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Research Article

RESEARCH OF STORAGE TERMS OF PRODUCTS FUNCTIONAL APPOINTMENT WITH ADDITION OF VEGETABLE INGREDIENT

Ivan Fiodorovich Gorlov^{1,2*}, Marina Ivanovna Slozhenkina^{1,2}, Yuri Dmitrievich Danilov¹, Natalia Ivanovna Mosolova¹, Elena Yurievna Zlobina¹, Arkadii Kanurovich Natyrov³

¹The Volga region research institute of manufacture and processing of meat-and-milk production, Volgograd, Russian Federation, ²Volgograd state technical university, Volgograd, Russian Federation, ³Kalmyk state university named after B.B. Gorodovikov, Elista, Republic of Kalmykia.

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Abstract:

The article presents the results of a study of microbiological indicators and shelf life of finished functional products – cooked smoked sausages with the addition of a vegetable ingredient. The basis for this study was the assumption of a change in the microbiological picture of the finished product when the plant component was introduced. As is known, cereals have a greater microbiological contamination compared to raw meat. In the finished product, the complete absence of E. coli bacteria, S. aureus, pathogenic microorganisms, including Salmonella, as well as sulfite-reducing clostridia, was revealed. During the determination of microbiological indicators, it was found that bacteria of the group of Escherichia coli, S. aureus, pathogenic microorganisms, including Salmonella, as well as sulfite-reducing clostridia were not detected in both the control and the test sample at all stages of storage. The control and test samples meet the requirements of SanPiN 2.3.2.1078-01, the shelf life during refrigerated storage is no more than 30 days. The main factors preventing the rapid deterioration of the product are the extrusion of the plant component, the moisture-binding capacity of the additive, which reduces the amount of free moisture, as well as the heat treatment of the product. This allows us to conclude that this product meets the regulatory requirements for traditional sausage products.

Key words: sausages, chickpeas, wheat, extrusion, shelf life, functional additive.

Corresponding author:**Natalia Ivanovna Mosolova,**

400131, Rokossovsky Str., 6, Volgograd.

E-mail address: niimmmp@mail.ru, Tel. +7(8442)391048 (I. Gorlov)

QR code



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INTRODUCTION:

One of the directions of the state policy in the field of healthy nutrition of Russians is to increase the domestic production of food raw materials and food products, including products that have functional and therapeutic properties. Unbalanced nutrition is a pressing issue in our country. Modern lifestyles make people eat on the go, which leads to various diseases. Actual problems in this area are problems of iodine and selenium deficiency, as well as a balanced amino acid composition. As a solution to these problems, it was proposed to create and introduce to the market food products of cooked smoked sausages of a functional purpose by adding to the composition of the vegetable component – a mixture of chickpea and wheat sprouted on iodine and selenium solutions, then passed through an extruder.

Domestic and foreign scientists (L.V. Antipova, A.I. Zharinov, Yu.A. Zharko, N.K. Zhuravskaya, A.N. Zakharov, G.I. Kasynov, A.I. Mglinets, A.N. Petrov, A.A. Pokrovskiy, A. Amos, D. Karlesking and others) proved the relevance of the production of functional food products of a combined preventive nature in combination with various dietary supplements, formulated principles for optimizing the preventive properties of food, managing the main physico-chemical and biological processes responsible for the formation of the quality characteristics of finished products.

However, in addition to useful properties, the developed products must meet safety standards: the content of heavy metals, microbiological indicators, the shelf life of the finished product. The task was to carry out microbiological studies of cooked smoked sausages of functional purpose, as well as to trace the growth dynamics of the number of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM) during refrigerated storage as the most common storage method for such a product.

Materials and methods:

The study of microbiological indicators of the quality of the finished product included a list of indicators: Determination of the number of mesophilic aerobic and facultative anaerobic microorganisms (GOST 10444.15-94); the presence of *E. coli* bacteria (GOST 31747-2012); the presence of *Staphylococcus aureus* in accordance with the regulatory requirements of GOST 31746-2012; *L. monocytogenes*, pathogenic microflora, incl. *Salmonella*, sulfide-reducing clostridia – according to the requirements of GOST 29185-2014, GOST 31659-2012, GOST R 50455-92.

