KAPITEL 3 / *CHAPTER 3* [3]
THE USE OF NON-TRADITIONAL RAW MATERIALS IN THE TECHNOLOGY OF THE PRODUCTION OF COOKED SAUSAGE PRODUCTS

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Introduction

The production of fish sausages has been successfully developed in many countries in recent years. This started in Japan. The expansion of this production is stimulated by an increase in the catch of small fish, as well as fish with low palatability, which can be successfully used in the production of fish sausage products.

Moreover, as experts note, due to the saturation of easily digestible protein and essential amino acids, such as lysine and tryptophan, fish sausage is more useful for human health than meat and chicken counterparts. Another advantage of fish sausage is that, having the initial raw materials, it is possible to establish its production not only at a specialized fish factory, but also at a regular meat processing plant.

The technology of sausage products has been developed and implemented in many countries of the world, but the production of these products in Ukraine is limited.

Recently, developments aimed at improving the use of new raw materials, technical production processes, and recipe compositions have become particularly important.

The modern classification of sausage products opens up the possibility of producing a wide range of products - cooked sausages, sausages in which the assortment can be expanded by developing new recipes due to the inclusion of additional raw materials in order to expand the range of sausage products.

The development of such a product when using combined components allows to create a product that will provide a person with a full spectrum of nutrients.

The purpose of the work is to improve the technology of cooked sausage products using non-traditional raw materials.

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Object, subject, and methods of research

The object of research is the technology of cooked sausage products using non-traditional raw materials in combination with dried vegetable raw materials (bell pepper, olives, garlic) and natural dye (cuttlefish ink).

The subject of the study is quality and safety indicators of cooked sausage products from non-traditional raw materials and their changes during storage.

Research methods. During the research, the following methods were used: organoleptic, physical, physicochemical, microbiological, methods of experiment planning and statistical and mathematical data processing based on computer technologies.

Studies of the chemical composition have been performed according to the following methods: mass fraction of moisture – by drying the product sample to a constant weight in an oven SNOL (Labimpex LTD, Ukraine) at a temperature of 100-105ºC according to DSTU 8029:2015; mass fraction of ash – by a weightning method, after the product portion mineralization in a muffle furnace SNOL (Labimpex LTD, Ukraine) at a temperature of 500−600°C according to DSTU 8718:2017; mass fraction of lipids – by the Soxhlet extraction-weight method according to DSTU 8718:2017 on the SOX 406 Fat Analyzer (Hanon Instruments, China); mass fraction of protein – by Kjeldahl method of the determination of a total nitrogen, which is based on the ability of organic matter of the product sample to be oxidized with concentrated sulfuric acid in the presence of a catalyst according to DSTU 8030:2015, while samples ashing has been performed on a DK6 digester (Velp Scientifica, Italy), with a vacuum pump JP, distillation has been carried out on a steam distillation apparatus UDK 129 (Velp Scientifica, Italy).

Determination of organoleptic parameters has been carried out by the profile method using a 5-point scale, according to the recommendations of Safronova T.M.

The acid number of lipids was determined according to DSTU EN ISO 660:2019. Peroxide number of lipids, according to DSTU EN ISO 3960:2019. Shelf life was determined by the dynamics of changes in the complex of organoleptic, physicochemical and microbiological indicators.

Results

The main raw material for the production of cooked sausage products is minced hake (frozen state) and chicken fillet (cooled state).

During the study of fish raw materials, its chemical composition was determined, which is shown in the table. 1.

Table 1 - Chemical composition of hake

Indicator	Content per 100 g of product
Calories, kcal	90
Protein, g	18,31
Fat, g	1,31
Water, g	79,9

Chicken has a moderate energy content, highly digestible proteins (low collagen) of good nutritional quality, unsaturated lipids (mainly found in the skin and easily removed), B vitamins (pantothenic acid, thiamine), helps reduce the risk of overweight and obesity , cardiovascular diseases and type 2 diabetes.

The chemical composition of chicken is given in the table. 2.

Table 2 - Chemical composition of chicken

Indicator	Content per 100 g of product
Calories, kcal	202
Protein, g	18,5
Fat, g	14,3
Carbohydrate, g	0
Water, g	0,9

The combination of fish and meat raw materials makes it possible to produce a new full-fledged product, namely a cooked sausage product in combination with various types of raw materials.

