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IMPROVEMENT OF SAUSAGE PRODUCTS TECHNOLOGY USING PROTEIN-FAT EMULSION BASED ON CHICKEN FAT

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ABSTRACT

o form and maintain health in childhood, it is important to regularly provide the body with proteins — natural substances from which cells are built, essential, micro- and macronutrients and, to the extent necessary, ballast and minor non-food biologically active components. When developing sausage recipes, turkey meat was selected, which has a high biological value and adding it to the diet will meet the human need for animal protein no worse than when eating other types of meat. According to the content of some minerals and vitamins, turkey meat satisfies the needs of the body quite fully.

The article presents a study of the developed recipes for sausages using turkey meat, defines the main functional and technological indicators of meat systems: moisture-binding capacity, emulsion stability and moisture-retaining capacity of finished meat products.

In order to improve the structure, increase the juiciness of sausages and ensure balance in amino and fatty acid composition in the developed sausages there was used protein-fat emulsion (PFE) based on animal functional protein ScanPro T 95 and chicken fat.

The use of functional proteins of animal origin is recommended provided they are pre-hydrated or made as a protein-fat emulsion. The results of studies of functional and technological indicators presented in the article showed that PFE, made by cold method, had greater stability and was able to better bind moisture, in contrast to PFE, made by hot method.

The development of recipes for sausages using turkey meat and protein-fat emulsion based on chicken fat has expanded the range of meat products. According to the organoleptic evaluation of the finished prototypes and the obtained functional and technological indicators, it was found that for further studies, the sample № 2 was selected as a basis with the replacement of raw meat by 30% PFE based on ScanPro T 95 protein and chicken fat.

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УДОСКОНАЛЕННЯ ТЕХНОЛОГІЇ КОВБАСНИХ ВИРОБІВ З ВИКОРИСТАННЯМ БІЛКОВО-ЖИРОВОЇ ЕМУЛЬСІЇ НА ОСНОВІ КУРЯЧОГО ЖИРУ

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Для формування та підтримання здоров'я в дитинстві важливим є регулярне забезпечення організму білками — природними речовинами, з яких будуються клітини, есенціальними, мікро- і макронутрієнтами і, в необхідному обсязі, баластними та мінорними нехарчовими біологічно-активними компонентами. При розробці рецептур сосисок обрано м'ясо індиків, яке має високу біологічну цінність, тому додавання його до раціону харчування дасть змогу задовольнити потребу людини в тваринних білках не гірше, ніж при вживанні інших видів м'яса. За вмістом деяких мінеральних речовин і вітамінів м'ясо індиків задовольняє потреби організму достатньо повно.

У статті досліджено розроблені рецептури сосисок з використанням м'яса індиків, приведені визначення основних функціонально-технологічних показників м'ясних систем: вологозв'язувальної здатності, стійкості емульсії та вологоутримувальної здатності готових м'ясних продуктів.

З метою покращення структури, підвищення соковитості та забезпечення збалансованості за аміно- і жирнокислотним складом у розроблених сосисках була використана білково-жирова емульсії (БЖЕ) на основі тваринного функціонального білка СканПро Т 95 та курячого жиру.

Використання функціональних білків тваринного походження рекомендують за умови їх попередньої гідратації або виготовлення білково-жирової емульсії. Результати досліджень функціонально-технологічних показників, представлені у статті, свідчать про те, що БЖЕ, виготовлена за технологією холодного способу, має більшу стійкість і здатна краще зв'язувати вологу, на відміну від БЖЕ, виготовленої за технологією гарячого способу.

Розроблення рецептур сосисок з використанням м'яса індиків і білково-жирової емульсії на основі курячого жиру розширює асортимент м'ясних продуктів. За органолептичною оцінкою готових дослідних зразків та отриманих функціонально-технологічних показників встановлено, що для подальших досліджень обрано за основу зразок № 2 із заміною м'ясної сировини на 30% БЖЕ на основі білка СканПро Т95 і курячого жиру.

