

PRODUCTION OF SEMI-SMOKED SAUSAGES USING GRINDING OF RAW MATERIAL BY MILLING

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Abstract – The article presents the research results of semi-smoked sausage samples produced from frozen block meat using new method of raw material grinding by milling. To produce test samples of semi-smoked sausage from frozen raw materials ground by milling, experimental meat blocks were used, which were cut from meat blocks of the industrial size (second grade beef) containing large amounts of the connective tissue. In the study of meat products, control samples were presented by semi-smoked sausages produced according to the traditional technological workflow with meat grinding in a grinder with a plate hole diameter of 5 mm and preparation of minced meat in a cutter. To produce test samples, grinding of frozen raw material was carried out only by milling with preparation of minced meat in a mixer. The research established that new method of frozen raw material grinding by milling did not affect the physicochemical and microbiological parameters of semi-smoked sausages while their sensory properties were characterized by more pronounced color, flavor and taste. Compared to the control, the structure of minced meat for sausage test samples was characterized by smaller particle size of muscle tissue (110 µm to 320 µm), which was 2 times less than in the control.

Key Words – grinding, frozen meat raw materials, semi-smoked sausages.

I. INTRODUCTION

Recently, there has been a tendency to expand the range of more expensive sausages, partially due to production of semi-smoked sausages.

Semi-smoked sausages are characterized by higher storage stability compared to cooked sausages, since they contain less moisture, more salt and fat, and are smoked.

The distribution between product line groups in the total volume of smoked sausage production shows that the leading position is maintained by semi-smoked sausages sharing 55.8% of the market.

The conditions of free market require improving the quality of semi-smoked sausages, which will ensure their competitiveness in the world with the least cost and the greatest benefit. In this regard, production technologies, formulations, technological methods, including methods for grinding of meat raw materials, are constantly being improved; modern packaging materials and other factors are used to ensure microbiological stability of the finished product.

The V. M. Gorbatov All-Russian Meat Research Institute developed new process for grinding of block frozen meat by milling, which is characterized by energy and resource saving [1,2]. The development of domestic resource saving equipment for grinding of frozen raw materials in sausage production is an urgent task in the current conditions of the industry dynamics.

II. MATERIALS AND METHODS

To produce test samples of semi-smoked sausage from frozen raw materials ground by new method, experimental meat blocks were used, which were cut from meat blocks of industrial size (second grade beef). To study test samples, the following generally accepted methods for studying meat products were used:

- determination of moisture content according to GOST 9793-74;
- determination of protein content according to GOST 25011-81;
- determination of fat content according to GOST 23042-86;
- determination of pH by "Zamer" portable pH-meter;

- structural and mechanical tests on "Instron" universal testing machine;
- determination of microstructural parameters according to GOST 51604-2000;
- sensory evaluation according to GOST 9959-15 (color, flavor, taste, consistency, appearance, general acceptance).

The produced samples of semi-smoked sausage had the following designations: sample No. 1 (control) was obtained by the traditional technological workflow - grinding of thawed raw material in a grinder and preparation of minced meat in a cutter; sample No. 2 (test) was obtained by grinding of frozen raw material only with mill and preparation of minced meat in a mixer. The formulations of samples No. 1 and No. 2 did not differ from each other.

Table 1. The formulation for semi-smoked sausage (sample No. 1, sample No. 2)

Raw materials, spices	Specification for semi-smoked sausage
Raw materials, kg per 100 kg of unsalted raw material	
Trimmed beef, second grade	65
Fat	25
Spices, g per 100 kg of unsalted raw material	
Sodium chloride	900
Nitrite	1600
Black pepper powder	150
Bayberry powder	50
Sugar	150

According to the traditional technological workflow for production of semi-smoked sausage (control sample), minced meat was produced in a cutter as follows:

Surface-frozen beef of the second grade, nitrite, sodium chloride, and spices were loaded in a cutter and ground (for 0.5-1 minute). Then, fat was added and ground (for 1-2 minutes) at a small rotation speed of a cutter to obtain pieces of the required size, which should be uniformly distributed over the minced meat volume.

Total duration of grinding was 4 minutes.

The minced meat temperature after cutting was minus 3 °C to minus 1 °C.

The technology of test sample manufacturing included the following stages:

Milled beef of the second grade was mixed in a mixer (for 4-5 minutes) with the addition of nitrite, sodium chloride, and spices. Then ground fat was added by gradually spreading it over the surface of minced meat and mixed for 2 minutes. Mixing was carried out to obtain homogeneous minced meat with uniform distribution of structural components pieces. Total duration of mixing was 6-8 minutes.

Then minced meat for the control and test samples was stuffed into fibrous casing with a diameter of 45 mm and transferred for thermal treatment.

Thermal treatment of sausage samples was carried out according to the modes indicated in the Technological Instruction to GOST 31785-2012 "Semi-smoked sausages. Specifications".

III. RESULTS AND DISCUSSION

The results of microbiological examination of semi-smoked sausage sample No. 1 and sample No. 2 are shown in Table 3.

Table 2. Results of microbiological examination of sausage samples.

