двух вариантах: навесная и самоходная. Их рационально использовать в больших хозяйствах, специализирующихся на выращивании овощей. Наиболее распространенной автоматической рассадопосадочной машиной является FUTURA TWIN фирмы FERRARI. Этот рассадопосадочный автомат разработан для пересадки рассады овощных культур из ячеек кассетной рассадницы [10]. Для обслуживания данной машины требуется всего 1 оператор - для осуществления подачи рассады на щитки внутри загрузочных направляющих каждого отдельного высаживающего элемента [10]. Автоматические рассадопосадочные машины довольно производительны, технологичны, затраты труда - минимальны, качество и точность высадки - на высоте, однако стоят такие машины, довольно дорого. К недостаткам машины можно отнести повреждение рассады при выталкивании ее цилиндрами из ячеек, а также невозможность контроля за процессом посадки.

Анализ показал, что наиболее востребованными являются полуавтоматические рассадопосадочные машины, в которых совмещен принцип работы ручных и автоматических машин отчего уменьшается воздействие человеческого фактора [5].

Усовершенствование конструкции полуавтоматических рассадопосадочных машин является наиболее рациональным, поэтому самыми перспективными для дальнейшего исследования являются следующие основные признаки функционирования:

- плоскостное движение рассады в рассадопосадочной машине;
 - конструктивное исполнение рабочих органов машины и их параметры.
- Составляя классификацию, были определены следующие группы машин (Таб. 2).

Таблица 2

Классификация рассадопосадочных машин

По автоматизации	ручные
	полуавтоматические
	автоматические
По типу высаживающего аппарата	револьверного типа
	вертикального типа
	горизонтально-вертикального типа
По виду высаживаемой рассады	выращенной в общем ящике
	из ячеек
	выращенной в торфяных таблетках
По типу высаживающего стакана	без стакана
	универсальный
	для рассады с голым корнем
	специфические
По виду перемещения рассады в пространстве	горизонтальное
	вертикальное
	смешанное
По способу укладки рассады в грунт	с сошником-бороздоделом
	с открывающимся стаканчиком
По способу привода высаживающего аппарата	вал отбора мощности
	гидравлический двигатель
	колесный привод

Классификация более наглядно представляет наиболее важные для рассмотрения аспекты конструкции рассадопосадочных машин. Два основных параметра - вид движения и рабочие органы - определяют выполнение основных функций. Из-за многообразия рабочих органов и конструкций рассадопосадочных машин непонятно, что является структурообразующим. Поэтому необходимо выделить следующие требования к технике:

1) машины должны высаживать рассаду, распределяя ее на поверхности почвы по возможности узкой полосой, с четко вымеренным междурядьем и расстоянием между высаживаемой рассадой. Процент огрехов не должен превышать 5-8%;

2) при посадке не должно быть повреждений рассады, так как поврежденные растения больше подвержены болезням, а их жизнеспособность ухудшается в разы;

3) высаживаемый материал рассады должен иметь три листочка и довольно крепкую корневую систему - это два основных фактора приживаемости рассады;

4) машины для посадки рассады должны быть просты по конструкции и обеспечивать повышение производительности труда в сравнении с ручной посадкой;

5) для лучшего и плотного контакта корней с почвой и поддержания устойчивого вертикального положения необходимо выполнить прикатывание рассады.

В результате проведенного анализа установлены следующие основные требования и направления в развитии рассадопосадочных машин:

1. *Точность посадки:* производители все больше уделяют внимание точности посадки и возможности настройки машины под различные типы рассады.

2. *Увеличение производительности:* с/х постоянно сталкивается с растущим спросом на машины обеспечивающие высокую скорость и производительность.

3. *Экологическая устойчивость:* современные машины должны быть эффективными в использовании ресурсов и неуклонно уменьшать их негативное воздействие на окружающую среду.