The nutritional value of salmon roe used for the production of cooked sausage products is given in the table. 3.

Cuttlefish ink is a natural dye to obtain a rich black color in a convenient single-use package of 2 sachets of 4 g. It contains: cuttlefish ink (40%), water, salt and stabilizer: sodium carboxymethylcellulose. Does not contain gluten. It may also contain shellfish and traces of crustaceans, celery and milk.

Table 3 - Nutritional value of salmon roe

Indicator	Content per 100 g of product
Calories, kcal	249
Protein, g	26,0
Fat, g	13,2
Water, g	62,0
Carbohydrate, g	1
B_1, µg%	1800
B_2, µg%	2100
Folic Acid, µg%	1300
PP, µg%	2,1
Pantothenic Acid, µg%	1,3
Vitamin C, µg%	93

In the production of cooked sausage products from non-traditional raw materials, samples from the manufacturer "Savin product" were taken as a basis. Product composition: turkey meat refined sunflower oil, red caviar, cow's powdered milk, kitchen salt, sugar, spice extracts (nutmeg, black pepper, allspice), color fixative (sodium nitrite), drinking water end cuttlefish ink.

In the developed recipes of cooked sausage products, additional vegetable raw materials were added to obtain pleasant taste properties, an increase in the content of natural dyes to obtain a rich color of the finished product, the introduction of fish raw materials and changes in animal raw materials to improve the taste properties taking into account the daily needs of the human diet, as well as the introduction of new water-retaining component for better stabilization and shape retention of the product. Developed cooked sausage products are presented in table 4.

The obtained samples of cooked sausage products are shown in fig. 1 - 3.

Therefore, when developing the above-mentioned recipes, one can get a cooked sausage product enriched with vitamins of group B, PP, A and E, mineral elements such as iron, iodine, phosphorus, calcium, essential Omega-3 fatty acids, which is quite easily absorbed by the body and corresponds to the principles of healthy food.

The results of the university study (Fig. 4) and water holding capacity (Fig. 5) of the ability of minced meat.

Table 4 - Sausage recipes "Squid ink & Red caviar and bell pepper", "Squid ink & Red caviar and olives", "Ink Cuttlefish & Red Caviar & Garlic"

The name of the components	Recipe composition, g/100 g of products		
	Sample 1	Sample 2	Sample 3
Hake meat	42	47	45
Chicken meat	10	10	10
Refined sunflower oil	20,5	20,5	20,5
Red caviar	6,5	6,5	6,5
Potato starch	2	2	2
Spelled flour	6	6	6
Kitchen salt	1	1	1
Sugar	0,4	0,4	0,4
Spices (basil, oregano, thyme)	5,55	3,55	5,55
Cuttlefish ink	1,05	1,05	1,05
Dried bulgarian red pepper	5	-	-
Dried olives	-	2	-
Dried garlic (granulated)	-	-	2

Figure 1 - Sample 1 "Squid Ink & Red Caviar & Bell Pepper"

Figure 2 - Sample 2 "Cutball Ink & Red Caviar & Olives"

Figure 3 - Sample 3 "Squid Ink & Red Caviar & Garlic"

