

STORING POULTRY IN VACUUM PACKAGES AND IN GAS ADJUSTED ENVIRONMENT

*¹Ștefîrța I., ¹Coev G., ²Gudima A., ²Rubțova S.

¹„Practical Scientific Institute of Horticulture and Food Technology” – Chișinău, Moldova

²Technical University of Moldova – Chișinău, Moldova

*Ștefîrța Irina, rafaela85@mail.ru

Abstract: The aim of this research is the study of the changes of microbiota in the atmosphere packaged, vacuum packed and gas packed (GAE - CO₂ -40%, O₂-20%, N₂-70%) poultry, stored in a frozen state at 0-4°C. Before being packed, the poultry has been treated with antimicrobial solution 0.5% H₂O₂, and subsequently with UV rays. The studies have been performed in the SPIHFT laboratory of food biotechnology. After storing the samples for 5 days in a frozen state at 0+4°C, we discovered that the level of NAMFAG was constant - 10⁵ UFC per 1g product and didn't exceed the admissible level in neither of the used methods of packing and storage.

Keywords: poultry, fowl processing, storage conditions, processing method.

Introduction

In the last decade, Republic of Moldova recorded an increase of poultry grown in breeding farms, as well as in the industrial process, with the use of intensive breeding technologies. This increase of poultry production is determined by the possibility of growing poultry in a short term (broiler chicken gain the necessary weight for slaughter in 40 days).

Poultry is considered white meat; it has dietetic properties and can be used in the alimentation of children of all ages (older than 3 months), grown-ups and elderly persons. People all over the world like to eat poultry in natural state, which represents 80-85% of the bird's weight and only 10-12% are used to prepare chopped meat products [1, 2].

Meat processing represents a complex of processes, closely related to biology, chemistry, processing technology and engineering, marketing and trade.

Worldwide, the industry of meat processing develops at a very high rate. USA has an increased interest in meat processing technology and in the poultry export. In the same time, EU and CIS countries develop their technologies, in order to obtain natural poultry products in cold storage and frozen state [3, 4, 5].

The main problem is that different species of prokaryotes such as *Pseudomonas*, *Clostridium bacillus*, *Listeria monocytogenes*, *Streptococcus*, *Lactobacillus* and *Enterobacter* can be found at the surface of poultry in frozen state. Moreover, because poultry (broiler chicken, duck, goose, turkey) contain easily oxidizable fat, the shelf life of these products in frozen or refrigerated state is relatively short.

There are several methods of antimicrobial treatment for poultry: physical, chemical and combined methods. The most efficient are the chemical methods, which imply the treatment with aqueous solutions of chlorine, paracetic acid, hydrogen peroxide, functional additives, and UV rays.

Poultry and poultry products represent one of the most important elements of a person's rational nutrition. Poultry products are considered a good source of proteins,

vitamins, fatty acids, polyunsaturated fatty acids and other substances vital for the normal development of the human body [6].

Packing and storage methods for poultry

The competition on the poultry meat market forces the manufacturer to come up with new decisions and original ways to sell the product better. These decisions may imply creating new and original products or improving the already known products and packages, which may increase the shelf life and make them "familiar" to the consumers. The innovation in this area can increase the sale rate up to 30%.

The package is very important in the branding process of any product, including the natural semi-finished poultry products. Marketing studies [7, 8, 9] showed that the proportion of spontaneous food purchases is high, and consumers choose goods within 10 seconds. The publicity also influences the consumer's choice, but the final decision is made right in front of the rack, when the person sees the exterior design and the package of the product.

The package used for natural semi-finished poultry products has several purposes: to protect the product from environmental factors; to give the product a nice appearance; to maintain the internal conditions (t, pH, p, W) of the products; esthetical aspect.

The requirements of the package are: chemical and microbiological harmlessness; to be air-proof, compact, according to the customer's demands; to maintain the shape of the products and to be ecological.

The most common package for the natural semi-finished poultry products are plastic bags and plastic trays of different origin, so-called containers.

