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PRODUCTION TECHNOLOGY FOR SMOKED SAUSAGES USING PROTEIN-FAT EMULSION

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ABSTRACT

This article presents the results of the development of technology for the use of protein-fat emulsion (PFE) based on wheat grain proteins in smoked sausage recipes. The main technological stages with a description of the methods for preparing a protein-fat emulsion and sausage meat are presented. The analysis of the quality and compliance of the finished product with the relevant regulatory and technical documentation. The results of organoleptic and physico-chemical studies of the finished product are presented. According to the research results, the use of protein-fatty emulsion as a substitute for part of meat and fatty raw materials in sausage production technology in an amount of up to 20% is justified.

Disciplinary: Food Science and Technology.

1. INTRODUCTION

Over the past decade, the demand for prescription compositions with a partial replacement of raw meat with vegetables has grown significantly. This technology is used to reduce the cost of finished products, improve the functional and technological properties of minced meat, and introduce additional easily digestible proteins into the formulation [5, 9, 13]. However, the use of a large number of vegetable proteins can have a negative effect on the organoleptic properties of the finished product. With an increasing amount of flour, starch, a strong distortion of the taste and structure of the finished product is observed. In such sausages, the formation of an “empty” or “bread taste” is observed [11, 12].

One of the methods for introducing vegetable proteins into the recipe for sausages is the

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preparation of a protein-fat emulsion. Most manufacturers use soy protein as a plant protein. Oversaturation of sausages with soy, causes a negative reaction among consumers [4, 10, 11].

In this regard, it is necessary to search for additional promising plant proteins that have good functional and technological properties. At the same time, it is necessary to take into account the economic efficiency of the implemented technology.

At the Department of Technology for Storage and Processing of Livestock Products of the Kuban State Agrarian University, the authors developed a technology and a prescription composition for producing a protein-fat emulsion for a cooked group of sausages. The functional and technological properties and chemical composition of the protein-fat emulsion were studied. Studies have been carried out on the partial replacement of raw meat with a protein-fat emulsion, an analysis of the finished product. However, the authors considered the application of the obtained development only in the production of a cooked group of sausages [7, 8].

This studied purpose is to learn the possibility of partial replacement of fatty meat raw materials in the technology of production of smoked sausages, to analyze the quality of the finished product.

2. METHOD

Mass changes were determined by weighing on a balance and in a ratio, in percentage to the mass of the feedstock. For each study, reliability is carried out in triplicate.

The mass fraction of moisture was determined in accordance with GOST 9793-74 by drying the sample to constant weight at a temperature of 105°C [3].

Mass fraction of fat was determined in accordance with GOST 23042-86 [2].

The mass fraction of sodium nitrite was determined in accordance with the research methods presented in the source [1]. In vitro protein digestibility analysis was evaluated by the ability of digestive enzymes to hydrolyze sausage proteins (by the method of Pokrovsky and Ertanov) [1]. The remaining research methods were taken from a specialized source [1] with a full explanation of the experiment and mathematical processing of the research results.

3. RESULT AND DISCUSSION

Smoked sausage was chosen as the object of study, in accordance with TU 9213-019-87170676-10. Since part of the fat (15 kg of the total amount of fat) goes to create a picture, a decision was made to partially replace it. The rest of the protein-fat emulsion is sent to replace pork fat. The composition of the main raw materials is presented in Table 1.

Table 1: The main raw materials for the model minced smoked sausage "Original"

Raw materials	For 100 kg of minced meat		
	Control	Experience #1	Experience #2
Beef (grade 1)	40	40	40
Beef (grade 2)	15	15	15
Fat pork	23	15	10
Bacon	22	15	15
PFE	0	15	20

To prepare the minced meat, the main and additional raw materials were prepared in accordance with the recommendations of TU 9213-019-87170676-10. The protein-fat emulsion was prepared according to the presented scheme (Figure 1).

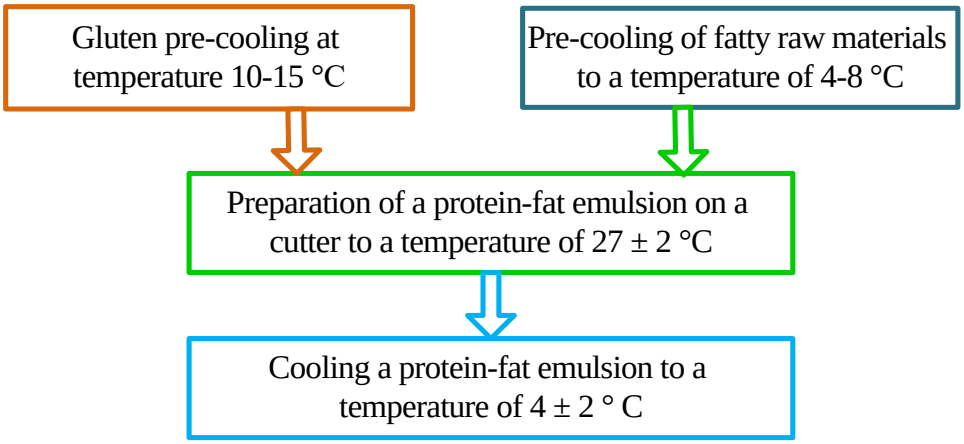

Figure 1: Diagram of the preparation and production of protein-fat emulsion on the cutter