***Ключові слова**: ковбасні вироби, сосиски, курячий жир, білково-жирова емульсія, функціонально-технологічні показники.*

Formulation of the problem. The main factor that determines human health in adulthood is nutrition during the first years of life. During this period, the body needs the right amount of micronutrients for the full development and growth of the child: formed and consolidated eating habits and preferences, further development of the

musculoskeletal system, development and differentiation of the central nervous system. Violation of the principles of nutrition at this age can lead to a predisposition to cardiovascular and food-dependent diseases, which can significantly reduce the health and quality of life of an adult. Good nutrition, along with other factors, ensures the development of the child's body, strengthens its immune status, supports adaptation processes at the appropriate level (Smolyar, 2007; Mayurnykova, 2005).

Meeting the demand of the population in safe and biologically complete sausage products is closely related to improving production technology and expanding the range of meat products. In modern conditions, the consumer seeks to eat products with natural ingredients, so sausage manufacturers need to diversify the range of sausages with the addition of healthy ingredients. When developing recipes for innovative meat products, scientists take into account the daily needs for essential nutrients and dietary characteristics of people of different ages.

Analysis of recent research and publications. Research on the problem of improving technology and developing food for children and other groups was contributed by M. Gulich, A. Dorokhovych, M. Peresichny, V. Korzun, V. Pasichny, P. Karpenko, L. Peshuk, Marteau, K. Zanini and others.

Primary processing of broiler chickens produces fat-containing by-products, mainly fat from the abdominal cavity, which without proper processing can cause environmental problems. The use of chicken fat as a protein-fat emulsion in the technology of sausages is relevant. Development of the recipe for sausages for baby food using turkey meat and protein-fat emulsion based on chicken fat and functional animal protein ScanPro T 95 will allow the combination of meat resources of different origin to balance the product's chemical composition and achieve good functional and technological indicators.

Food modeling is the process of designing product as a holistic system, consisting of elements that do not separately provide the specified properties. Only food combinatorics in food design can provide body with essential substances, which causes the problem of expanding the range of functional meat products (Mayurnykova, 2005).

The purpose of scientific work was to improve the technology and development of recipes for sausages from turkey meat using protein-fat emulsion based on low-functional fats and the study of organoleptic and functional-technological indicators of minced meat and finished products.

Materials and methods. Standard research methods were used to determine the organoleptic and physicochemical parameters of model minced meat systems.

Protein-fat emulsion based on ScanPro T 95 protein and chicken fat was prepared according to the recommendations by cold and hot methods.

Hot method: 25 parts of chicken fat, pre-crushed on a skewer with a hole diameter of 2…3 mm, was loaded into a blender and grounded to a homogeneous mass. Then one part of the protein ScanPro T 95 was loaded, the mass was mixed and 25 parts of hot water were poured at a temperature of 75°C and treated to obtain a homogeneous elastic emulsion.

Cold method: 8 parts of chicken fat, pre-crushed on a skewer with a hole diameter of 2…3 mm, was loaded into a blender and grounded to a homogeneous mass. Then

one part of the protein ScanPro T 95 was loaded, the mass was mixed and 8 parts of warm water were poured at a temperature of 30°C and treated to obtain a homogeneous elastic emulsion.

Quality control of the developed recipes was carried out according to the recipe of Sausage "Baby meat" according to TU U 15.1-30486765-002:2005 — Sausage products.

Presentation of the main results of the study. When developing the recipe for sausages, turkey meat was chosen, which has a tender texture, juiciness, aroma and high taste. Low fat content was one of the characteristic features that affected the consistency, color, taste preferences and energy value of this meat in comparison with the meat of broiler chickens (Table 1). Turkey meat is rich in minerals, including iron, phosphorus and sodium (Table 2) (Stefanova, Kulishev & Shakhnazarova, 2013).

Table 1. **Chemical composition of turkey meat and broiler chicken 100 g**

Name Contents:	Broiler chicken fillet	Turkey fillet	Dark broiler chicken meat	Dark turkey meat
Proteins, g	31	30	27	28
Fats, g	4	2	10	6
Energy value, kcal	165	147	205	173

Table 2. **Mineral and vitamin composition of turkey and broiler meat**

Indicator	Content, mg/100 g of meat	
	Turkey meat	Chicken meat — broilers 1 cat.
Minerals:		
Phosphorus	320	200
Calcium	24	12
Potassium	210	236
Sodium	90	70
Magnesium	19	19
Iron	3.2	1.5
Vitamins:		
A (retinol)	0.18	0.12
B_1 (thiamine)	0.06	0.15
B_2 (riboflavin)	0.08	0.16
PP (nicotinic acid)	7.0	6.5

In the diet of preschool children there should be optimal ratio of calcium and magnesium — 1:0.22. It is known that an excess of magnesium can lead to impaired absorption of calcium (Stefanova, Kulishev & Shakhnazarova, 2013).