4. *Автоматизация и инновации*: важный тренд в развитии рассадопосадочных машин связан с автоматизацией процессов и использованием инновационных технологий, таких как искусственный интеллект и роботизация.

Выводы

1. Анализ существующих технологий показал, что в условиях Республики Молдова для посадки рассады используют разные типы рассадопосадочных машин, но зачастую посадка в поле производится вручную.

2. Рабочие органы посадочных машин требуют конструктивных изменений, которые позволили бы удовлетворить требования к технологии и решение технологических и технико-экономических проблем при выращивании культур рассадой.

3. Предлагаемая классификация наглядно представляет наиболее важные для рассмотрения аспекты конструкции рассадопосадочных машин.

4. В результате изучения специальной научной литературы и существующих конструкций рассадопосадочных машин были определены основные требования к процессу посадки рассады. Выявленные недостатки позволили установить, что наиболее важными и перспективными для дальнейшего исследования основными признаками функционирования машин являются: плоскостное движение рассады в рассадопосадочной машине и конструктивное исполнение рабочих органов машины.

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PROBLEME ACTUALE ALE SISTEMELOR DE TRANSPORT PUBLIC MUNICIPAL

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Rezumat. În contextul urbanizării globale a populației, problemele transportului public în municipiile urbane nu fac decât să se agraveze. Mobilitatea crescută a populației urbane impune organizarea eficientă a transportului de pasageri prin mijloace tradiționale de transport, respectiv autobuze și troleibuze. În același timp, o tranziție calitativă la transportul de pasageri pe liniile principale ale orașului cu vehicule de mare capacitate (tramvai și metrou) nu este posibilă din cauza cererii insuficiente și a necesității de investiții mari în infrastructură. Articolul, folosind exemplul municipiului Chișinău, examinează problemele actuale ale marilor orașe și propune principalele modalități de rezolvare a acestora.

Cuvinte cheie: abordare sistemică, transport public de rută,

Introducere

În condiții de urbanizare globală a populației problemele transportului public în cadrul municipiilor urbane doar se agravează.

În mod deosebit de actuale problemele examinate sunt pentru orbirii cu numărul de populație mare (de la 500 000 până la 1 milion de locatori) cum este capitala al Republicii Moldova.

Specificul acestor aglomerații urbane constă în funcționare la limită capacităților a sistemului de transport public format prioritar cu autobuze și troleibuze de clasa mare.

Tot odată trecere la un sistem de transport public dotat cu alte module cum este tramvai lung sau metro nu este rațională din motivul mobilității redusă a populației și a investițiilor depășite pentru bugetul municipal.

În conformitate cu Strategia de Dezvoltare a Poporului [1] aprobată de Națiunile Unite în 2015, unul dintre obiectivele de dezvoltare durabilă (numărul 11) este „Orașele și comunități durabile”.

Ținta 11.2 a acestui obiectiv impune ca, până în 2030, populațiile urbane să beneficieze de sisteme de transport sigure, accesibile, accesibile și durabile din punct de vedere ecologic, bazate pe o siguranță rutieră îmbunătățită, în special creșterea utilizării transportului public, cu o atenție deosebită nevoilor celor din situații vulnerabile, femei, copii, persoane cu dizabilități și persoane în vârstă.

Lipsa unei viziuni comune pentru dezvoltarea sistemului de transport public urban și eșecul de a lua măsuri pentru rezolvarea problemelor sale inerente contribuie la crearea unui cerc vicios de probleme pentru traficul urban.

Nerespectarea nivelului serviciilor oferite de transportul public urban cu cerințele actuale ale pasagerilor duce la creșterea vehiculelor individuale, ceea ce la rândul său va crea o serie de probleme, după cum urmează:

- creșterea numărului de congestioni în trafic și pierderea timpului pasagerilor, oboseala acestora,
- reducerea beneficiilor economice și sociale de la locuirea în marile aglomerări urbane,
- emisii crescute de poluanți și condiții de viață nesatisfăcătoare în orașele mari,

- o scădere a veniturilor operatorilor de transport și o creștere a sarcinii asupra bugetului municipalităților.

