Using lingonberries in the production of meat products

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Abstract. The article describes the solution to the problem of expanding the range of meat products with the addition of plant-based ingredients of a functional orientation with a reduced caloric content. The research was carried out on experimental samples of raw smoked sausages, for which original recipes were developed. The study is aimed at studying the effect of a plant food additive on the nutritional value of a meat product, namely, energy, biological and organoleptic values. For this purpose, the content of the mass fraction of moisture, fat and vitamin C in the finished product was determined.

1. Introduction

The range of meat products, in the formulation of which various ingredients of non-meat origin are used, has increased quite significantly in recent years. The trend is explained by fashion and, accordingly, the desire for a healthy lifestyle and proper nutrition, as well as curiosity and, accordingly, the need to try new things. This makes the food industry set the task of developing and implementing new technologies for creating products that not only have a balanced content of nutrients and energy, but also give new organoleptic sensations [1].

The relevance of modernizing the production of meat products through the introduction of vegetable ingredients is not in doubt, both from the consumer and economic side. Many people adhere to proper nutrition, including controlling the energy component of the products consumed. Therefore, by reducing the energy value of the product being developed, we will definitely attract a certain share of consumers. Plant-based dietary supplements balance the composition of the meat product, enrich it with missing nutrients, reduce the caloric content and, as a rule, the cost. Meat products are the most important components of the human diet and therefore one of the most consumed and sought-after products on the market. In this regard, we have chosen raw smoked sausages as a model product. Moreover, this type of sausage is one of the most popular meat delicacies, and the approach of consumers to buying this product is more thorough and thorough. It is important that the content of meat in raw meat products, and not soy, starch and other ingredients that can replace meat, compared to other types of products, is many times higher, and the production technology is more complex, therefore, the price is much higher [2].

However, most raw smoked sausages have a high caloric content, due to the high fat content in the finished product. Since at the moment most people adhere to proper nutrition and monitor the caloric content of their diet, the reduced caloric content of any meat product created should attract the attention of the consumer [3, 4].

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At the moment, the consumer is also interested in the biological value of the product. One of the ways to increase the biological value (in terms of the content of full-fledged proteins and vitamins) is to add specially selected ingredients of plant origin, including high-protein ones, to the recipe.

Also, most consumers today pay attention to new products, so it is important to expand the range by creating innovative, multi-component, balanced, healthy food products that are different from others with a bright, memorable taste, attractive appearance, interesting composition, including components of both plant and animal origin [5, 6].

It should be noted that the development and introduction of a new range of meat products in the market segment is the creation of a new or modernization of existing production, which contributes to the development of the national economy, solving social problems, ensuring employment of the population. The appearance of new high-quality meat products on the consumer market will lead to price and non-price competition and, as a result, to lower prices.

The purpose of the research is to develop an effective technology of meat products with the addition of ingredients of plant origin and to study the nutritional value of the resulting meat product. The developed innovative meat product should have attractive, distinctive organoleptic properties, reduced fat content and, accordingly, have a low caloric content, higher biological value and yield in comparison with the product developed using traditional technology [7, 8].

2. Materials and methods

The object of research is a whipped fermented dessert with the addition of vegetable ingredients. The experiment was carried out at the Department of Food Production Technology of Volgograd State Technical University and in the laboratory of Volga Region Scientific Research Institute of Meat-and-Milk Production and Processing.

The object of research was selected raw smoked meat product. At the traditional recipe were added raw vegetable materials – lingonberries.

The experimental study was to reduce the energy value and vitamin enrichment of raw meat products by using low-fat meat raw materials and introducing a vegetable ingredient. To do this, we selected the optimal recipe, developed the technology for the production of raw smoked sausages and evaluated the nutritional value of the finished product. The quality assessment was carried out according to organoleptic and physico-chemical parameters. Based on the information obtained as a result of experimental studies, a technological scheme of production was compiled and a range of raw smoked sausage products was developed. Upon completion of the experimental studies, we developed the regulatory and technical documentation of the technical specifications 10.13.14-014-0202860-2019.

The production of raw smoked meat products was carried out according to the following method (adapted for laboratory conditions): grinding of frozen raw materials on a cutter, followed by the introduction of starter cultures, lard, salt, sodium nitrite, sugar, spices, cognac and pre-prepared berries. The resulting minced meat was sent for molding and binding. Then heat treatment was carried out-cold smoking at 20 ° C and prolonged drying.

To develop the entire range of prototypes, the following raw materials were required: the main (pork, beef and bacon in a chilled state and lingonberries) and auxiliary (salt, sodium nitrite, sugar, starter cultures, ground black pepper, cognac), as well as auxiliary materials (shell and vacuum bags for packaging).