To prepare a protein-fat emulsion, pre-cool the fatty raw materials in the refrigerator or freezer and bring it to a temperature in the center of the product to 4-8°C. Gluten of wheat grain after its production has a temperature of 26-30°C. In this regard, if it is prepared directly at the meat processing enterprise, it must be kept for 24 hours and brought to a temperature in the center of the product of 10-15 °C, after which gluten is fed to the production for cutting.

Figure 2: Protein-fat emulsion after formulation and cooling.

The preparation of the protein-fat emulsion occurs in the cutter with the following feed loading scheme. First of all, they introduce chilled gluten and grind it with a knife speed of at least 3000 rpm, and a bowl of 12 rpm. After three turns of the bowl, the entire volume of water with a temperature of at least 20°C is introduced. When the overall temperature in the cutter reaches 20°C, fatty raw materials are introduced into the cutter and they continue to cut at a blade rotation speed of at least 3000 rpm until the total temperature of the mixture reaches 28°C. After that, the mixture is unloaded into wheelbarrows with a layer thickness of not more than 40 cm and sent for cooling to a temperature in the center of the product of 4±1°C. Sausage production was carried out based on the «Agrobiotechpererabotka» educational-scientific-production complex of the Faculty of Processing

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Technologies of the I.T. Trubilin Kuban State Agrarian University. Protein-fat emulsion is shown in Figure 2.

The preparation of smoked sausage stuffing is carried out according to the standard scheme, the introduction of protein-fatty emulsion is carried out at the final stage of chopping before introducing salted pork fat into the figure. The remaining technological operations were carried out without change. Finished products are presented in Figure 3.

(A) (B)

Figure 3: Finished products with protein-fat emulsion:
A - sausages after precipitation, B - finished sausages after heat treatment

Finished products were subjected to organoleptic evaluation according to GOST 9959-91 in accordance with a nine-point assessment. The tasters included employees of the Research Institute of Biotechnology and Food Certification.

Appearance, sectional view fully complies with the requirements of TU 9213-019-87170676-10. The output of finished products was, for control 66%, Experience #1 69%, Experience #2 72%. Preparation for the organoleptic evaluation of finished products is presented in Figure 4.

Figure 4: Preparation for organoleptic assessment.

The results of the main organoleptic indicators of the finished product are presented in Figure 5.

Figure 5: Organoleptic characteristics of the finished product

Figure 5, the control lags behind the experimental parties in almost all respects. The average indicator for all samples was distributed as follows: control 7.8, Experience #1 8.8 and Experience #2 8.4 points. Experience #1 and Experience #2 do not differ significantly from each other. The main differences are observed in the greater juiciness of Experiment #2. This is due to the best moisture and fat-holding abilities of the protein-fat emulsion. This is confirmed by the increased yield of finished products. According to other indicators, Experiment #2 loses to Experiment #1 by one point.

An important indicator for sausage products is the texture that affects the general opinion of the products [6, 10]. To analyze the texture mechanically, we experimented to analyze the shear force. The results of the experiment are presented in Figure 6.

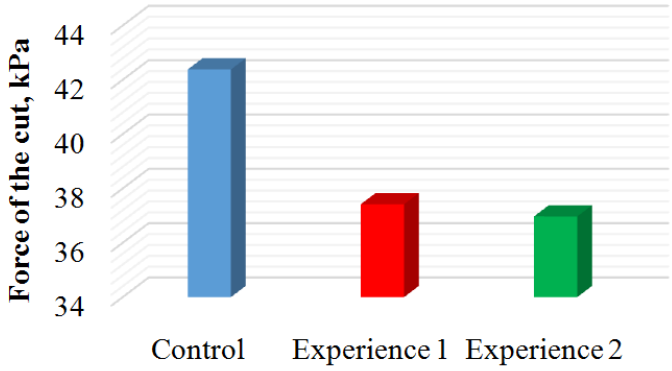

Figure 6: Results of a shear stress study

An increase in the proportion of protein-fat emulsion in the prescription composition leads to an increase in the softness of the finished product. Plant proteins have good moisture-binding and fat-holding ability. But unlike animal proteins, they have a weaker matrix and, after heat treatment, have a lower density [14, 15].