Pentru a rezolva problemele de transport existente, este necesară dezvoltarea unor baze metodologice pentru crearea și funcționarea durabilă a sistemului de transport urban al orașului în general și a componentei sale principale și definitorii a transportului public în special.

Scopul acestui articol este de a identifica și descrie principalii factori care ar trebui luați în considerare la elaborarea planurilor de mobilitate durabilă a populației urbane și a căror respectare contribuie la rezolvarea problemelor de transport.

Factorii care determină funcționarea sistemelor de transport public municipal.

Studiul este realizat în baza:

- rezultatelor și experienței de elaborare proiectelor de dezvoltare durabilă a transportului public al municipiului Chișinău [2-3] cu forța a cadrelor didactice și a studenților al departamentului Transporturi a Universității Tehnice a Moldovei;
- analiza experienței străine în planificarea transporturilor sistemelor de transport și practicarea funcționării acestora [4].

Lista principalelor factorilor ale sistemului de transport public municipal este:

1. Factorii naturali:

- a) condiții climaterice;
- b) relieful aglomerației urbane;

2. Factorii sociali:

- a) nivelul actual de trai a populației;
- b) factor istoric de dezvoltare orașului și în formarea sistemului de transport;
- c) politica tarifară a administrației publice municipale;
- d) gradul de acces a populației la linia de transport public;
- e) tradiții și mentalitatea populației;

3. Factorii economice:

- a) nivelul dezvoltării economice și surse de finanțare sistemului de transport public;
- b) nivelul de dezvoltare infrastructurii rutiere și în special pentru transport public;
- c) gradul de dotare a sistemului de transport public cu mijloace de transport în raport cu cererea;

4. Factorii ecologice:

- a) gradul înalt de poluare a mediului ambiant;
- b) dotarea parcului rulant cu mijloace de transport ecologice sau cu consum de combustibil econom;
- c) optimizarea planului de prestare serviciilor de transport public în funcție de cerere mobilității;

5. Factorii de management:

- a) lipsa strategiilor de dezvoltare a orașului și a sistemelor de transport public;
- b) lipsa sistemului centralizat de managementul sistemului de transport public;
- c) lipsa sistemului de priorități pentru dezvoltarea infrastructurii de transport;
- d) lipsa concepțiilor inovatoare pentru funcționarea sistemului de transport public;

6. Factorii de planificare, organizare și gestionare:

- a) imperfecțiunea rețelei de rute de transport public;
- b) nerespectarea graficului de circulație;
- c) funcționarea imperfectă a materialului rulant de transport public;
- d) nerespectarea graficului de circulație pe rută;
- e) organizarea și siguranța circulației rutiere;
- f) monitorizarea procesului de circulație și informarea pasagerilor.

Caracteristicile principalelor probleme ale creării unui sistem de funcționare durabilă a transportului public urban

Atunci când se formează funcționarea durabilă a transportului public urban, trebuie să se țină seama de o serie de probleme emergente datorate sistemului existent sub influența factorilor istorici și climatici, potențialul economic existent, precum și barierele legale și culturale.

Pe lângă cele enumerate, mai salvează următoarele probleme:

- o serie de decizii sunt luate pe baza împrumutării experienței străine fără a ține cont de specificul local;
- la luarea deciziilor nu se urmează întotdeauna o abordare sistematică, ceea ce duce la schimbări în etapa de implementare;
- toate programele și strategiile sunt împărțite în activități locale în domenii separate de lucru, ceea ce duce la inconsecvența acțiunilor și la duplicarea eforturilor;
- nu sunt utilizate pe deplin capacitățile noilor tehnologii, ceea ce nu permite realizarea progresului scontat;
- deciziile convenite colectiv luate în etapa de elaborare a unei strategii de dezvoltare a sistemului de transport sunt implementate doar parțial, iar în alte cazuri prevalează interesele pur corporative ale operatorilor de transport.