Packing meat in containers has already become a classical method. The bags can be air pumped, thermal sealed and tied. The downsides of this type of package - low rate of hygiene, short shelf life and unattractive design.

The polymeric materials that can be used for the containers are polypropylene (PP), polystyrene (PS), polyamide (PA), oriented polyamide (OPA), polymer ethylene with vinyl alcohol (EVOH) [5, 7].

Each of these polymers has its own benefit, but their combination will increase the storage period of poultry products, while ensuring all the necessary protection.

Poultry products belong to the group of alimentary products that "breathe" during the storage [8]. The storing process limits the oxygen's access to the package and maintains the uniform elimination of the breathing products - CO₂.

Packing poultry products in the protection gas atmosphere prevents the penetration of steam and foreign gas into the package. The benefits of gas packing method are: the increase of the shelf life and the impossibility of the package to touch the product's surface. The gas adjusted environment is composed of oxygen, carbon dioxide and nitrogen. The nitrogen is the one that provides volume. The high content of oxygen is used to maintain the color of the meat stable. The gas with high content of CO₂ prevents the reproduction of aerobic micro flora.

Storing the fresh meat in CO₂ atmosphere enhances the storage period with 15-40%, the conservation effect being directly proportional to the concentration of CO₂. The action of CO₂ has an impact on fungi, Pseudomonas and Achromobacter bacteria, while the yeast and Lactobacillus are less affected.

The meat of the broiler chicken requires storage of CO₂ and nitrogen atmosphere, at 50:50 or 30:70 ratios.

Still, nowadays most of the manufacturers pack poultry in bags or containers of different polymeric material and the vacuum or inert gas environment pressurization is less used. One plausible explanation can be that the last two methods make the price higher and this is characteristic not only for Moldova, but also for Russia, Ukraine and European countries. These methods are popular in USA, where 90% of products are cooked and ready for direct consumption.

Results and discussions:

Before proceeding with the lab testing, we have purchased anatomical parts of broiler-chicken (wings, legs, mesh, and thigh) from “Vispas and Co” LLC, in Hirbovat village, Anenii-Noi, Republic of Moldova. The fresh refrigerated meat has been technologically treated in different conditions. The primary procedures of cleaning and rinsing with ice water, ice water + 0.5% H₂O₂; 0.1% H₂O₂ and treatment with UV rays and the dosage in polymeric propylene containers were held at the laboratory of food biotechnology in SPIHFT.

The final procedures of packing, pressurization in atmospheric and gas adjusted conditions (CO₂ -40%, O₂-20%, N₂-70%) were performed in the packaging department of the “Harvit-Pro” company, in Cricova, Chisinau.

The prepared samples have been stored in the refrigerated state at the 0+4°C in the laboratory fridge.

The following microbiological parameters have been determined during the storage:

NAMFAG (number of Aerobic mesophilic and facultative anaerobic germs) - GOST 10444.15, GOST 9958;

- coliform bacteria - GOST 30518, GOST 4288, GOST 9958;

- pathogenic microorganisms, including Salmonella - GOST 30519, GOST 9958, GOST 4288;

- sulfate-reducing Clostridia - GOST 10444.9 – 88;

- Staphylococcus aureus - GOST 10444.2;

Table 1 Microbiologic indices of the fresh broiler meat after the primary treatment

Microbiological indices	Treating method		
	Ice water	Ice water + H ₂ O ₂	H ₂ O ₂ +UV
NAMFAG, UFC per 1g product	1.2x10 ²	2x10 ²	1.5x10 ²
Coliform bacteria per 0.001g product	Detected	Detected	Detected
Pathogenic microorganisms, including Salmonella per 25g	Not detected	Not detected	Not detected
Sulfate-reducing Clostridia per 0.1g and 0.01 g product	Not detected	Not detected	Not detected
Staphylococcus aureus per 1.0 g product	Not detected	Not detected	Not detected

The microbiological analysis of the fresh broiler meat revealed that the NAMFAG is in admissible limits 1×10^3 UFC per 1g of wings and thigh, 1×10^4 UFC per 1g of legs and mesh (SanPiN 2-3-2-1078-01 stipulates that the admissible limit of NAMFAG for the natural semi-finished poultry products with bones is 1×10^5 UFC per 1g).

