Influence of plant-based additives on the biological value of sausage products

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Abstract The article presents the results of research aimed at developing a new product - a cooked sausage product with specified quality parameters: improved organoleptic properties, increased protein content and a balanced amino acid composition. The positive effect of sprouted wheat, maize germ and kelp in the recipes of sausage products was proved, so the iodine content in the experimental sample III was higher than in the other samples by 27% (15% of the daily requirement) for people.

1. Introduction

The most important problem of the modern world is providing the population with food products. Especially scarce in the diet are products of animal origin, primarily meat. World experience shows that the main direction of solving this problem is the development of poultry meat production as a source of complete protein, balanced in amino acid composition [1, 2]. Existing technologies for the production of meat products are aimed at compliance with the existing ratios of necessary consumption standards in accordance with the recommendations of the world health organization. For this purpose, new recipes of meat products are being developed that are most adapted to the modern needs of certain groups of society [3, 4].

The nutritional needs of the body can not always be met by ordinary food. Often, diseases, injuries, and malaise contribute to a lack of nutrients [5]. The world health organization has named iodine deficiency as one of the global problems of humanity, and health disorders associated with it are the most common non-infectious diseases worldwide. Iodine can not be synthesized in the human body, it must come from outside: with food, water, special drugs and additives [6].

For the human body, Selenium (Se) performs a number of functions: Increases immunity (participates in the formation of red blood cells, white blood cells, antibodies and interferon). In this regard, we have developed new cooked sausages enriched with iodine and selenium (selenium is a necessary component for the best assimilation of iodine) [7, 8].

When conducting research, we set the following goal: to develop a recipe and optimize the production technology of sausage products using sprouted wheat and kelp, in order to correct the deficiency of iodine and selenium, their impact on the properties of the product.

During the research, the following tasks were solved:
to investigate the chemical composition, quality and safety indicators of sprouted wheat, corn germ and kelp produced in Russia;  
• to develop a recipe for the production of sausage products based on the specified components;  
• to optimize the production technology of sausage products;  
• to investigate the chemical composition, quality and safety indicators of the new sausage product.

During the research, we formulated a working hypothesis, which assumed that the use of wheat germ together with the kelp in the production of sausages will increase the content of macro- and micronutrients, and will help to fill the need of the human body iodine, selenium and other elements, with the result that the resulting product will be referred to the group of functional (enriched).

2. Research methods and materials
The research was conducted at the Department of food production engineering and technology of the Don state technical University. The experimental part is realized in the test laboratory "Niceie", located in Rostov-on-Don. The objects of research were samples of cooked sausage.

The research was conducted in several stages:

• The first stage was to study the chemical composition of sprouted wheat, corn germ and kelp.  
• The second stage: the doses of sprouted wheat, corn germ and kelp were determined in the recipes of sausage products.  
• The third stage was to optimize the technological process of sausage production using non-traditional vegetable ingredients.  
• At the fourth stage, the quality and biological value of the developed sausage products were evaluated.

2.1. Production technology and samples.
All components were added to the samples in a certain proportion, according to the developed recipe. Then each sample went through the remaining operations of the technological process. In accordance with the set goals, the objects of research were sausage products: control sample of cooked sausage «Lubitelskaya», developed according to the traditional GOST technology, with sprouted wheat and corn germ and kelp in the amount of 15% – I, with kelp in the amount 10% – II, with all three plant components - 5, 5 and 5% of each, respectively – III. sprouted wheat sprouts used after 36-48 hours of germination from normal wheat grains. We also studied the maize germs that are released during the processing of maize grains and kelp. Spices and materials were added to all samples according to the recipe, in the same amount per 100 kg of unsalted raw materials, with the exception of water, which was added according to the recipe in the amount of 15, 18, 20% of the main unsalted raw materials. When optimizing the production technology of sausage products using sprouted wheat, corn germ and kelp, in accordance with the research methodology, sprouted wheat was introduced into the minced meat after the introduction of crushed meat, lard. For this purpose, three samples of minced meat were prepared using ground sprouted wheat and kelp.

2.2. Experimental study.
Sausages were subjected to laboratory tests, which determined: mass fraction of protein, fat, moisture, carbohydrates, organoleptic indicators, nutritional and energy value and amino acid composition.

Determination of organoleptic indicators was carried out according to the requirements of GOST 9959-91; GOST R 53159-2008; GOST R 53161-2008. The mass fraction of moisture in finished products was determined according to GOST 33319-2015. Determination of the mass fraction of the protein was carried out according to GOST 25011-2017. The content of amino acids and their ratio were studied using the "Aracus" amino acid analyzer. The mass fraction of fat was determined according to
GOST 23042-2015, carbohydrates-GOST 31470-2012, sodium chloride-by Folgard method according to GOST R 51480-99 (ISO 1841-1-96).

3. Results

3.1. Results of organoleptic research

The results of organoleptic studies are presented in the form of a profilogram in figure 1. It should be noted that the vegetable additives in the developed sausage products did not have a negative impact on such indicators as taste, aroma and appearance. The consistency score in samples containing wheat sprouts and maize germs was higher.

![Figure 1. Profilogram of organoleptic indicators of experimental samples.](image)

3.2. Physical and chemical indicators of samples

Table 1 shows the results of studies of the chemical composition of the developed samples. The results of research have shown that vegetable additives had a significant effect on the protein component of the product (increase in protein content), carbohydrate (increase by 1.2, 0.8 and 1.5%, respectively), as well as ash content, which indirectly indicates a change in the microelement composition, namely, an increase in the content of individual trace elements. The effect of ingredients on the salt and moisture content did not show significant differences.

| Indicator                        | Control | I    | II    | III   |
|----------------------------------|---------|------|-------|-------|
| Mass fraction of moisture, %     | 67±1.8  | 69±1.5 | 67.8±1.6 | 68.4±1.4 |
| Mass fraction salt, %            | 2±0.6   | 2.1±0.5 | 1.9±0.2 | 2.08±0.3 |
| Mass fraction of protein, %      | 11.2±0.4 | 16.5±0.5 | 13.48±0.5 | 17.8±0.7 |
| Mass fraction of fat, %          | 18.58±0.5 | 8.97±0.6 | 14.7±0.9 | 7.96±0.2 |
| Mass fraction of carbohydrates, %| 1.2±0.06 | 3.4±0.01 | 2.0±0.02 | 3.7±0.02 |
| Mass fraction of ash, %          | 0.02    | 0.03  | 0.05   | 0.06   |

After studying the amino acid composition of samples of cooked sausage products, we obtained the following data presented in figure 2. As can be seen from the diagram, the content of both essential and essential acids increased by about 2 times, and we should note a high level of optimization of the amino acid profile in the third sample. Studies were conducted for the control and experimental third sample, since it had the highest protein content.
4. Conclusions

On the basis of theoretical and experimental studies, recipes have been developed and the content of ingredients for the production of sausage products has been determined. The mass fraction of sprouted wheat is 10 % of the 5% of the ingredient that we replace (wheat flour) plus 5 % of kelp. Experimentally established a positive effect of the ingredients we offer (sprouted wheat and kelp) to increase the yield of the finished product by 9 %. The increased biological value of the developed products has been proved. It was found that the use of sprouted wheat and kelp contributed to a decrease in energy value.

Based on studies of changes in organoleptic, physical and chemical quality indicators, microbiological and other safety indicators of products, taking into account the reserve coefficient, the shelf life has been developed. According to the results of organoleptic examination, the finished products were highly evaluated by independent experts, while the original appearance, pleasant aroma and taste of the products were particularly noted.

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