Pentru a rezolva eficient aceste probleme pe termen lung, este necesar să se determine corect scopul și obiectivele dezvoltării durabile a populației care locuiește în oraș. Implementarea scopurilor și obiectivelor proiectului de dezvoltare durabilă a sistemului de transport public urban este posibilă numai dacă interesele tuturor participanților la proces sunt coordonate la etapa formării acestora. Practica implementării proiectelor de dezvoltare durabilă arată că interesele diferitelor părți sunt diferite. Este posibil să se realizeze un echilibru al intereselor majorității participanților, cu condiția ca scopul proiectului să corespundă priorităților lor de viață.

Prioritatea principală pentru toți oamenii rezonabili este viața însăși și suportul ei de viață. Prin urmare, proiectele pentru dezvoltarea durabilă a sistemelor de transport public în orașele mari ar trebui să fie dezvoltate în următoarele condiții:

- să respecte nevoile și interesele populației în mobilitate;
- să nu contravină legii a naturii și să nu producă daune mediului și sănătății umane;
- promovarea unei dezvoltări economice eficiente.

Concluzii

Obținerea consensului între părțile interesate în etapa de dezvoltare a unui proiect de dezvoltare durabilă ajută la reducerea costurilor generale ale implementării acestuia și la îmbunătățirea funcționării acestuia.

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ОБЗОР МАШИН И ОБОРУДОВАНИЯ ДЛЯ УБОРКИ ОРЕХОВ

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Реферат. В статье приведен обзор машин и оборудования для уборки орехов, в рамках которого были изучены существующие технологии уборки орехов и основные конструктивные схемы машин и оборудования для уборки орехов с представлением их классификации и основных характеристик. Были выявлены преимущества и недостатки существующих технологий и машин для уборки орехов. Данный обзор даёт возможность выявить основные направления усовершенствования конструкции машин для уборки ореховых культур в условиях Республики Молдова, а на основе приведенного анализа были установлены основные критерии их классификации. Были выявлены основные и перспективные конструктивные схемы для совершенствования и дальнейшего исследования машин и оборудования для уборки орехов. В статье представлен анализ основных рабочих органов встряхивателей и выявлены проблемы, связанные с механизированной уборкой ореховых культур.

Ключевые слова: технология, производительность, встряхиватель орехов, параметры.

Rezumat. În articol s-a efectuat un studiu al mașinilor și utilajelor de recoltat nuci în cadrul cărui s-au analizat tehnologiile existente de recoltare în cultura nucului și schemele constructive de bază ale mașinilor și utilajelor agricole de recoltat nuci cu prezentarea clasificării lor și a caracteristicilor principale ale acestora. Au fost identificate avantajele și dezavantajele tehnologiilor și mașinilor existente pentru recoltarea nucilor. Studiul permite a identifica direcțiile principale în perfecționarea construcției mașinilor de recoltat culturi nucifere cu propunerea soluțiilor tehnice privind elaborarea ulterioară a schemelor constructive și perfecționarea organelor de lucru în condițiile Republicii Moldova și identificate cele mai raționale direcții de îmbunătățire a acestora, iar în baza analizei efectuate s-au stabilit criteriile principale de clasificare a lor. Au fost identificate schemele constructive esențiale și de perspectivă pentru perfecționarea și cercetarea ulterioară a mașinilor și utilajelor de recoltat culturi nucifere. În articol este prezentată o analiză a principalelor organe de lucru ale scuturatoarelor de nuci și identificate probleme ce țin de recoltarea mecanizată a culturilor nucifere.

Cuvinte cheie: tehnologie, capacitate de lucru, scuturător de nuci, parametri.