Therefore, turkey meat has a high protein value, and the inclusion of this meat in the diet will meet the human need for animal protein no worse than when eating other types of meat. According to the content of some minerals and vitamins, turkey meat satisfies the needs of the body quite fully (Смоляр, 2013; Haschuk, Moskalyuk, Grishchenko & Huraleych, 2020; Haschuk & Moskalyuk, 2020).

Among the protein preparations used in sausage production to improve the functional and technological properties of meat systems, as well as to increase the nutritional and biological value of meat products are eggs or egg products, milk protein preparations (milk powder, sodium caseinate, dairy whey), soy protein concentrates and isolates and animal proteins. Functional animal proteins have a neutral smell or taste of fried meat or pork skin, which distinguishes them from soy proteins. The use of animal proteins significantly improves the sensory characteristics of the finished products and consistency. They act as stabilizers, fat emulsifiers, jellies and gem formers, which significantly improves the appearance of products. ScanPro T 95 protein has unique properties to bind water and fat. It also emulsifies vegetable oil in cold form. This protein can reduce heat loss by up to 10%, thus making the finished products juicy and improving their texture.

The most effective use of functional proteins of animal origin was achieved under the condition of their preliminary hydration, preparation of protein-fat emulsion (PFE), which led to improved structure, increased juiciness of meat products and balance in amino and fatty acid composition (Кишенько, Крыжова, Донец & Топчий, 2014; Пасічний & Полумбрик, 2016; Pasichny, Marinin, Moroz & Geredchuk, 2015).

Emulsification or processing of emulsions is the basis of many technological processes of food production. Emulsions include prodycts of natural origin (milk, dairy products, minced meat). The efficiency of production and stability of emulsions depend on the type of fat and emulsifier, the degree of dispersion of particles, temperature, pH and other factors. Protein plays an important structural role in the process of obtaining emulsions (Kyshenko, Kryzhova & Zhuk, 2017).

When adding fats directly into the minced emulsion, they cause the appearance in the finished product of such defects of consistency as smearing, stickiness. Low-value fats contain a large amount of saturated fatty acids, so at room temperature they are quite solid, which complicates their emulsification. In order to neutralize these shortcomings and to increase the use of low-functional fats, it was advisable to pre-manufacture a protein-fat emulsion, followed by its introduction into the minced meat systems. Emulsions were able to stabilize the fat in their composition and eliminate the granular texture of fat in the finished product (Kotlyar, Topchiy, 2017).

To study the functional and technological parameters of PFE on the basis of the protein ScanPro T 95 emulsion was prepared, according to the recommendations, by cold and hot methods, according to recipes (Table 3).

Table 3. **Formulation of protein-fat emulsion**

The name of the component	The method of preparation of PFE	
	Cold	Hot
	The amount of ingredient, kg	
Protein ScanPro T 95	1.0	4.0
Chicken fat	8.0	25.0
Water	8.0	25.0

After the experiment, the moisture-binding capacity of the emulsions and their stability were determined. The data obtained are presented in table 4, they indicate

that the BJE, made by the method of cold method, had greater stability and was able to better bind moisture, in contrast to the PFE, made by hot method.

Table 4. **Functional and technological indicators of PFE depending on a manufacturing method**

Indicator	Cold way	Hot way
Determination of moisture-binding capacity (DMC), % to total moisture	89.3±0.7	87.8±0.4
Emulsion stability (ES), %	82.0	66.0

So, analyzing the obtained results, it was found that in the development of experimental recipes for sausages it was necessary to use PFE based on chicken fat, made by the cold way.

Protein-fat emulsion can replace from 20 to 40% of raw meat. A series of experiments were performed to determine the amount of replacement of turkey meat with PFE in sausage recipes and to obtain optimal organoleptic and physicochemical parameters. A different amount of PFE was added to each sample: sample 1 — 35%, sample 2 — 30%, sample 3 — 25% of the mass of minced meat. The control of indicators was carried out according to the recipe of Sausage "Baby meat" according to TU U 15.1-30486765-002: 2005 — Sausage products.