Pathogenic microorganisms, such as Salmonella, sulfate-reducing Clostridia and Staphylococcus aureus have not been found in neither of the initial samples.

Coliform bacteria, which are not limited by the SanPiN and the Rules of the microbiological criteria for the alimentary products, approved on 16.03.2009 by the Decision nr.221 of the Government of Republic of Moldova (Monitorul Oficial nr. 59-61, art. 272 on 24.03.2009), have been found in all of the initial samples.

We consider that the causes of the presence of coliform bacteria in the initial samples are the unsatisfactory conditions of preparation and industrial transportation of the researched raw material.

Table 1 reveals that all 3 methods of primary treatment: ice water; ice water + 0,5% H_2O_2 ; 0,1% H_2O_2 and subsequent treatment with UV rays reduces the level of NAMFAG in semi-finished products such as mesh and thigh from 1×10^3 UFC per 1g to 1×10^2 UFC per 1g of product.

Even after the initial treatment, the coliform bacteria have been detected in 0.01g of product, same as in the fresh samples. This proves that the treatment measures do not kill them. Other groups of microorganisms have not been detected.

According to the data from table 2, the storage of semi-finished tested products in the refrigerated state at the $0+4^\circ C$ for 5 days allows us to maintain the level of NAMFAG in the legs and wings samples in the admissible limits for all 3 methods of storage and pasteurization: atmospheric conditions, vacuum and gas adjusted environment (CO_2 -40%, O_2 -20%, N_2 -70%), which correspond to the level 10^5 UFC per 1g product. 6 days of storage in the same conditions caused the increase of the total number of germs up to 10^6 UFC per 1g product, which exceeds all the admissible limits.

It is worth mentioning that the result of sensory evaluation of the samples stored for 3 days is satisfying: the appearance, color and smell of the samples correspond to the characteristics of the refrigerated poultry meat. After 6 days of storage in the conditions named above the sensorial characteristics of the products are poor: the wings, legs and thigh emanated an inadmissible smell for an alimentary product, the surface of the refrigerated products was sticky, which means that the process of alteration has already begun.

The physico-chemical characteristics revealed the increase of the acidity and peroxide index, as a result of the process of fats oxidation. This correlates with the decrease of the mass of fat in the legs and wings samples, packed in atmosphere, vacuum and gas adjusted environment.

Table 2 The microbiological changes of the semi-finished poultry products during the storage at the temperature 0+4°C (3-6 days of storage) A – simple atmosphere, V – vacuum, GAE – gas adjusted environment

Microbiological indices	Legs						Wings			
	A		V		GAE		V		GAE	
	5 days	6 days	5 days	6 days	5 days	6 days	5 days	6 days	5 days	6 days
NAGFAG	2,5x10 ⁵	3,1x10 ⁶	1,3x10 ⁵	3,3x10 ⁶	3,0x10 ⁵	4x10 ⁶	0,5x10 ⁵	1,5x10 ⁶	1,5x10 ⁵	2x10 ⁶
Coliform bacteria per 0.001g of product	Detected	Detected	Detected	Detected	Detected	Detected	Detected	Detected	Detected	Detected
Pathogenic microorganisms, including Salmonella per 25g	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Sulfate-reducing Clostridia per 0.1g and 0.01 g product	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected
Staphylococcus aureus per 1.0g product	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected

Conclusions

The technological tests performed in the laboratory of food biotechnology, where the anatomic parts of chicken-broiler have been treated with ice water, ice water + 0.5% H₂O₂; 0,1% H₂O₂ and subsequently treated with UV, showed that the level of NAMFAG decreases from 1x10³ to 1x10² UFC per 1g of product.

Packing the natural semi-finished poultry products in containers with vacuum and gas adjusted environment (CO₂ -40%, O₂-20%, N₂-70%) makes possible their storage for 5 days in the admissible limits of the microbiological characteristics.

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