Введение

Сельскохозяйственный сектор Республики Молдова был и остается одним из основных опор национальной экономики и играет очень важную роль [1]. Плодородная почва и умеренно-континентальный климат дают Молдове конкурентное преимущество в с/х производстве.

Из плодовых культур орехи являются наиболее ценными и высоко котируемыми на мировом рынке. По питательным веществам орехи превосходят хлеб, мясо, молоко и широко используются в пищевой промышленности. Наибольшее распространение в

Молдове получил грецкий орех. Научно-практическое обеспечение ореховой отрасли Республики Молдова на протяжении многих лет сопровождают такие ученые и практики, как Рыбин В.А., Дорофеев П.П., Команич И.Г., Цуркану И.П., Жадан В.М. и другие [2].

Изучение и анализ существующих технологий показало, что в цепочке технологических операций выращивания грецкого ореха можно выявить достаточно большие проблемы. Актуальными проблемами в технологии выращивания грецкого ореха являются такие важные операции, как обрезка и опрыскивание высокорослых деревьев, обработка почвы вокруг них из-за большой кроны и сбор урожая. По большей части эти проблемы связаны с механизацией технологических процессов в сельском хозяйстве.

Сбор урожая это одна из важнейших операций в технологии возделывания плодовых культур. При этом сбор и товарная обработка плодов являются наиболее трудоемкими операциями в плодоводстве, затраты на которые даже в самых передовых специализированных садоводческих хозяйствах мира составляют в среднем 50–60% от общих затрат на выращивание плодов [2]. В условиях Республики Молдова это касается и к технологической операции по уборке плодов ореховых культур и оно связано с достаточно высокими затратами, в первую очередь, на использование ручного труда.

В настоящее время вопрос механизации уборки плодов грецкого ореха связан с усовершенствованием существующих конструкций машин, которые будут приспособлены для уборки плодов в плодоносящих насаждениях грецкого ореха, ввиду их морфологических особенностей: довольно больших размеров штамба, кроны и ветвей. Поэтому механизация уборки плодов с крупноштабных деревьев актуален. Его решение позволит прежде всего, поднять производительность труда, обеспечить полноту сбора выращенного урожая, поднять общий уровень механизации возделывания грецких орехов и решить социальную проблему по безопасности работ при уборке плодов [3, 4].

Машинные методы сбора урожая обеспечивают частичное решение проблемы, эффективно удаляя плоды с деревьев, снижая затраты на сбор урожая до 35–45% от общей себестоимости продукции, что способствует повышению общей эффективности производства [4, 5]. С целью облегчения выполнения трудоемких и повторяющихся задач возникает необходимость в разработке интеллектуальных и более эффективных машин, тем самым увеличивая их производительность.

Материалы и методы

Для проведения необходимого анализа существующих орехоуборочных машин и оборудования необходимо использование таких научных методов как индукция и дедукция, а в результате выявления преимуществ и недостатков исследуемых конструкций - использование сравнительного анализа. Классификация как метод упорядочения рассматриваемых машин даст возможность сгруппировать выявленные недостатки с целью усовершенствования рассматриваемых конструкций, а по результатам проведенного анализа сделать общие выводы и рекомендации.

На основании метода системного анализа наиболее перспективных технологий и конструкций машин для уборки орехов необходимо определиться с требованиями предъявленными как к процессу уборки, так и к техническим уборочным средствам.

Результаты и обсуждения

В существующих технологиях уборки орехов уборку начинают после полного созревания грецкого ореха, то есть когда начал трескаться зеленый околоплодник. Процесс уборки орехов включает в себя несколько основных операций: встряхивание, подбор орехов, погрузка в транспортные средства, транспортировка плодов на склад. В зависимости от применяемой технологии уборки плодов необходим тот или иной комплекс машин для проведения уборочных работ [5].

В зависимости от объема производства и уровня механизации различают следующие способы уборки орехов: ручной, полумеханизированный и механизированный [5, 7].