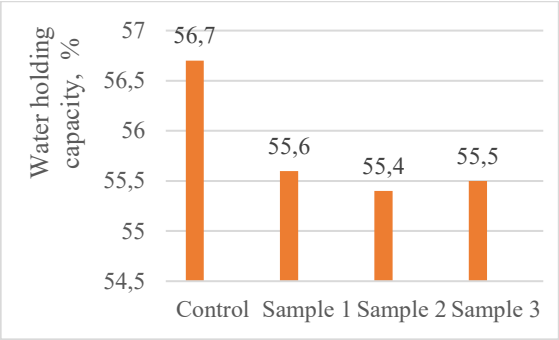


Figure 4 - Changes in the moisture-retaining capacity of minced meat

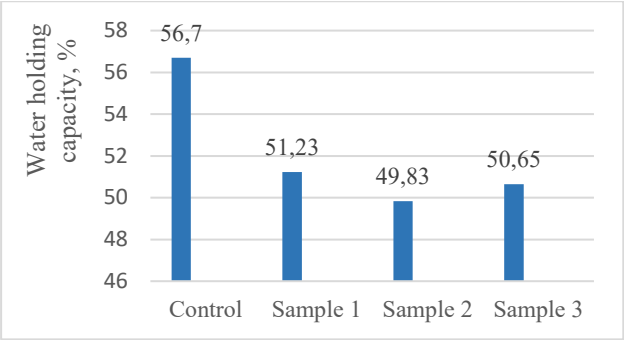


Figure 5 - Changes in the hair-binding capacity of minced meat

Based on a set of organoleptic indicators, a quantitative evaluation of cooked sausage products was carried out in comparison with the control sample. When obtaining an overall evaluation based on organoleptic indicators, it is possible to assert the superiority of experimental formulations No. 1 and No. 3 over the control sample, as it had a very dense consistency, an unpleasant taste, in which none of the components of the sausage stood out.

In recipe No. 1, the taste, smell and juiciness are improved due to the introduction of red bell pepper, due to the high moisture content it increases the juiciness and also provides a pleasant sweet taste. In recipe No.3, due to the introduction of dried garlic, the taste properties of the product are improved, which provides a subtle, soft taste. In recipe No.2, the overall score is lower compared to recipes No.1 and No.3, but higher than the control, due to the addition of dried olives and herbs, which improve the consistency and give a unique smell.

To determine the qualitative differences in the organoleptic evaluation of the developed product, the construction of profilograms was added, which will allow to visually demonstrate the full picture of the comparative evaluation of the samples. The graphically obtained indicators are presented in fig. 6 - 8.

Summarizing the obtained results of the comparative evaluation of organoleptic indicators, it can be stated that the introduction of plant raw materials allows to increase organoleptic indicators. All developed recipes had high overall scores compared to the control sample, but differed in the improvement of some specific indicator due to the introduction of different plant materials.

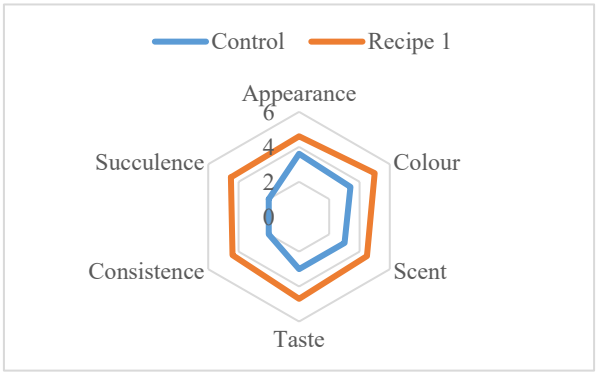


Figure 6 - Comparative analysis of Sample 1 with the control sample

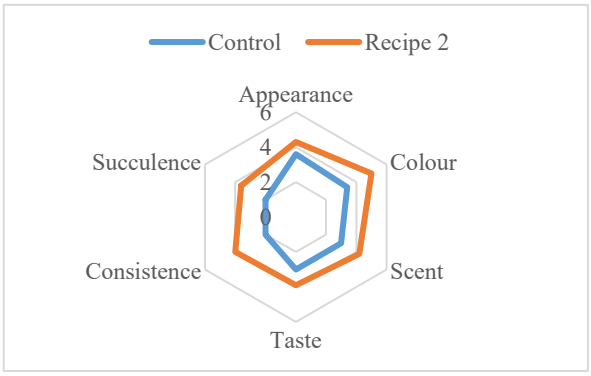


Figure 7 - Comparative analysis of Sample 2 with the control sample

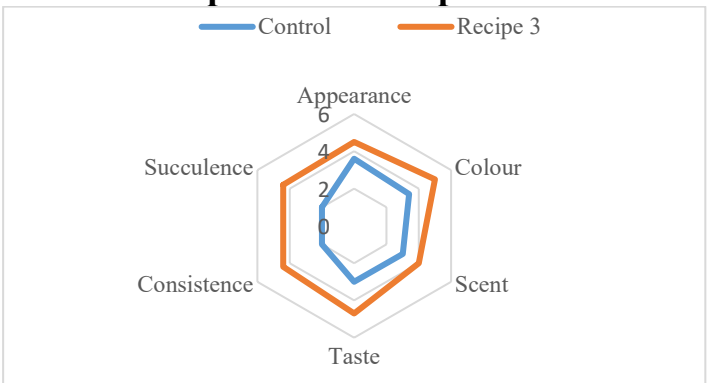


Figure 8 - Comparative analysis of Sample 3 with the control sample

A needle indenter (m=2 g) was used to determine the penetration of ready-made cooked sausages (spring-elastic products). Measurements are carried out on the open surface of the sample, at a distance of at least 10 mm from the edge of the sample and the maximum distance from the points of other measurements while avoiding air inclusions and other defects on the surface.