The growth dynamics of microflora during storage of cooked smoked sausages was recorded by counting QMAFAnM (Muih et al., 1986; Yatsuda, 2005). The method of determining the number of mesophilic aerobic and facultative anaerobic microorganisms is based on seeding 1 gram of the product on an agar nutrient medium – meat-peptone agar. For this purpose, an initial dilution and a series of 10-fold dilutions were prepared. In cups with 0.1 grams of the product, grown colonies were counted on the surface of nutrient agar and the number of colony forming units was calculated. In the control and test samples of cooked smoked sausage every three days after the first sowing, the values of QMAFAnM were calculated (Betts, 2008; Bobrik et al., 2019). This study was conducted to determine the dependence of the content of bacteria in the finished product from the introduction of vegetable supplements and from the shelf life at normalized temperature.

The studies were carried out in the Integrated Analytical Laboratory of the Federal State Budget Scientific Institution "The Volga region research institute of manufacture and processing of meat-and-milk production", as well as in the laboratory of the Industrial Ecology and Safety of Federal State Budgetary Educational Institution of Higher Education "Volgograd State Technical University". A control sample without the addition of the plant component participated in the studies and the sample under study with a partial replacement of raw meat with a vegetable ingredient in hydrated form in an amount of 15%.

RESULTS AND DISCUSSION:

Features of the vegetable component:

Orientation to a healthy lifestyle is becoming increasingly popular among different age groups of the population, which in turn helps to increase the demand for healthy food products, which include foods with a high content of dietary fiber, vitamins, minerals.

For the enrichment of products using a variety of raw materials and, above all, grain. Cereal products are sources of minerals, vitamins, essential amino acids (Vasilieva, 2008; Petibskaya et al., 2005). However, in the production of various grain products, the most valuable parts are removed, which makes it advisable to search directions for using whole grains in food production. Grain seedlings are of particular interest in this regard. In ordinary seeds, the content of vitamins and trace elements is relatively small. Reserve substances are presented in the form of complex molecules of proteins, fats and carbohydrates. During germination, the enzymes found in the seeds break down complex proteins, fats and carbohydrates into

simpler substances that are necessary for the growth of the future plant. Therefore, when using germinating grains in food, the human body receives readily available substances (Zubareva et al., 2011). Germinating seeds have a huge energy potential, contain all the necessary vital components.

The plant component includes chickpeas of the new variety "Volzhanin 50", enriched with iodine, and wheat of the variety "Kamyshanka-4", enriched with selenium. Seeds were selected promising varieties of plants growing on the territory of the Volgograd region. Germinated grain undergoes an extrusion process, which breaks down starch into simple sugars, harmful microflora is disinfected, anti-nutrients are deactivated in legumes, and vitamins and acids contained in cereals are preserved almost completely (Danilov et al., 2018). When using grain extrusion, the digestibility of dry matter increases by 2.1%, organic by 1.9, crude protein by 4.5, and crude fat by 3.8% (Yanova, 2011).

The ratio of chickpea and wheat in the finished additive is 1: 4, before making the additive is hydrated. Chickpea and wheat are natural stabilizing ingredients in minced meat, as they contain dietary fiber and gluten. Thanks to these components, the water in the stuffing is fully bound, the fat is partially bound. As a result, minced meat is obtained with a more viscous and elastic texture. When shells are filled with such stuffing, the likelihood of voids in sausage loaves and fatty drips in the finished product decreases (Gorlov et al., 2019).

Thus, the use of a mixture of extruded wheat and chickpea will provide the following benefits: enrichment of cooked smoked sausages in a sufficient amount of bioavailable forms of iodine and selenium; obtaining a product with more complete protein and with improved digestibility; enrichment with vitamins

A, C and group B, as well as dietary fiber (Treger et al., 2005).