Ручной способ уборки подразумевает сбивание орехов с дерева палкой или ручное встряхивание веток с последующим *ручным сбором* или *простыми орехосборниками*. Данный способ не является безопасным и производительным, так как требует огромных трудовых и финансовых затрат.

Полумеханизированный способ уборки представляет собой способ, при котором встряхивание осуществляется *встряхивателями* деревьев, а сбор выполняется вручную или орехосборниками. Данный способ считается более безопасным и производительным по сравнению с предыдущим и не имеет большого негативного влияния на дерево и его корневую систему, но не предполагает значительного сокращения сборщиков ореха.

Механизированный способ уборки это тот случай когда не только процесс встряхивания *механизирован*, но и сбор орехов *автоматизирован*. При данном способе уборки значительно сокращается задействованный штат персонала, увеличивается производительность труда и безопасность. Поэтому в промышленных садах для уборки урожая плодов используются специальные инструменты и уборочное оборудование, что позволяет быстро и с минимальными затратами собрать урожай. Из всех способов уборки плодов наиболее перспективным и экономически выгодным является механизированный, обеспечивающий увеличение производительности труда в 5 – 12 раз.

Существуют 2 способа механизированной уборки: *однофазный способ*, когда встряхивающая установка оборудована улавливателем плодов или используются в тандеме встряхиватель с улавливателем и дополнительный подбор исключается, и *двухфазный или раздельный*, который включает операцию встряхивания плодов на землю, а потом подбор орехов с помощью специальных подборщиков. Примером первой группы машин для уборки однофазным способом является комбайн для уборки плодов Maja WEREMCZUK (рис. 1) [4, 8].

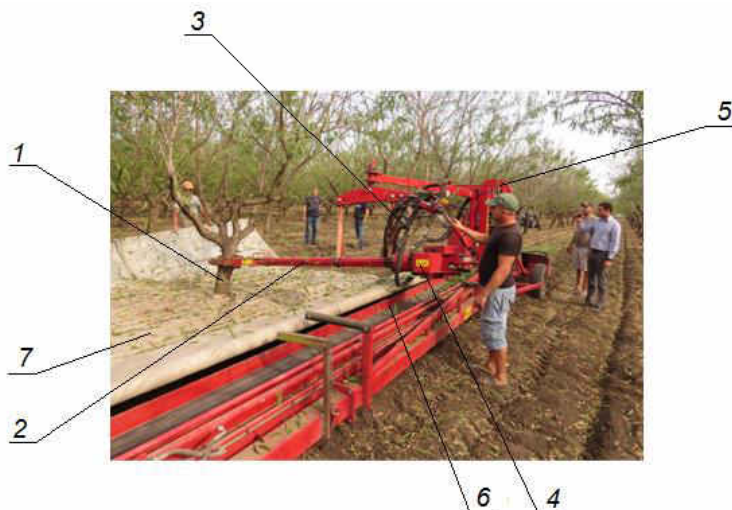


Рисунок 1. Комбайн для уборки плодов Maja WEREMCZUK:

1 – ствол дерева; 2 – подвижная штанга с приспособлением для зажима ствола;
3 – гидросистема для управления механизмами; 4 – вибратор; 5 – вентилятор;
6 – транспортер продольный; 7 – улавливающее устройство.

Из второй группы машин для уборки раздельным способом можно отметить встряхиватель Tornado, который служит для уборки ореха, миндаля и фундука, а также вишни и сливы (рис. 2) [9]. Он может работать на любом типе орехоплодных культур (молодые или взрослые деревья) и любом рельефе (плоский или холмистый) (рис. 2). В данной модели присутствует настройка нескольких уровней вибрации, в зависимости от того, какое дерево необходимо встряхивать, молодое или старое, выставляется разная амплитуда и интенсивность вибрации.