The received recipes of model forcemeats with various content of PFE are presented in table 5.

Table 5. **Recipes of model stuffing of sausages with different content of PFE**

Name of raw materials	Raw material content, %			
	Control	Sample 1	Sample 2	Sample 3
Beef trimmed 1 grade	20.0	—	—	—
Veal trimmed single grade	30.0	—	—	—
Pork trimmed semi-fat	42.0	—	—	—
Turkey meat	—	57.0	62.0	67.0
Whole milk powder	5.0	5.0	5.0	5.0
Egg melange	3.0	3.0	3.00	3.0
PFE (1:8:8)	—	35.0	30.0	25.0
Spices in g per 100 kg of unsalted raw materials:				
Food salt	2200	2200	2200	2200
Black pepper	—	100	100	100
Sodium nitrite, ml	120	—	—	—

The results of organoleptic evaluation of the developed model recipes of sausages with different content of PFE are presented in the table 6.

Table 6. **Organoleptic characteristics of model minced meat systems**

Samples	External appearance	Color	Smell	Consistence	Taste	Averagerating
Control	4.3	4.7	5.0	3.0	4.0	4.2
№ 1	4.0	3.0	5.0	4.3	5.0	4.26
№ 2	4.5	3.0	5.0	4.7	5.0	4.44
№ 3	4.0	3.0	5.0	4.0	4.5	4.1

Sample № 1 was characterized by too springyand dense consistency. Moisture in the form of infusion of broth under the shell was released in sample № 3, and the consistency of the experimental sample was loose. Therefore, according to organoleptic parameters, according to the score, the best sample was № 2 with the replacement of 30% of raw meat by PFE.

The main functional and technological indicators of model meat systems with the use of PFE were determined: moisture-binding capacity, emulsion stability and moisture-holding capacity of finished products (Table 7).

Table 7. **Functional and technological indicators of model meat systems with different content of PFE**

Indicator	Control	Sample 1	Sample 2	Sample 3
Determination of moisture-binding capacity (DMC), % to total moisture	78.1±0.1	82.2±0.6	81.7±0.2	78.1±0.1
CE, %	56.8±0.5	75.4±0.1	75.5±0.4	56.8±0.3
Moisture holding capacity (MHC), %	69.25±0.03	76.2±0.2	75.4±0.3	66.3±0.1

The obtained experimental data show that the best indicators of emulsion stability, moisture-binding and moisture-holding capacity were in the samples № 1 and № 2 and were respectively: DMC — 82.2% and 81.7%, CE — 75.4% and 75.5%, moisture holding capacity in accordance — 76.2% and 75.4%.

The results of studies of the chemical composition of the developed recipes for sausages are shown in table 8.

Table 8. **Chemical composition of the formulations of the developed sausages from PFE**

Sample	Indicators				
	Protein content, %	Moisture content, %	Fat content, %	Ash content, %	Energy value (kcal/100g)
Control	no less than 10	no more than 75	no more than 30	no more than 1.2	252
Sample 1	12.5	68±0.3	17±0.16	1.2±0.1	203.0
Sample 2	11.2	65.8±0.2	21±0.2	1.1±0.15	233.8

Developed sausages were characterized by a high content of complete animal protein and important for the body collagen, protein that participates in various body functions: protective — ensuring the strength of tissues and protection against mechanical damage; support — fastening and forming the shape of organs and skeleton as well as restorative (cell regeneration); which together with elastin fibers provides elasticity of fabrics; inhibits the development of melanoma (tumor-like formations of the skin); stimulates the formation of cell membranes.

Conclusion

1. By optimizing the choice of different types of raw materials and ratios of ingredients, there were received model minced systems of protein-fat emulsion based on chicken fat and animal protein ScanPro T 95, as well as model minced sausages

from turkey meat with different content of protein-fat emulsion, corresponding to the best organoleptic, functional-technological indicators and content of essential substances.

2. According to the results of organoleptic evaluation of finished prototypes and obtained functional and technological indicators, it was established that for further research to improve the technology and development of the recipe there was selected sample № 2 as a basis with replacement of raw meat by 30% of protein-fat emulsion based on ScanPro protein T 95, chicken fat.

3. According to organoleptic parameters and chemical composition, the developed sausages meet the requirements according to regulatory documents. The protein content was 12.5%, fat content — 17%.

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