

IV. ȘTIINȚE EXACTE ȘI INGINEREȘTI

DETERMINANTS OF CONSUMER BEHAVIOUR RELATED TO SUGAR SUBSTITUTES INTAKE IN THE REPUBLIC OF MOLDOVA

DETERMINANȚII AI COMPORTAMENTULUI CONSUMĂTORILOR ÎN VEDEREA UTILIZĂRII ÎNLOCUITORILOR DE ZAHĂR ÎN REPUBLICA MOLDOVA

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Abstract: *Problema creșterii bolilor asociate cu consumul exagerat de kilocalorii a servit drept baza extinderii pe piața națională a sortimentului de produse alimentare obținute cu adaos de îndulcitori non-calorici. Producătorii, în căutarea profitului, dar și în baza aspectelor tehnologice, oferă populației Republicii Moldova preponderent produse cu adaos de îndulcitori sintetici (E 950, E 951, E 952, E 954, E 955). Utilizarea acestora duce la o serie de boli, precum și din cauza substanțelor chimice care sunt aplicate suplimentar pentru a masca neajunsurile senzoriale ale unor îndulcitori. Ca una din măsurile necesare pentru îmbunătățirea calității vieții și asigurarea sănătății populației locale se recomandă informarea cetățenilor despre riscurile asociate utilizării îndulcitorilor prin programe de informare, precum și prin etichetarea corespunzătoare a produselor alimentare.*

Cuvinte cheie: *îndulcitori naturali și sintetici, riscuri nutriționale, receptorii de gust dulce, produse non-calorice*

Abstract: *The problem of the increased number of diseases associated with the excessive consumption of kilocalories served as the basis for the expansion of the assortment of food products obtained with the addition of non-caloric sweeteners within the national market. Producers, in search of profit, but also based on technological aspects, mainly offer to the population of the Republic of Moldova products with the addition of synthetic sweeteners (E 950, E 951, E 952, E 954, E 955). Their use provokes a number of diseases, as well as due to chemicals that are additionally applied to mask the sensory deficiencies of some sweeteners. As one of the necessary measures to improve life quality and ensure the health of the local population, it is recommended to inform the citizens about the risks associated with the use of sweeteners through information programs, as well as through the appropriate food labeling.*

Keywords: *natural and synthetic sweeteners, nutritional risks, sweet taste receptors, non-caloric products*

Introduction

Sweeteners as a part of food additives or sensory ingredients are used to impart a sweet taste to the

final products. These substances activate sweet taste receptors in the same way as sugar, but unlike the latter, they either contain much fewer calories or exhibit a more high sweetening capacity and, respectively, are used in much smaller quantities. Thus, sweeteners are classified according to their sweetening power, nutritive value and provenance [1]. A clear difference in the degree of impact on human health can be seen in the so-called natural and synthetic sweeteners (Figure 1).

