Cooked and smoked meat products with the addition of L-carnitine for the nutrition of athletes

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Abstract. The article discusses the issue of organizing the production of cooked-smoked meat products for the nutrition of athletes and increasing the functionality of the assortment positions of the line of cooked-smoked products by using L-carnitine as a food additive. It was proposed to use pork, turkey and chicken in the form of whole muscle pieces as the main raw material. For a sports diet, the use of poultry meat is promising and relevant, since it is known that the proteins of chicken and turkey meat are successfully absorbed by the body. Pork use is directed at a target consumer group other than athletes. A recipe and technology for the production of cooked-smoked meat products were developed, taking into account the requirements for sports nutrition, the technological properties of L-carnitine were also taken into account and a number of laboratory studies were carried out to substantiate them, physical, chemical and organoleptic studies of the product were carried out.

1. Introduction

The relevance of sports nutrition has increased dramatically over the past 20 years [1]. The popularity of various categories of sports nutrition in Russia for 2019 is shown in figure 1.

![Figure 1. Food categories in Russia for 2019.](image_url)
dry milk combined mixtures, drink cocktails, fermented milk and curd products, products with a sugar substitute or its reduced content, as well as dietary supplements and various food additives [2]. The share of meat products in this segment is small. However, the popularity of meat products in the diet of athletes, according to statistics, can be determined from 2017. The main goal of consuming meat products in a sports diet is to obtain high-quality proteins, complete in composition [3]. According to the Ministry of Sports of the Russian Federation, in 2019 there was a sharp demand for products containing protein, and primarily for meat.

Thus, we can conclude that there is a demand for meat products for the nutrition of athletes, since they are the best source of protein. The production of cooked-smoked meat products with the addition of L-carnitine has a high marketing component, which entails an increase in demand for meat products.

The purpose of the work is to introduce cooked-smoked products with the addition of L-carnitine in the nutrition of professional athletes and consumers who want to reduce body weight by performing sports exercises and adherence to a sports diet, as well as to substantiate the technological properties of L-carnitine as a food additive in the food industry in production of meat products. To achieve the goal, the following tasks were solved: analysis of the market for meat products; the study of sports diets and general patterns in the nutrition of athletes; development of an assortment line of products of cooked-smoked products with the addition of L-carnitine; conducting a number of laboratory studies to substantiate the technological properties of L-carnitine; determination of physicochemical and organoleptic properties of cooked-smoked products with the addition of L-carnitine.

2. Materials and research methods
Cooked-smoked products from chicken, turkey and pork with the addition of L-carnitine, developed according to TU 10.13.14.620-005-02068060-19, were used as the test samples. The control sample, developed according to TU, without the addition of L-carnitine. Prototypes developed according to TU with increased and decreased L-carnitine content. The increased content - 9 g / 100 g of the product, the lower content - 6 g / 100 g of the product, is due to the difference in the technological properties of L-carnitine and the difference in organoleptic characteristics [4].

The organoleptic assessment of the samples was carried out according to the generally accepted methods described in GOST 9959-2015. To calculate the results, a point assessment was used, according to the data obtained, profilograms of the general organoleptic assessment were built.

Physicochemical indicators were determined according to the methods described in the regulatory documents, respectively: mass fraction of moisture in accordance with GOST 33319-2015, mass fraction of fat in accordance with GOST 23042-2015, mass fraction of protein in accordance with GOST 25011-2017.

3. Research results
Analysis of the sports nutrition market, as well as patent search and literature review, led to the conclusion that there are no similar products in sports nutrition [5]. Thus, the marketing component remains, since L-carnitine as a food additive is used mainly in the composition of fermented milk and tonic drinks [6]. The relevance of the production of cooked-smoked products with the addition of L-carnitine for the nutrition of athletes directly depends on the developing general relevance of sports nutrition, as well as on the lack of analogues in the consumer market [7].