However, in the preparation of new types of products, including products of a functional orientation, in addition to the basic quality characteristics, it is necessary to study microbiological indicators and shelf life. Traditional sausages are made from raw meat, the introduction of vegetable components can affect these characteristics.

The study of the microbiology and shelf life of the product:

According to the requirements of SanPiN 2.3.2.1078-01, the maximum allowable content of QMAFAnM for cooked smoked sausages is 2.5×10^4 CFU / g. Functional vegetable supplement consists of extruded chickpea and wheat, for such an additive there is no regulatory information in SanPiN 2.3.2.1078-01 therefore, as standards were chosen allowable microbiological parameters of food bran. For bran from germ seeds of cereals, leguminous plants, and other crops, the limit value of CMAFAnM is 4.0×10^4 CFU / g, which is much more than is acceptable for cooked smoked sausages, therefore, the definition of shelf life is appropriate. Studies were conducted on a control sample of cooked smoked sausage without the addition of the vegetable component and the test sample with the partial replacement of raw meat with vegetable in hydrated form in an amount of 15%. Standard storage conditions were chosen – In a refrigerator at a temperature of 4-6 ° C and relative humidity not more than 75%. Sampling for analysis was based on the requirements of GOST R 31904-2012.

The research results are presented in Table 1 and in Figure 1. The bacterial infection of freshly cooked smoked sausage is 10^2 CFU per 1 g of the product.

Table 1 – Results of the study of the dependence of the shelf life of the finished product on the growth of bacteria

Time storage, day	Content QMAFAnM in 1 g of product (CFU / g)		Product weight (g), which is not allowed									
	control sample	test sample (15%)	control sample				test sample (15%)					
			E. coli bacteria	S. aureus	Pathogens, incl. Salmonella	Sulfite-reducing bacteria	E. coli bacteria	S. aureus	Pathogens, incl. Salmonella	Sulfite-reducing bacteria		

On regulatory documents	$2,5 \times 10^4$	$2,5 \times 10^4$	1,0	1,0	25	0,1	1,0	1,0	25	0,1
Background	$1,0 \times 10^2$	$1,0 \times 10^2$	not found				not found			
3	$1,0 \times 10^2$	$1,0 \times 10^2$								
6	$1,4 \times 10^2$	$1,4 \times 10^2$								
9	$1,7 \times 10^2$	$1,9 \times 10^2$								
12	$3,2 \times 10^2$	$4,5 \times 10^2$								
15	$6,8 \times 10^2$	$8,5 \times 10^2$								
18	$1,8 \times 10^3$	$2,3 \times 10^3$								
21	$3,9 \times 10^3$	$5,0 \times 10^3$								
24	$7,2 \times 10^3$	$9,1 \times 10^3$								
27	$1,28 \times 10^4$	$1,49 \times 10^4$								
30	$2,23 \times 10^4$	$2,44 \times 10^4$								

During the determination of microbiological indicators, it was found that bacteria of the group of *Escherichia coli*, *S. aureus*, pathogenic microorganisms, including *Salmonella*, as well as sulfite-reducing clostridia were not detected in the control or in the test sample at all measured storage intervals. According to the requirements of GOST R

55455-2013, the shelf life of cooked smoked sausages in a cooled state is no more than 30 days. The growth dynamics of bacteria in the control sample is less intense than in the test sample. However, both samples are preserved for a fixed period, typical of traditional cooked smoked sausages (Lisitsyn et al., 2007).