When using a needle indenter, measurements were made at five points along the length of the product for each sample. In fig. 9. the results of the ultimate shear stress for cooked sausage products are given.

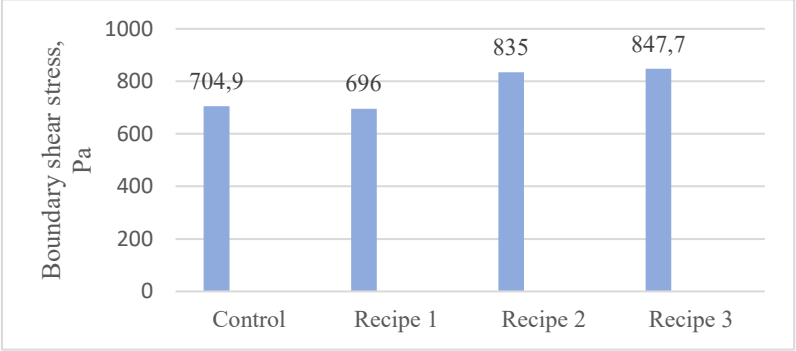


Figure 9 - Boundary shear stress of cooked sausage products

According to the diagram, better structural and mechanical properties were noted for samples 2 and 3 due to an increase in fish raw materials (in sample 2 - by 5 g, in sample 3 - by 3 g) and a different ratio of spices and dried vegetable raw materials (the amount of dried vegetable raw materials was introduced in the same amount - 2 g each, but in sample 2 - a reduced amount of spices compared to sample 3).

Compared to the control sample, the density of samples 2 and 3 increased by 18-20% due to the replacement of the pasting agent (replacement of powdered milk and a mixture of potato starch and spelled flour in a ratio of 2:6, respectively) and the use of small pieces of plant material compared to the sample 1.

In laboratory conditions, in order to evaluate the quality of ready-made cooked sausage products from non-traditional raw materials, chemical composition studies were conducted. The comparative characteristics of the chemical composition depending on the introduced auxiliary raw materials are presented in fig. 10 - 12.

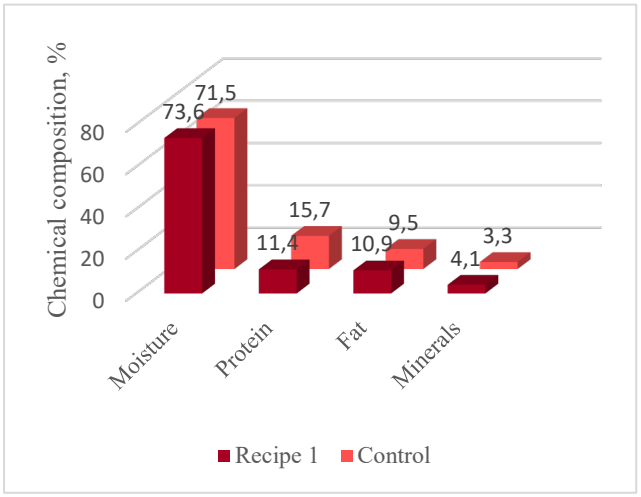


Figure 10 - Comparative analysis of the chemical composition of cooked sausage products (Control and sample 1)