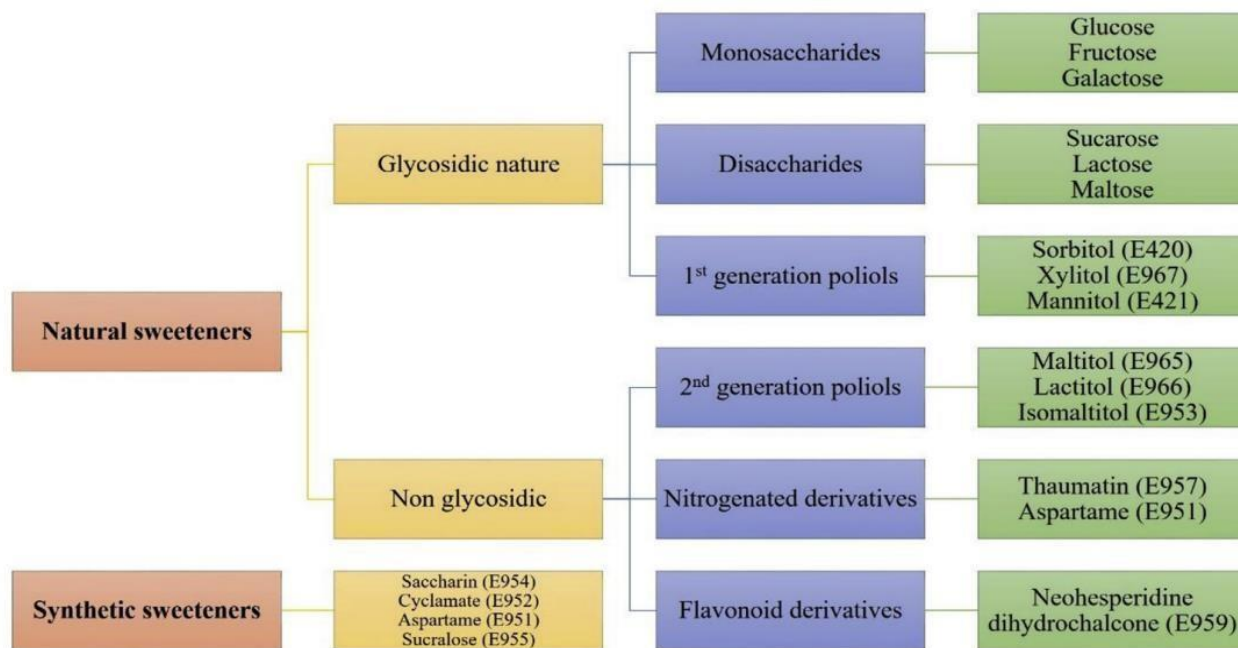


Figure 1. Natural and synthetic sweeteners [1]

Sweet taste preferences vary and are perceived differently from person to person. It is known that excessive sugar consumption is tantamount to increased energy intake, which in turn can cause various chronic diseases such as obesity, tooth decay, diabetes, etc. [2]. Synthetic sweeteners appeared in the 1950s to satisfy the population's sweets craving as sugar ingestion increased to an extremely enormous level (equivalent to about 20 teaspoons per day, which consist of 100 g on average) [3].

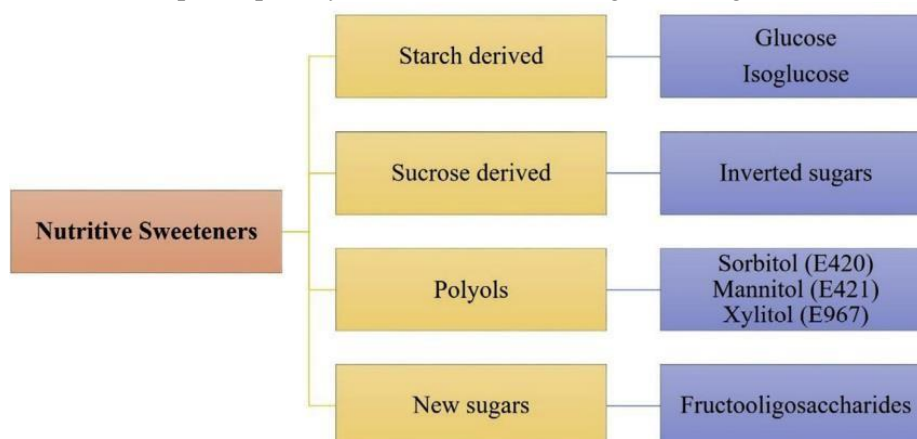


Figure 2. Nutritive sweeteners [1]

Some experts believe that sweeteners pose a risk to public health. The Journal of the American College of Cardiology published the largest study on the effects of sugar substitutes on the body. Experts said that sugary drinks, such as diet sodas, can negatively affect metabolism and the state of blood vessels [4]. However, it is not uncommon for health advocates to choose sugar substitutes as a healthier option [5]. Alternative sweet additives can be roughly divided into two types. The first type is represented by sweeteners, that more often are natural products and, in their taste, are closed to the original (Figure 2). Nutritive sweeteners are a source of calories, but are suitable for diabetics. The second group includes

intense sweeteners. Their energy value is often close to zero. They are many times sweeter than sucrose and are of synthetic origin [6] (Figure 3).

Both types are often used in the production of conventional products. For example, some sweeteners have water-retaining properties and require a certain amount of heat to dissolve, which is ideal for the production of hard candies. In turn, synthetic sweeteners are used in the production of ice-cream, as they prevent the crystallization of the structure at low temperatures [7].