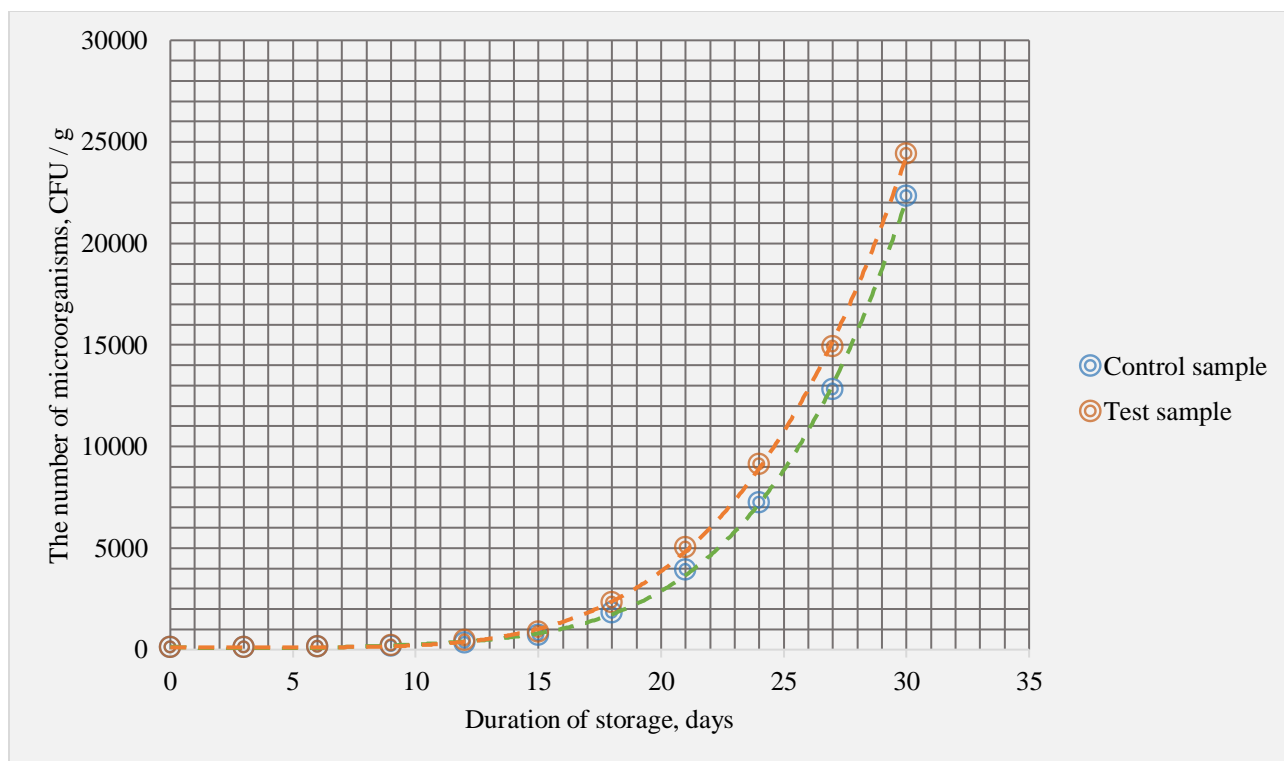


Fig. 1. Dependence of shelf life on bacterial growth

It should be noted the main factors hindering the rapid growth of microflora in the finished product. First of all, it is carrying out heat treatment. Cooking and hot smoking destroy most microorganisms; hot smoking contributes to the formation of a protective surface layer that prevents secondary contamination of the

product (Fessman, 1995; Feiner, 2006). Secondly, this disinfection of vegetable supplements in the process of its preparation at the stage of extrusion. Thirdly, the plant component has a high moisture-binding capacity. The decrease in free moisture in the finished product slows down the growth of microorganisms.

CONCLUSION:

Thus, the use of the vegetable component in the production of cooked-smoked sausages of functional purpose does not impair the microbiological indicators and the storage capacity of the finished product. This product meets the regulatory requirements for traditional sausages.

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Author's contributions

Study conception and design: Yuri Dmitrievich Danilov, Natalia Ivanovna Mosolova; Literature review – Yuri Dmitrievich Danilov, Elena Yurievna Zlobina, Arkadii Kanurovich Natyrov. Measurements, Acquisition and analysis of Data: Yuri Dmitrievich Danilov; interpretation of data and drafting of manuscript – Yuri Dmitrievich Danilov, Elena Yurievna Zlobina. Critical revision – Ivan Fiodorovich Gorlov, Marina Ivanovna Slozhenkina.

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