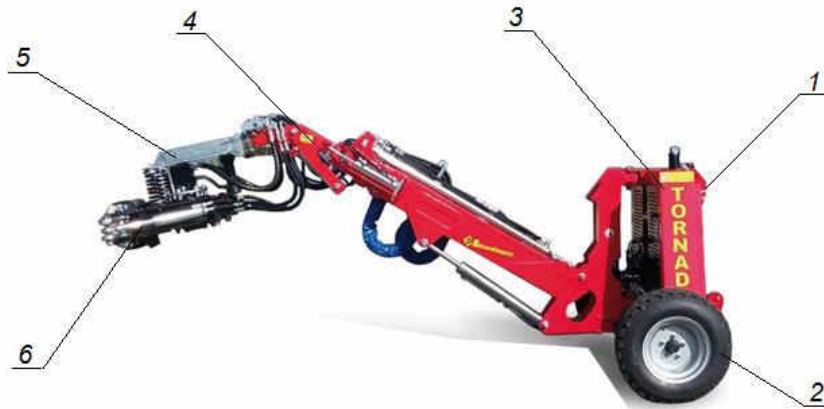


Рисунок 2. Встряхиватель Tornado:

1 - рама встряхивателя; 2 - опорные колеса; 3 - гидросистема с поршневым вибронасосом; 4 - телескопическая стрела; 5 - вибратор (гидромотор на вибрирующей головке); 6 - приспособление для зажима ствола дерева.

Существующие орехоуборочные машины в основном созданы на основе плодуборочных комбайнов для яблоневых, сливовых, вишневых и т. д. садов [4-10]. Изучение конструкции этих машин, а также еще большой гаммы технических средств для уборки орехов, что существуют на сегодняшний день были установлены следующие критерии их классификации:

1. По способу соединения с энергетическим средством (трактором):

- прицепные;
- навесные;
- самоходные.

2. По назначению:

- для встряхивания;
- для сбора с земли или с деревьев;
- для встряхивания и сбора.

3. По принципу работы:

- вибрационные;
- с использованием воздушных потоков;
- ротационные;
- с использованием комбинаций различных механизмов.

4. По уровню автоматизации:

- полуавтоматизированные;
- автоматизированные.

Проведенный анализ, изучение научной литературы и предварительные теоретические исследования с целью совершенствования конструкции вибрационных машин для уборки орехов позволил определить требования предъявляемые к процессу уборки и уборочным машинам и оборудованию:

- количество поврежденных плодов не должно превышать 1%;
- допускаются локальные повреждения коры деревьев, не влияющие на жизнедеятельность растений;
- количество плодов, остающихся на дереве, не должно превышать 50 шт на одну скелетную ветвь;
- время непрерывных колебаний не должно превышать 10 секунд;
- улавливающее устройство должно улавливать не менее 95% плодов;
- вибрирующий стержень должен иметь подъем и опускание в вертикальной плоскости, а нижнее положение центра захвата должно быть не менее 0,5 м от уровня земли;

- подъем и опускание штанги должны быть плавными и, в целом, не повреждать дерева.

При уборке орехов к почве, также, предъявляются определённые требования. За 10 - 15 дней до уборки она должна быть ровной и прикатанной, а если в саду газон, то он должен быть подстрижен. Для этой цели применяют специальные почвообрабатывающие орудия, совмещающие операции выравнивания и прикатывания почвы, или косилки высокой производительности с низким срезом.

Следует отметить, что в современных технологиях используется с/х техника для механизированной уборки грецких орехов, сочетающая в себе как механизмы стряхивания деревьев, так и механизмы сбора плодов в специальные бункеры машины или непосредственно с земли с помощью мощных пылесосов. У них есть свои преимущества и недостатки, но можно с уверенностью сказать, что эти машины не в полной мере пригодны для использования в условиях Республики Молдова, в первую очередь из-за высоких первоначальных капиталовложений на приобретение комбайнов и комплекта специального технологического оборудования для уборки и последующей дополнительной обработки плодов.