To assess the quality of experimental samples of raw smoked sausage products in order to determine the effectiveness of the use of vegetable raw materials, comparative studies were conducted on organoleptic (tasting assessment) and physico-chemical indicators (fat, moisture, table salt, as well as the safety of vitamin C), as well as the yield of the finished product. The experiment was carried out in stages.

The first stage was to adapt the recipe and technology to identify the most optimal recipe ratios. For this purpose, experimental samples of raw smoked sausages with different fat content and lingonberries were produced: sample 1 contained 2.5% of berries, sample 2 – 5%, sample 3 – 10%.
At this stage, the production method was also optimized to determine in what form the plant raw materials were introduced. Vegetable raw materials can be made in the form of a paste, pre-crushed, or in whole form.

The second stage is to evaluate the quality of the best recipe. For this purpose, two samples of products were developed: control sample 1 – does not contain vegetable raw materials; prototype 2 (the best of the first experiment) – contains 5% of vegetable raw materials. The experimental samples were evaluated by physical and chemical parameters, and the yield of the finished product was determined to assess the effect of the added plant raw materials on it.

Sampling from batches of manufactured prototypes of raw smoked meat products and their preparation for analysis was carried out according to GOST 9792-73.

Organoleptic parameters were determined by commission according to GOST 9959-2015 "Meat and meat products. General conditions for organoleptic evaluation". A 5-point evaluation scale was used to evaluate the organoleptic parameters. The evaluation was carried out by a tasting committee of 5 experts.

Physical and chemical parameters were studied according to the following methods: the mass fraction of fat – GOST 23042-2015 "Meat and meat products. Methods for determining fat", the mass fraction of protein – GOST 25011-2017 "Meat and meat products. Methods for determining protein", mass fraction of moisture – GOST-9793-2016 "Meat and meat products. Methods for determining moisture", the mass fraction of table salt – GOST 9957-2015 "Meat and meat products. Methods for determining the content of sodium chloride", the mass fraction of vitamin C – GOST 7047-78 "Vitamins A, C, D, B1, B2 and PP. Sampling, methods for determining vitamins and testing the quality of vitamin preparations".

In addition, the study was conducted using methods of statistical data analysis, comparison, analogy and systematization.

3. Results and discussion

In recent years, there has been a positive trend in the consumption of sausage products. According to Rosstat, the share of raw smoked sausages is 10%. At the same time, there is a tendency to increase their consumption, due to their high nutritional and biological value [6].

Raw smoked meat products are a product without heat treatment, so this product can be recommended to children and the elderly in limited quantities, as it will be quite heavy for digestion. In this connection, the main consumers of the created product will be the adult population, aged 18-60 years. The recommended consumption rate of raw smoked products is 20-30 g / day.

Due to the unusual organoleptic, and first of all taste sensations, the content of vitamins, minerals, organic acids and other useful substances for human health, the created innovative product, despite the presence of a fairly large number of similar products, will be competitive in the consumer market.

We have developed a method for the production of raw smoked sausage products with the addition of ingredients of vegetable origin. The properties and features of the technology of raw smoked sausage products of the new range are studied. The peculiarity of the production technology is: the addition of a smaller amount of lard, as well as the inclusion of berries in the recipe in order to improve the organoleptic properties, increase the content of vitamin C and yield, as well as the release in a vacuum package, which allows you to achieve the preservation of taste and reduce natural weight loss during storage.

The following starter cultures are used in the production of the developed sausage products:

- **Pediococcus pentosaceus** – for a controlled and mild pH reduction, acid formation gives a mild taste, leads to the formation of a dense texture of sausages.
- **Staphylococcus xyosus, Staphylococcus carnosus** – for a good stable color formation, full and soft taste.

The process of preparing frozen berries involves washing in warm water. Due to pre-washing, the berries will thaw a little and will not give extra moisture in the process of sausage production.
The developed production method allows to reduce the time of the technological process by half, eliminating the long-term consumption of meat raw materials and reducing the drying time, thanks to the use of starter cultures. Thus, the time of the entire technological process, taking into account all stages of preparation, is 15 days.

Depending on the amount of raw meat and vegetable raw materials used, the following assortment of raw smoked meat products was developed: with the use of lingonberries, cranberries and black currant berries. The product with lingonberry was taken as a model sample.

At the first stage, it was necessary to adapt the recipe and technology - to identify the most optimal recipe ratios.