For a comparative analysis of the chemical composition of the experimental batches following TU 9213-019-87170676-10, sausages were subjected to a study on the total moisture content (norm

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no more than 65%), protein (not less than 11.5%), fat (not more than 26.8%) in% and mass fraction of residual sodium nitrite in mg% (not more than 0.005 mg%). The results of the study are presented in Figure 7.

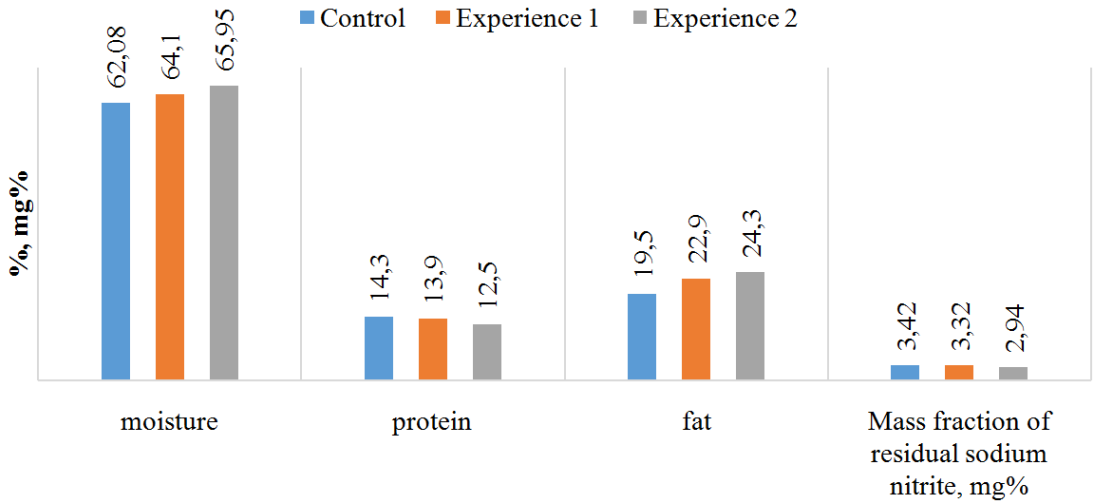

Figure 7: Results of the analysis of the chemical composition of sausages.

As can be seen from the presented figure, the total amount of moisture in experiment 2 exceeds the norm by 0.95%, which may be a mistake in the experiment. For other indicators, all types of products comply with the standards and requirements of TU 9213-019-87170676-10. The increase in the amount of fat in Experiment #2 was expected since the protein-fatty emulsion replaces not only salted pork but also fatty pork in the formulation. In this regard, we can observe a decrease in total protein and an increase in the fat component.

The increase in the share of total moisture is due to the additional water-holding ability of the protein-fat emulsion introduced. It also justifies an increase in the yield of finished products. The amount of moisture is normalized by regulatory and technical documents for the production of this type of sausage. Exceeding the norm leads to additional drying times for sausages, which in turn affects the duration of the production cycle and additional costs for drying sausages [16, 17].

The introduction of an additional amount of the fat component may affect the deterioration of the digestibility of the finished product by the human gastrointestinal tract. Using an analysis of the digestibility of proteins by proteolytic enzymes, one can judge the degree of assimilation of sausage proteins. The research results are presented in Table 2.

Table 2: Sausage digestibility analysis

Sausage Samples	Digestibility in vitro mg tyrosine / g protein		
	Pepsin	Trypsin	Amount
Control	10.03±0.48	10.72±0.51	21.00±0.50
Experience #1	11.09±0.59	11.72±0.45	22.81±0.52
Experience #2	12.07±0.59	12.14±0.56	24.21±0.58

Analyzing the data obtained, we can speak of a more complete hydrolysis in Experiment #2 by 13.3% in relation to control and 5.8% in relation to Experiment #1. We assume that more complete

hydrolysis in experimental batches occurs due to partial replacement of animal protein to vegetable, which in turn is easier to digest.

4. CONCLUSION

The result of the partial replacement of fatty meat raw materials with protein-fatty emulsion in the production technology of smoked sausages, positive results were obtained with 15 and 20% replacement. The average indicator of organoleptic evaluation for all samples was distributed as follows: Control 7.8, Experiment #1 8.8, and Experiment #2 8.4 points. With the introduction of a 20% protein-fat emulsion in the prescription composition, an excess of the total moisture level in the finished product by 0.95% of the norm is observed, which may be a mistake in the experiment. For other indicators, Experience #1 and Experience #2 fully comply with the requirements of TU 9213-019-87170676-10. The results of the analysis of protein digestibility by enzymes of the gastrointestinal tract indicate a more complete hydrolysis in Experiment #2. The complex of studies indicates the possibility of replacing part of the fat and meat raw materials with a protein-fat emulsion based on gluten of wheat grain without loss of quality of the finished product.

5. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding authors

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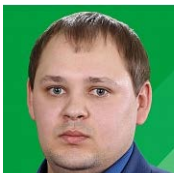

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