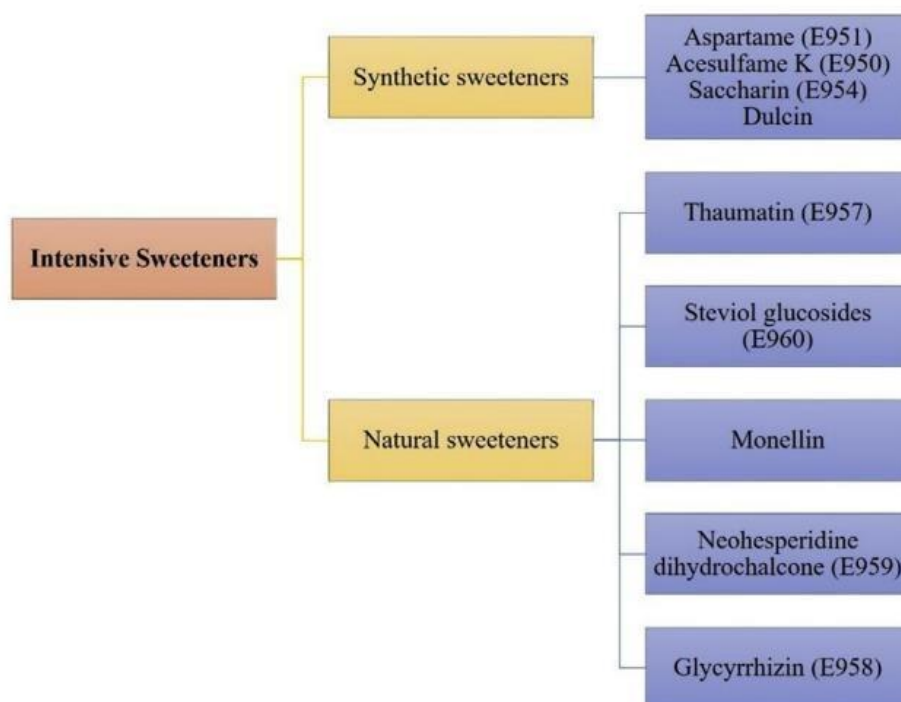


Figure 3. Intensive sweeteners [1]

A number of sweeteners is available on the market of the Republic of Moldova. In general, they have entered the daily diet of local consumers due to the spread of diseases associated with excessive consumption of sugar. Recent data show that more than 463 million people (1 in 11) worldwide live with diabetes and that their number is growing. In 2019, diabetes caused more than 4.2 million deaths. By 2030, the number of people with diabetes is expected to rise to 578 million.

In the Republic of Moldova, in 2019, one in three out of 100 people, aged 30 to 70, may die prematurely due to chronic diseases. Statistics show that men are almost 3 times more likely to suffer from this non-communicable disease than women. Therefore, there is a need to study in detail the nutritional and technological characteristics of sweeteners available to the population of the Republic of Moldova.

The influence of sweeteners on the human body

The inclusion of sweets in the diet helps to stimulate the pleasure center in the human brain. The sweet taste is associated with pleasant sensations, which causes a certain psychological dependence on sugar. Experts note that psychological or emotional addiction to sweets can lead to physiological dependence. This is due to the fact that the sweet taste receptors are located not only in the oral cavity but also in other human organs [8].

Recent findings suggest that the sweet taste receptor T1R2 / T1R3, which is expressed in many extraoral tissues, such as the intestine and pancreas, plays an important role in nutrient detection and metabolic regulation processes associated with insulin secretion. The sweet taste receptor has also been found in tissues where its function seems less obvious, such as the brain, colon, bladder, lymphocytes and heart (Figure 4) [9].

Ingested sweeteners effect the human body by excreting intestinal hormones and expressing glucose-carrying proteins. Sweet receptors in bone and adipose tissue stimulate bone cells, which can lead to osteoporosis. Saccharin, for example, increases the tone and contraction of the bladder [11].