Parameter	Speci-fica-tion	Results for the samples
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			No. 1	No. 2
Not allowed in the following weight of a product (g):	Coliforms	1.0	Not detected	Not detected
	Sulfite-reducing Clostridia	0.1	Not detected	Not detected
	<i>S. aureus</i>	1.0	Not detected	Not detected
	Patho-genic, including <i>Salmo-nella</i>	25.0	Not detected	Not detected
	<i>L. monocytogenes</i>	25.0	Not detected	Not detected

Control and test samples of sausages were stored at 0 to 60 °C for 30 days. The results of microbiological examination showed that the samples met regulatory requirements.

Based on the results of microstructural and structural-mechanical studies of semi-smoked sausages, it was established that:

- sample No. 1 had non-uniform minced meat with insignificant number of voids; minimum shear force (not included in sampling) was 38.23 N/m²;
- sample No. 2 had non-uniform minced meat with small number of voids; minimum shear force (not included in sampling) was 28.83 N/m².

Microstructural study of sausage sample No. 1 established that minced meat was characterized by relatively dense arrangement of the structural elements. Also, minced meat is characterized by large fascicles of muscle fibers in transverse and longitudinal sections, and fragments of adipose and connective tissue with a size of 655-760 µm. Between the particles of coarse-ground tissue, there was fine-grained protein mass permeated with large and medium vacuoles often merging with each other with a size of 115-330 µm. The cross striation of the muscle fibers was distinctly expressed; the fibers were placed freely to each other. Destructive changes were revealed as micro-cracks and transverse fiber ruptures with formation of fine-grained protein mass in the areas of destruction. Fragments of dense connective tissue were loosened. Fat was presented in the form of intact round cell groups filled with fat; part of the fat was distributed in individual vacuoles and as droplets of different sizes in fine-grained protein mass of minced meat (Figure 1).

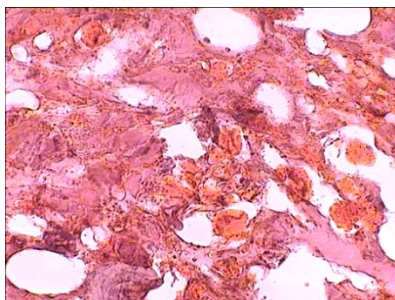


Figure 1. The microstructure of semi-smoked sausage sample No. 1 (magnification x350)

The microstructure of sample No. 2 was characterized by fascicles of muscle fibers in the transverse and longitudinal sections, and fragments of adipose and connective tissue with a size of 700-950 µm. Between the particles of coarse-ground tissue, there was fine-grained protein mass permeated with large and medium vacuoles often merging with each other and forming narrow slits with a size of 143-420 µm. Minced meat was relatively compact. In muscle fascicles, fibers most often retain cross striation, and were placed freely to each other. Destructive changes were revealed as micro-cracks and transverse fiber ruptures with formation of fine-grained protein mass in the areas of destruction. Fragments of the dense connective tissue were characterized by turgent loosened collagen fascicles. Fat was presented in the form of intact round cell groups filled with fat; part of fat was distributed in individual vacuoles and as droplets of different sizes in fine-grained protein mass of minced meat (Figure 2).

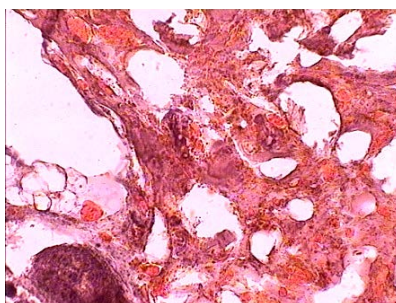


Figure 2. The microstructure of semi-smoked sausage sample No. 2 (magnification x350)

Sensory evaluation of finished product samples by panelist revealed that sample No. 1 had pleasant taste and pronounced dark red color without leakage under the casing; on the slice, there were inclusions of fat pieces, which were characteristic of semi-smoked sausage.

Sample No. 2 had meaty taste and pleasant flavor, moderately salty; the color of the sausage was more saturated compared to sample No. 1.

Based on the conclusion of the tasters, the sample No. 1 was marked as "good", and the sample No. 2 was marked as "excellent".

Color is one of the parameters determining the consumer's preference in choosing products. Therefore, the color characteristics of the finished products were studied.

The results of color evaluation are shown in Table 3.

Table 3

Sample	Lightness L*	Redness a*	Yellowness b*
No. 1	62.0	11.4	12.2
No. 2	67.0	15.0	15.3

IV. CONCLUSION

The complex research established that new method of frozen raw material grinding by milling did not affect the physicochemical and microbiological parameters of semi-smoked sausages while their sensory properties were more pronounced. Compared to the control, the structure of minced meat for test sausage samples was characterized by smaller particle size of muscle tissue (110 μm to 320 μm), which was 2 times less than in control samples [3]. Thus, new method of raw material processing allows fine grinding of block frozen meat on a single meat cutting machine while saving energy and resources.

The study of test meat products has proved the possibility of improving the quality of semi-smoked sausages produced from frozen meat ground by milling.

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