Optimization of the production method included the selection of the type of vegetable raw materials to be applied: pasta, crushed or whole berries. The introduction of berries in the form of paste has a negative effect on the organoleptic and physico-chemical parameters. The paste stains the finished sausages in an unpleasant red color. The addition of an ointment-like structure – paste and crushed berries, negatively affects the physical and chemical parameters and increases the duration of the drying process, due to increased moisture due to its release from the berries into the product during the grinding process. Therefore, we chose the introduction of whole berries in the process of cutting meat raw materials, since not all berries in the process of cutting will be crushed, will not give an unpleasant color and will not emit excess moisture.

In order to choose the final recipe and production technology, four samples were produced with different amounts of vegetable raw materials in the form of whole lingonberries. The results of the organoleptic evaluation of the prototypes and the determination of the yield of the finished product are presented in table 1.

Table 1. Organoleptic parameters of experimental samples.

| Indicator | Samples with different containing of lingonberries | Control sample (no lingonberries added) |
|-----------|--------------------------------------------------|-----------------------------------------|
|           | Sample 1 2.5% | Sample 2 5% | Sample 3 10% |                                                                 |
| Appearance | loaves with a clean, dry surface, without stains, slips, damage to the shells, bursts of minced meat, sausages 12-15 cm long | through the shell hardly can see the pieces of berries, pieces of lard are visible | through the shell can see a large number of berries and pieces of lard are visible | through the shell pieces of lard are visible |
| Score: | 4.6 | 4.0 | 3.2 | 4.6 |
| Colour | dark red | proper, dark red | un proper, unpleasant dark red | dark red |
| Score: | 4.2 | 4.8 | 1.8 | 4.2 |
| Smell | smoked meat | proper, smoked meat | un proper, weak aroma of smoked meat | smoked meat |
| Score: | 4.0 | 4.8 | 3.4 | 4.0 |
| Taste | smoked meat, slightly spicy, salty, with a subtle sweet and sour tint | smoked meat, slightly spicy, salty, with a sweet and sour tint | weak smoked meat, vegetable, not spicy, bland, with a strong sweet and sour tint | smoked meat, slightly spicy, salty, |
| Score: | 3.6 | 5.0 | 2.2 | 4.0 |
| Consistency | solid, dense | solid, dense | dense | solid, dense |
| Score: | 4.2 | 4.6 | 3.2 | 4.4 |
| Total: | 20.6 | 23.2 | 13.8 | 21.2 |
The results obtained showed that the carrying of vegetable raw materials in the amount of 2.5% (sample 1) of the mass of unsalted raw materials does not affect the organoleptic parameters and the yield of the product. When applying 10% of the mass of raw materials (sample 3), the minced meat turns an unpleasant red color, thereby worsening the organoleptic parameters, despite the increase in yield. As a result, during the development, it was revealed that the optimal application of lingonberries is 5% of the mass of raw materials – sample 2. With the introduction of such an amount of vegetable raw materials, the sausage becomes a pleasant dark red shade, the taste is more pronounced, it acquires a light, pleasant, piquant sourness. In addition, the addition of lingonberries, as a vegetable raw material, revealed an increase in the yield of the finished product by 3%. The average yield of the finished product was 61%.

The control sample has the taste of a classic smoked sausage.

The profilogram based on the results of the point evaluation of the prototypes is shown in figure 1.

![Figure 1. Profilogram of organoleptic evaluation of experimental samples of meat product (stage 1 – adapting the recipe).](image)

At the second stage of the experiment, to determine the effectiveness of the use of vegetable raw materials in the production of raw sausage products, it is necessary to conduct studies comparing the indicators of the nutritional value of the product. These indicators were studied on an experimental sample of raw smoked sausage products that was optimal according to the recipe (a sample of 2-5% of lingonberries), produced according to the developed technology in comparison with the control made according to the traditional recipe and technology. Experimental studies included a tasting assessment on organoleptic indicators, as well as an assessment on physical and chemical indicators: the mass fraction of fat, the mass fraction of moisture, the mass fraction of table salt, as well as the determination of the safety of vitamin C. The determination of the mass fraction of fat is carried out to prove the low fat content in the finished raw meat product. The determination of the mass fraction of moisture is carried out to prove that the introduced vegetable raw materials do not give excess moisture to the sausage production process. Determination of the mass fraction of salt in the finished product is carried out to exclude the fact of its excessive content in plant raw materials. The determination of the mass fraction of vitamin C is carried out to establish its safety in the finished product – a raw smoked sausage product. Since the introduced vegetable raw materials in the form of lingonberries are rich in vitamin C and there is no strong heat treatment in the production process, therefore, the vitamin must be preserved.
The results of determining the physical and chemical parameters of the samples under study are presented in table 2.

| Indicator              | Control sample 2 | Sample 4 |
|------------------------|------------------|----------|
| Moisture content, %    | 31.2             | 32.7     |
| Fat, %                 | 44.6             | 41.5     |
| Protein, %             | 18.8             | 20.3     |
| Sodium chloride, %     | 5.4              | 5.1      |
| Vitamin C, mg%         | 0                | 0.62     |
| Energy value, kcal     | 476.6            | 457.1    |

The experimental data obtained show that the prototype—an innovative raw smoked meat product with the addition of 5% lingonberries—was better than the control one both in organoleptic and physico-chemical parameters.