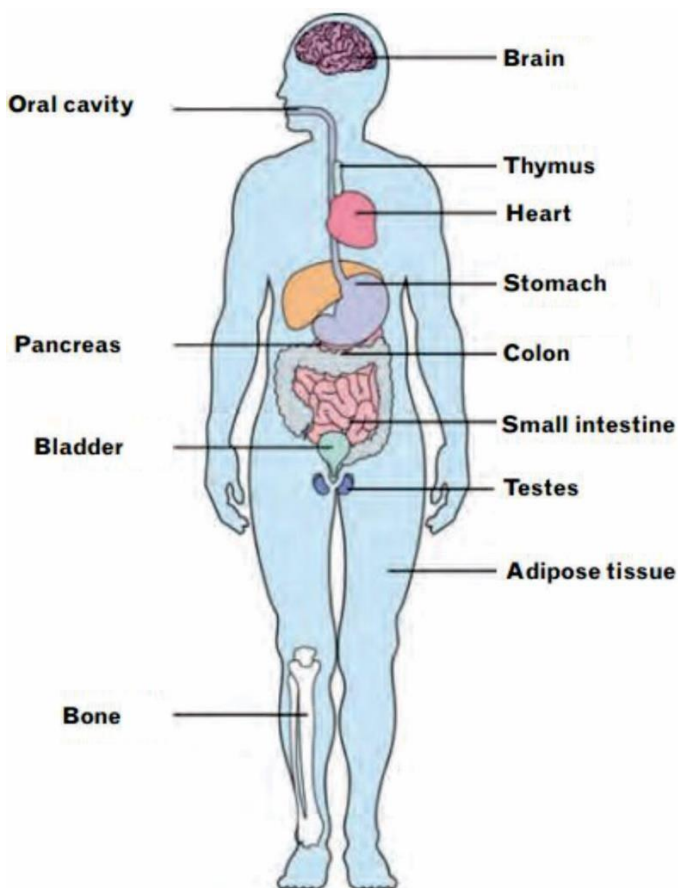


Figure 4. Sweet taste receptors [10]

cancer, caries and weight gain [14].

The risks of high consumption of synthetic sweeteners are:

- risk factors for the development of metabolic syndrome, including abdominal obesity;
- high levels of triglycerides and low levels of HDL cholesterol;
- high blood pressure;
- high blood sugar;
- the increased risk of developing metabolic disorders;
- hormonal imbalance difficult to remedy;
- change in the level of biochemical concentrations of amino acids and fats;
- change in the way of fat processing;
- change in the body's energy level;
- change in the quality of sleep and memory;
- the appearance of addiction at daily consumption;
- gastrointestinal imbalance [15].

These risks are mainly associated with the fact that synthetic sweeteners contain certain ingredients that are harmful to health (phenylalanine, aspartic acid, methanol, cyclamic acid) [16]. Also, the biggest benefit of these additives can turn into the biggest problem. On the one hand, synthetic sweeteners are low in calories and are useful for people who want to lose weight. The important property of these substances is that they have a high sweetening power of food (100-600 times higher than sugar), while having a minimum of calories. Thus, it is an ideal alternative for people with diabetes [17]. Besides, synthetic sweeteners do not cause tooth decay compared to sugar. On the other hand, sweetener-based products are low in calories, which leads to excessive consumption of certain groups of foods/beverages rich in carbohydrates and fats, being the cause of metabolic disorders.

Particulars of natural and synthetic sweeteners available to consumers in the Republic of Moldova

Sweeteners cause a rapid elimination of insulin by acting on the pancreatic receptors. The activation of sweet receptors leads to a decrease in blood flow to brain vessels, which increases the risk of strokes and neurodegenerative diseases. The function of the receptors is important for human health, so consumers of dietary products need to be serious about choosing sweeteners, the benefits and harms of which are still being debated [12].

Health benefits and risks

Natural sweeteners are associated with more health benefits than synthetic sweeteners. For example, stevia has no calories or carbohydrates. Researchers have found that stevia can lower LDL cholesterol and prevent type 2 diabetes by increasing insulin sensitivity, thereby reducing blood glucose synthesis [13]. Another study showed that stevia can improve memory and reduce oxidative damage to the brain.

Synthetic sweeteners are associated with more negative aspects for compared to the natural ones. Some synthetic sweeteners (E 950 - Acesulfame, E 952 - Cyclamate, E 954 - Saccharin, etc.) are even banned in some countries due to their carcinogenic properties. Studies show that synthetic sweeteners such as aspartame and sucralose can lead to birth defects,

Sweeteners are used as the main ingredient in the fabrication of confectionery and are obtained from animal or vegetable sources. For example, honey is a natural sweetener made by bees using nectar from flowers. In contrast, synthetic sweeteners are mainly derived from synthetic chemicals through industrial processing. This is the key difference, although both are used for the same purpose, they have different sensory and nutritional properties, such as different health effects that are specified in Table 1 [18].