Из анализа конструкций плодуборочных машин установлено, что одним из наиболее распространенных недостатков стряхивателей является передача вибраций на трактор или раму прицепного комбайна. Поэтому вибрационное устройство 6 (рис. 3) должно решить эту основную задачу садов [4].

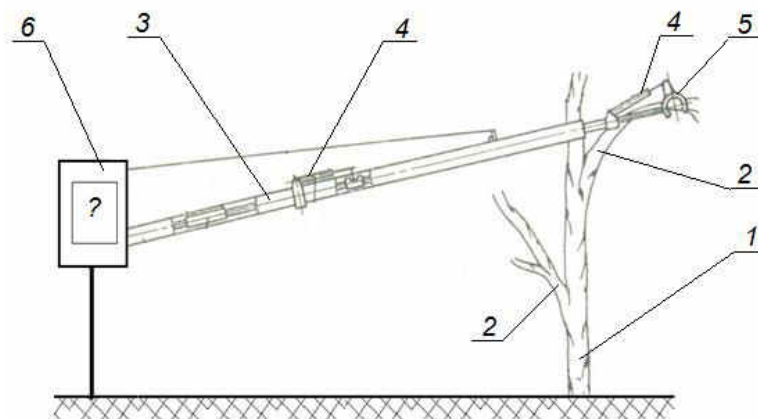


Рисунок 3. Встряхиватель:

1 - ствол дерева; 2 - ветви ореха; 3 - штанга с приспособлением для зажима ствола;
4 - гидроцилиндр; 5 - приспособление для зажима ствола (веток); 6 – вибратор.

Вибратор 6 и его приводной механизм являются основными элементами разрабатываемой конструкции. Устройство 5 для зажима ствола или ветки дерева, также, важно для процесса тряски и дальнейшей жизни плодового дерева, так как это обусловлено воздействием интенсивности вибраций на кору и корневую систему. Поэтому для совершенствования конструкции машины для встряхивания орехоплодных культур необходимо также изучать сам процесс стряхивания.

Итак, изучение теоретических предпосылок технологического процесса встряхивания плодов грецкого ореха с обоснованием основных параметров, влияющих на процесс отрыва плодов и их падения на землю, является одним из важнейших элементов, влияющих на производительность машины и качественные параметры ее работы.

Так как сбор орехов подразумевает обязательное встряхивание, такой метод может крайне негативно повлиять на само плодоносящее дерево, что приводит к повреждению коры, вызывая отмирание стволов, развитие болезней и, как следствие падение урожая в последующие годы. С целью минимизации травмирования дерева следует исследовать как

величина амплитуды колебаний и её продолжительность влияет на само дерево в зависимости от возраста дерева, диаметра и высоты захвата ствола.

Выводы:

1. Изучение и анализ существующих технологий показало, что в цепочке технологических операций по выращиванию орехоплодных культур существуют достаточно большие проблемы, а уборка урожая является одной из важнейших и наиболее трудоемкой технологической операцией, в которой, затраты на сбор и товарную переработку плодов составляют не менее 50-60% от общих затрат на выращивание плодов.

2. Предлагаемая классификация машин для уборки орехов указывает на область в которой намечаются дальнейшие исследования по разработке и совершенствованию конструкции машин и технологического оборудования.

3. В результате изучения существующих конструкций плодуборочных машин и специальной научной литературы были определены основные требования к процессу механизированной уборки орехоплодных культур.

4. Установлено, что передача вибраций на трактор или раму комбайна является одним из наиболее распространенных недостатков при встряхивании ореховых деревьев.

5. Дальнейшее изучение теоретических предпосылок технологического процесса стряхивания орехов с обоснованием основных параметров, влияющих на процесс отрыва плода и его падения на землю, является одним из важнейших элементов, влияющих на производительность машины и качественные показатели ее работы.

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