The results of determining the mass fraction of fat prove that a decrease in the amount of fat injected does not negatively affect the organoleptic parameters, but at the same time it reduces the caloric content of the finished product by almost 20 kcal (5%), including by adding a vegetable ingredient that does not contain fat.

The replacement of a small amount of fat raw materials in the recipe with meat without loss in organoleptic properties led to an increase in the content of full-fledged animal protein by 1.5%.

The study of the content of the mass fraction of moisture revealed that the introduction of vegetable raw materials in such an amount as in the sample 4 (5%) and in that form, does not carry with it the negative consequences of the presence of excessive moisture (lengthening of the production technology, shortening the shelf life, etc.). Thus, the introduced vegetable raw materials in the form of whole lingonberries, added in the process of cutting, does not reduce the manufacturability of production.

As a result of the study, in the experimental sample (when applying lingonberries in the amount of 5% of the weight of unsalted raw materials), the content of vitamin C in the finished product was 0.62 mg%. In comparison with the calculated content of vitamin C (0.75 mg%) in the semi-finished product of raw smoked sausage (according to the tab), its safety in the product after heat treatment was 82.7%. In this way, we can talk about the rational use of vegetable raw materials rich in vitamin C in the technology of raw smoked meat products, since its safety is more than 80%.

During the experimental study, it was proved that the introduced vegetable raw materials in the form of lingonberries do not increase the mass fraction of table salt in the finished meat product.

4. Conclusion

The result of the development of the recipe and production technology of innovative meat products with the addition of vegetable ingredients is an assortment of raw smoked sausages with the addition of vegetable raw materials in the form of berries. The novelty and distinctive feature of the innovative product is the use of non-traditional vegetable raw materials, lower fat content, higher protein content, the preservation of vitamin C after heat treatment and the preservation of shelf life. As a result, an increase in the biological and organoleptic values of the product.

In the course of adapting the technology, a new method of producing raw smoked sausage products with the stage of applying lingonberries was developed. The production differs from the traditional one by the presence of the stage of adding vegetable raw materials. Based on the experimental development of the developed assortment and the conducted research, a technological scheme of production was developed - the sequence and modes of individual operations, their nominal values of characteristics, parameters, indicators of all stages of production, the necessary and sufficient tolerances for obtaining a high-quality innovative meat product—raw smoked sausages. So the developed technology includes the following operations of production of raw smoked sausage products: freezing of raw meat, grinding, preparation of minced meat, adding berries, molding, smoking, drying, packaging, storage.
During the experimental organoleptic tests, the most optimal size of the addition of lingonberries in the amount of 5% of the mass of unsalted raw materials, and the form of vegetable raw materials introduced into the sausage minced meat – the best option is to add berries in their whole form.

Physical and chemical experimental studies of experimental samples of innovative meat products, suggests that the developed recipe has a lower caloric content of the finished product, compared with similar products, due to the replacement of fat raw materials. The added vegetable raw materials in the form of whole lingonberries improves organoleptic parameters, creates a variety of taste, increases the content of vitamin C. These data indicate the feasibility of producing an assortment of raw meat products with non-traditional vegetable ingredients. It should be noted that the key point in the production of raw smoked products with the addition of vitamin ingredients, such as berries, is that their safety remains very high. Vitamin C is stored in the finished product due to low heat treatment by 80%.

All these advantages can favorably affect the demand and competitiveness in the consumer market of the innovative meat product being created. And for the manufacturer, the expansion of the range of competitive products is directly related to the receipt of additional income. We believe that the developed product will have a high practical and social significance.

Thus, the developed recipe and technology of the product of raw smoked sausage is quite adequate, and the developed product has pleasant taste and aroma characteristics, attractive appearance, higher biological value, and it also has a reduced caloric content. The added lingonberries do not affect the standard course of the technological process and do not extend the shelf life, since the difference in the moisture content in the final product between the experimental and control samples was not significant. In addition, the importance of the study is determined by the expansion of the range of this product group. As a result of the conducted experimental studies, an assortment of meat products was developed - raw smoked sausage products that meet the requirements of the modern consumer.

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