Table 1: Characteristics analysis of natural and synthetic sweeteners

Synthetic sweeteners	Natural sweeteners
Are cheaper	Are more expensive
Have a low caloric content or are non-caloric	Have varied caloric content
May have adverse health effects (migraine, upset stomach, increased risk of obesity, allergic skin reactions)	Are associated with several health benefits (reduced risk of chronic diseases, heart and bone health benefits)
Amino acids, peptides and sugar alcohols are the main sweet taste compounds	Fructose and sugar alcohols are the main sweet taste compounds
Are used to sprinkle food, sweeten hot drinks, confectionery and caramels to add sweetness and texture to cooked products	Are used for baking, bread or biscuits, sweetening various drinks, and preserving meat

In the Republic of Moldova, the use of sweeteners as additives in food products is strictly limited by the GD 229/2013 regulation [19]. According to the document, local producers have the right to use 17 food sweeteners, of which 8 are natural and 9 are synthetic.

Table 2: Characteristics of the main synthetic sweeteners consumed by the population of the Republic of Moldova [20]

Sweetener name	Sweetness coefficient	Benefits	Disadvantage	Consumption norm
Aspartame E 951	200	Stable in liquid	Unpleasant aftertaste	50 mg per 1 kg body weight
Potassium acesulfame E 950	200	It has a long shelf life; does not cause allergies; does not contain calories	Weakly soluble; products containing it should not be used for children, pregnant and lactating women; contains methanol, which leads to disruption of the heart and blood vessels; contains aspartic acid, which excites the nervous system and causes addiction	Not more than 1 g per day
Potassium saccharin E 954 (IV)	300–500	Resistant to heat and acids; no calories	Slight odor, unusual metallic taste	0,2 g per day
Calcium saccharin E 954 (III)	300–500			
Calcium cyclamate E 952 (III)	30	Calorie-free, high temperature resistant	Prohibited use in the European Union and America	0,8 g per day
Sucralose E 955	600	no calories	Applicable to beverages, sweets, protein powders	Not more than 60 g per day

The analysis of the chemical composition of a wide range of foods available to consumers in the Republic of Moldova was carried out. Thus, the main sweeteners used in the production technology of such food groups as beverages, preserves, dairy products and pastries were identified (Figure 5).

It has been established that the diet of consumers from the Republic of Moldova includes foods with a high content of synthetic sweeteners (E 951, E 950, E 952, E 954, E 955). The properties of the respective

sweeteners were studied in more detail in order to establish their influence on the health of the local population (Tabel 2).



Figure 5. The assortment of sweet compounds found mainly in the diet of local consumers

According to Tabel 2, most synthetic sweeteners have certain disadvantages, such as low digestibility (E 950), unpleasant aftertaste and odor (E 951, E 954), health risk (E 952). From the nutritional and technological point of view, the sweetener E 955 – sucralose, which is currently found more in domestic baked goods, can be considered the most promising.

Conclusions

The issue of choosing natural and synthetic sweeteners to obtain quality food plays an important role today, as it concerns consumer goods. It can be mentioned that the main natural sweeteners available to consumers in the Republic of Moldova are sugar and glucose-fructose syrup used for preserves and Erythritol E 968 and Sorbitol E 420 for confectionaries. Items such as stevia and honey, despite a number of positive qualities, are rarely used due to the high price. Popular synthetic sweeteners in the local market are acesulfame E 950, aspartame E 951, cyclamate E 952 and saccharin E 954, which are often found in food groups such as beverages, dairy products and pastries.

This fact can be explained not only by their low cost, but also by the technological application criteria. So, for example, some sweeteners are highly soluble in water, but lose their properties at high temperatures (aspartame). Others have an unpleasant aftertaste (saccharin, acesulfame) that is masked by various additional flavours, which is acceptable for drinks, but not for other food groups.

Thus, synthetic sweeteners with a low price policy are the most popular, which is associated with the economic situation in the country, as well as with the benefit for food producers. The use of these food additives, according to scientific studies, can cause a number of diseases not only by itself, but also due to additional chemicals that mask the shortcomings of synthetic sweeteners.

As one of the measures necessary to improve the life level and health quality of the population of the Republic of Moldova, it is recommended to inform citizens about the risks associated with the use of

sweeteners through food labels with the obligatory indication of the recommended daily dose.

Acknowledgment: The research was funded by the State Project 20.80009.5107.09 “Improving of food quality and safety through biotechnology and food engineering”, running at the Technical University of Moldova.

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