By analyzing and calculating the traditional recipe for cooked-smoked meat products, an experimental recipe for cooked-smoked products from chicken, turkey and pork with the addition of increased and decreased L-carnitine content was produced for laboratory research, presented in table 1.

| Table 1. Recipes for cooked-smoked meat products with the addition of L-carnitine. |
|-----------------|---------------------------------|---------------------------------|
| Ingredient      | Weight, kg                      | recipe 1, with a reduced content | recipe 2, with a high content   |
| Pork            | 100                             | pork samples                     |                                 |
| Rosmix Combi    | 5.5                             |                                 |                                 |
Nitrite curing mixture 4.8
L-carnitine 6
Water / ice 89.7

chicken samples

Chicken breast 100
Rosmix Combi 5.5
Nitrite curing mixture 4.8
L-carnitine 6
Water / ice 89.7

Turkey samples

Turkey breast 100
Rosmix Combi 5.5
Nitrite curing mixture 4.8
L-carnitine 6
Water / ice 89.7

Next, the sensory assessment of pork and poultry samples was carried out, described in tables 2 and 3, respectively, and profilograms of the overall sensory assessment were compiled (figure 2).

Table 2. Organoleptic evaluation of pork samples.

| Indicator                  | Characteristic                                                                 |
|----------------------------|-------------------------------------------------------------------------------|
| Appearance and consistency| control sample sample with a high content of L-carnitine sample low in L-carnitine |
| Taste and smell            | pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor |
| Color                      | from yellow-brown to deep brown eveny colored muscle tissue of pale pink or pink color, without gray spots, fat color is white or with a pink tint, with a fat thickness of not more than 2.5 cm, adipose tissue with layers of muscle tissue |
| Sectional view             | eveny colored muscle tissue of pale pink or pink color, without gray spots, white fat color with a milky brown tint, without yellowing |

Table 3. Sensory evaluation of poultry meat samples.

| Indicator                  | Characteristic                                                                 |
|----------------------------|-------------------------------------------------------------------------------|
| Appearance and consistency| shape rectangular, trapezoidal, spherical, rounded-oval, etc., surface without torn or broken edges |
| Taste and smell            | pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor pronounced pleasant smell of smoking, salty taste, for example, a slight bitter aftertaste, without extraneous aftertaste and odor |
| Color                      | from yellow-brown to deep brown |
| Sectional view             | evenly colored muscle tissue of pale pink or pink color, without gray spots, white fat color with a milky brown tint, without yellowing |
The results of physicochemical studies of pork and poultry samples are described in tables 4 and 5, respectively.

**Table 4. Physicochemical indicators of samples of cooked-smoked pork products.**

| Indicator                          | Characteristic control sample | sample with a high content of L-carnitine | sample low in L-carnitine |
|-----------------------------------|-------------------------------|------------------------------------------|--------------------------|
| Moisture content, %               | 113.2±0.05                    | 154.7±0.05                               | 146.4±0.05               |
| Mass fraction of fat, %           | 3.0±0.1                       | 4.0±0.1                                  | 3.2±0.1                  |
| Mass fraction of protein, %       | 30.5±0.1                      | 35.4±0.1                                 | 33.87±0.1                |

**Table 5. Physicochemical indicators of samples of cooked-smoked products from poultry meat.**

| Indicator                          | control sample | Characteristic control sample | control sample |
|-----------------------------------|----------------|-----------------------------|----------------|
| Moisture content, %               | 97.4±0.05      | 110.6±0.05                  | 103.9±0.05      |
| Mass fraction of fat, %           | 1.1±0.1        | 1.5±0.1                     | 1.3±0.1         |
| Mass fraction of protein, %       | 30.5±0.1       | 29.7±0.1                    | 28.7±0.1        |
The functionality of cooked-smoked products, obtained by calculating experimental data, is: in samples with a low content of L-carnitine (up to 6 g / per 100 g of product) - 15.3%, in samples with an increased content of L-carnitine (no more than 9 g / per 100 g of product) - 17.8%. Thus, according to the results of the studies described in tables 4 and 5, it can be concluded that the food additive has technological properties, since in the samples with an increased content of L-carnitine, the level of moisture content is significantly exceeded. It can be concluded that L-carnitine has a direct effect on the content of the mass fraction of protein and fat, since in the experimental samples the values of the corresponding indicators are higher than in the control. This phenomenon can be explained by the effect of L-carnitine on the main nutrients in meat and the effect on technological losses during production.

4. Conclusion
Cooked-smoked meat products with the addition of L-carnitine for the nutrition of athletes are functional, have marketing and production relevance, and are also competitive in the meat products market [8]. It should be borne in mind that the analysis of the demand for meat products in the nutrition of athletes is growing together with the popularity of sports nutrition and this ensures the growth and development of the rates of production and sales of these products.

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