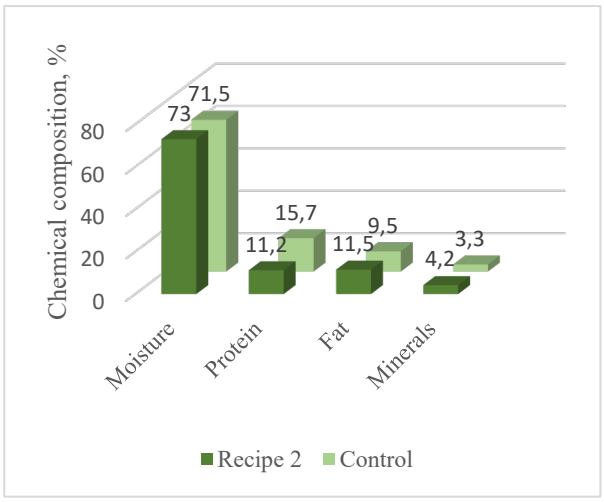


Figure 11 - Comparative analysis of the chemical composition of cooked sausage products (Control and sample 2)

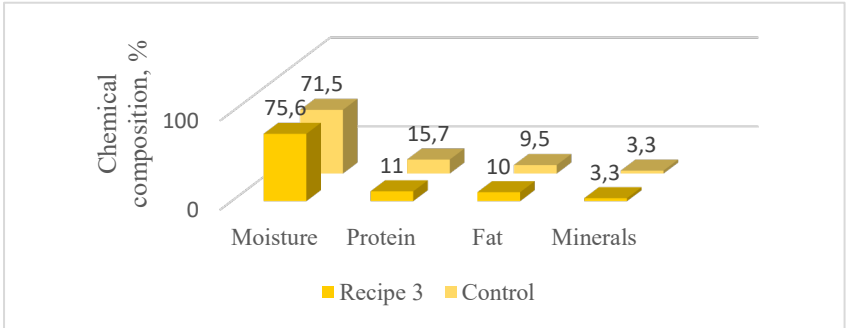


Figure 12 - Comparative analysis of the chemical composition of cooked sausage products (Control and sample 3)

Based on the obtained data, it can be concluded that the created recipes have a lower protein content by partially replacing fish raw materials with vegetable ones, a reduced fat content in all samples and an increased mineral content compared to the control sample.

The energy value of the product was calculated according to MU 4287-86. The obtained data are presented in the table. 5.

Table 5 - Energy value of cooked sausage products

Indicator	Boiled sausage products from non-traditional raw materials			
	Control	Sample 1	Sample 2	Sample 3
Energy value, kcal	148,3	143,7	149,5	134

Analyzing the obtained data, it can be concluded that the energy value of the studied samples does not differ much from the control. This is due to the small difference in chemical composition between the control and the tested samples.

Determination of the fatty acid spectrum was carried out according to DSTU ISO 5508-2001 by the method of gas chromatography of methyl esters of fatty acids. Sample preparation was carried out according to DSTU ISO 5509-2002. Chromatographic analysis of fatty acids was performed on a Trace Ultra gas chromatograph with a flame ionization detector, on a SP-2560 capillary column (Supelco). Method limit < 0.01%. The obtained results of the studied samples are presented in fig. 13 - 15.

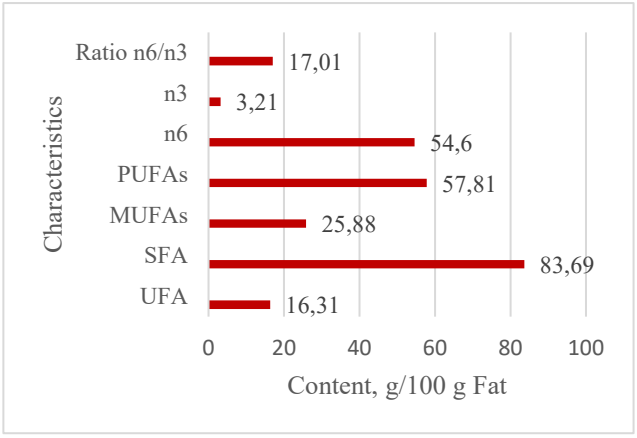


Figure 13 - Total amount of fatty acids in sample 1

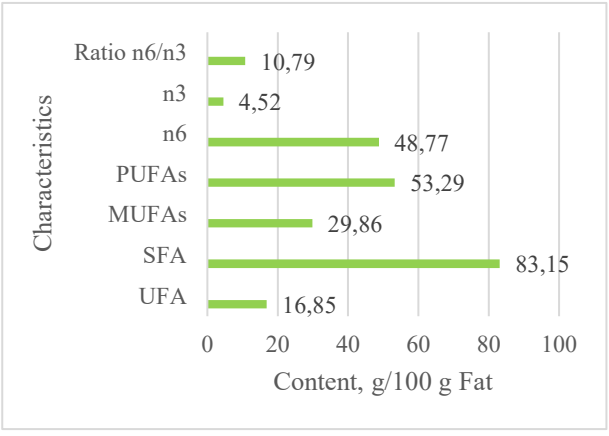


Figure 14 - Total amount of fatty acids in sample 2

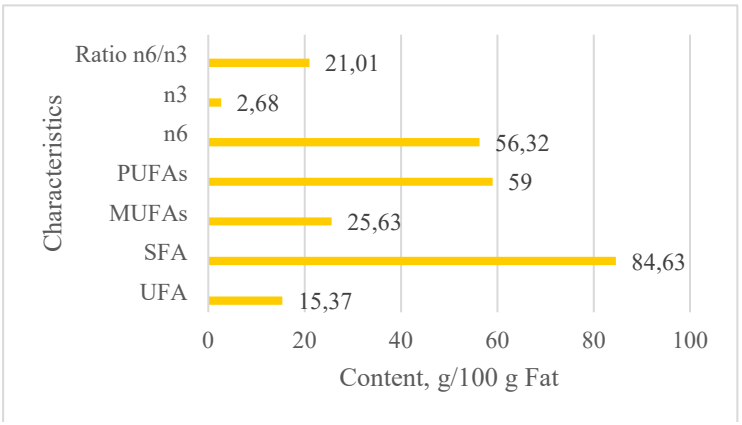
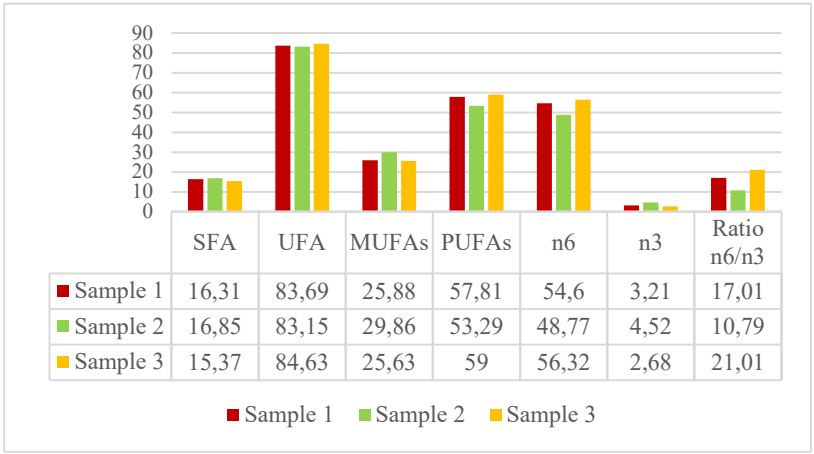


Figure 15 - Total amount of fatty acids in sample 3

The comparative characteristic of the amount of fatty acids of the studied samples is formally presented in fig. 16.



	SFA	UFA	MUFAs	PUFAs	n6	n3	Ratio n6/n3
Sample 1	16,31	83,69	25,88	57,81	54,6	3,21	17,01
Sample 2	16,85	83,15	29,86	53,29	48,77	4,52	10,79
Sample 3	15,37	84,63	25,63	59	56,32	2,68	21,01

Figure 16 - Comparative characteristics of fatty acid content

The total number of SFA almost does not change. The SFA content in the obtained samples does not exceed the daily norm. The total number of MUFAs almost does not change. A high indicator is observed in sample 2. The total amount of PUFAs almost does not change. A high indicator is observed in sample 3. The quantitative indicator of Omega-6 prevails in sample 3 over samples 1 and 2. The quantitative indicator of Omega-3 prevails in sample 2. The obtained result in sample 3 is 2 times less than in samples 1 and 2.

Evaluation of the organoleptic parameters of cooked sausage products was studied for 6 days at a temperature from 0 °C to 5 °C using a five-point scale. The results of changes in organoleptic parameters of cooked sausage products during 6 days of

storage are presented in fig. 17.

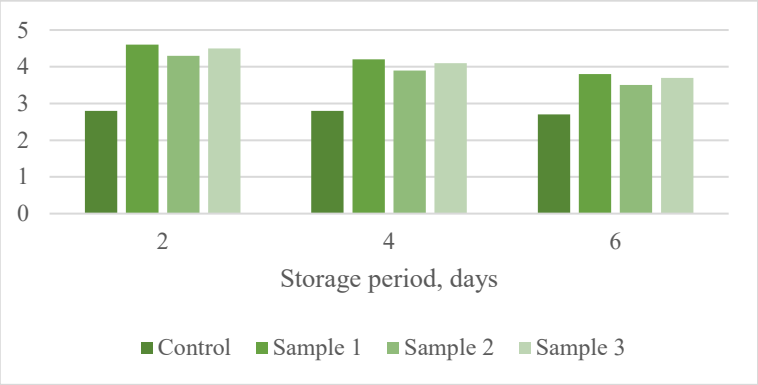


Figure 17 - Dynamics of organoleptic evaluation indicators during storage

During the organoleptic assessment, it was established that the most optimal storage period for cooked sausage products is 3 days. During this period, cooked sausage products correspond to high taste properties. When storing cooked sausage products (the studied samples) for more than 4 days, a decrease in organoleptic properties is observed (loss of saturated color, appearance of a strong fishy smell, deterioration of taste) due to the absence of a color fixative (sodium nitrite and quality indicators due to the deterioration of the muscle tissue of the raw material compared to the control sample.

The acid number is one of the main quality indicators characterizing the degree of freshness of the fat, as it determines the amount of free fatty acids, including those formed during the oxidation of fish fat during its storage.

In the process of storage, free fatty acids accumulate as a result of the hydrolysis of muscle lipids under the action of tissue lipases. The intensity of the lipid hydrolysis process and its directionality were judged by the accumulation of free fatty acids in the lipids of fish muscle tissue. The change in the acid number of lipids in the process of cold storage of experimental and control samples of cooked sausage products is presented in fig. 18.

Analysis of the change in the lipid acid number of experimental samples during cold storage showed that the rate of increase of this indicator was slower in the control sample compared to the experimental ones. The slowest change in acid number was observed in sample 1.

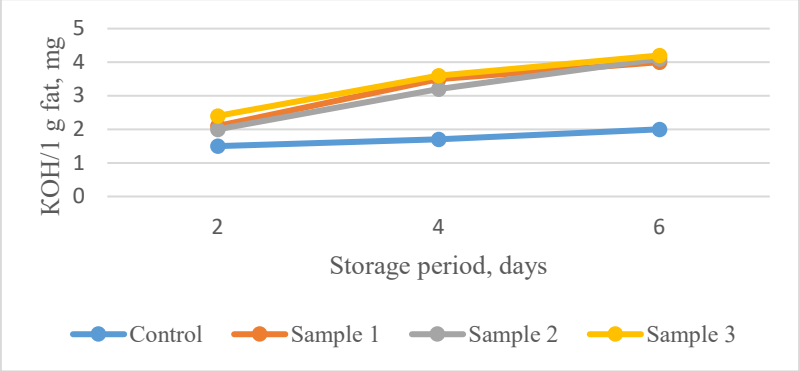


Figure 18 - Dynamics of changes in the acid number of cooked sausage products during storage

The content of peroxide compounds in fat was judged by the value of the peroxide number, which is a fairly sensitive indicator that characterizes the beginning and depth of oxidative deterioration of fat.

Conclusions

1. After analyzing the literature review, the current state of the fish products market, monitoring the missing elements for the human body and the introduction of products with a combined composition, it was advisable to improve the boiled sausage product with non-traditional raw materials.

2. After conducting technochemical studies of raw materials and chemical composition, it was proved that the introduction of fish raw materials and plant components, which were under the control of the manufacturer "Savin product", are suitable for improvement and development of a new formulation. An organoleptic, physico-chemical evaluation of finished products was carried out.

3. Research has established that the development of recipes for cooked sausage products from non-traditional raw materials have a dense consistency, a juicy structure, a pleasant taste, smell, and a uniform, saturated black color.

The use of hake, spelled flour and vegetable components (bell pepper, olives, garlic) enriches the product with fiber, vitamins and minerals.