

Analysis of the effectiveness of the use of a new plant functional additive in the production technology of frozen chopped semi-finished products

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Abstract. The article presents the results of studies of the protein and fat composition of frozen chopped semi-finished products with a new plant functional additive in the field of their quantitative determination, and also describes the functional and technological properties of the additive based on the results of the study. The authors experimentally studied the amino acid composition of chopped semi-finished products. In addition, the article describes the technological scheme of frozen chopped semi-finished products with a new vegetable functional additive and presents the output of these meat products. For laboratory studies, three samples with a given formulation were developed to determine the effect of a new plant functional additive on the nutrients of chopped semi-finished products. Also, the amino acid composition of a new plant functional supplement consisting of 14 amino acids was studied.

1 Introduction

The Russian meat industry today produces an extensive assortment of semi-finished products. The most important tasks of the state in the field of healthy nutrition of the population is to create fundamentally new and safe food ingredients that can meet a number of specified indicators, namely: product quality, consumer properties, technological properties, economic indicators. In view of this, the urgency of developing a new plant functional food additive for use in the production of frozen chopped semi-finished products has appeared [1,2]. Frozen chopped semi-finished products are frozen portioned products made of minced chicken with the addition of a vegetable functional additive. The new plant functional supplement contains chickpeas and sea buckthorn in its composition, which confirms its functionality. According to the generally accepted definition, a functional additive is an additive that improves the organoleptic properties and quality indicators of

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meat products [3]. The functional additive from chickpeas and sea buckthorn is available in the form of a hygroscopic yellow powder without smell and taste. Due to its functional properties, the additive is able to give the product a dense consistency.

2 Materials and methods

The purpose of experimental studies was the need to confirm the functional properties of a new herbal supplement, as well as to study the protein, fat, carbohydrate and amino acid composition of frozen chopped semi-finished products.

The technological scheme of production includes the following stages: receiving frozen meat blocks, grinding chicken meat on a spinning top with the addition of bacon, mixing minced meat in a minced meat mixer with the addition of pumpkin and vegetable additives, subsequent molding of nuggets, layering by coating with mixed egg powder and water with molded products, applying a breadcrumb mixture of corn bran and breadcrumbs, subsequent freezing of nuggets, their packaging and labeling. The output of finished products is 93.3%.

Studies on the content of the mass fraction of protein were conducted in the GNU NIIMMP in accordance with GOST 25011-2017 "Meat and meat products. Methods of protein determination" in three samples: control sample, sample No. 1 and No. 2. Studies on the content of the mass fraction of fat in samples No. 1 and No. 2 were conducted at the Volga Research Institute in accordance with GOST 23042-2015. Studies on the content of the mass fraction of carbohydrates were conducted at the Volga Research Institute in accordance with GOST 31470-2012.

Determination of the amino acid content in the new plant supplement was carried out according to the method of measuring the mass fraction of amino acids by the CE method on the "Kapel-105M" system, also the mass fraction of moisture in the additive was determined according to GOST R 54951-2012. The mass fraction of protein, according to GOST 25011-2017 by the Kjeldahl method, was determined by the following formula:

$$x = \frac{0,0014 \times (V_1 - V_2) \times K \times 100}{m} = 6,25 \quad (1)$$

where 0,0014 - the amount of nitrogen equivalent to 1 cm³ 0,1 mol/dm³ of hydrochloric acid solution or 0,05 mol/dm³ of sulfuric acid solution, g;

V₁ - the volume of 0.1 mol/dm³ of hydrochloric acid solution or the volume of 0.05 mol/dm³ spent on titration of the test sample, cm³;

V₂ - the volume of 0.1 mol/dm³ of hydrochloric acid solution or the volume of 0.05 mol/dm³ spent on titration of the control sample, cm³;

K - coefficient of correction to the nominal concentration of hydrochloric acid solution;

100 - conversion factor to percent;

m - sample weight, g;

6,25 - conversion factor to protein.

The mass fraction of fat in the product, described in GOST 23042-2015, according to the accelerated method for determining the fat content, was calculated using the following formula:

$$x = \frac{(m_6 - m_5) \times 100}{m \times 100} \quad (2)$$

where m₆ - the mass of the weighing bottle with fat, g;

m₅ - the mass of the weighing bottle, g;

100 - the total volume of the extract, cm³;

100 - conversion factor to percent;

m - mass of the analyzed sample, g;

20 - the volume of the extract selected for evaporation, cm³.

MS Office 2010 package was employed for graphical presentation of the data.

Laboratory samples for research are ready-made nuggets with different additive content: the control sample does not contain a new functional vegetable additive, in control sample 1 the additive content is normalized, in sample 2 it is exceeded. The formulations of the samples are presented in Table 1.

Table 1. Formulation of laboratory samples.

Name	Content, kg		
	control sample	sample №1	sample №2
Broiler chicken fillet	70	70	70
Mid-back fat	3	3	3
Vegetable supplement	0	10.2	11
Pumpkin	16.1	16.1	16.1
Breadcrumbs	0.9	0.9	0.9
Water	0.6	0.6	0.6
Whole egg powder	0.45	0.45	0.45
Salt	1.1	1.1	1.1
Marjoram	0.04	0.04	0.04
Basil	0.04	0.04	0.04

The total vitamin C content in the samples is 200 mg per 100 g of the product. It was found that during heat treatment, the content of ascorbic acid in semi-finished products practically does not change.

3 Results and discussion

From the data obtained, it can be concluded that the research goal has been fulfilled, since studies have been conducted on the impact of the use of herbal ingredients included in the composition of a new functional herbal supplement. It should be noted that the protein and carbohydrate content is influenced by breeding consisting of corn bran and breadcrumbs. All the tasks were completed, such as: determination of the mass fraction of protein, fat and carbohydrates in the samples, as well as conducting an organoleptic assessment.

As a result of the studies (Table 2), it was found that the highest content is contained in sample No. 1 – 21.8%, which is 1.3% more in comparison with the prototype No. 2, and also exceeds the standard value by 8.3%. The result obtained is due to the presence of vegetable protein in the additive and breeding. The fat content in the studied samples is close to the standard value and has minor deviations from it. The highest carbohydrate content is in sample No. 2, the difference with the control sample is 4.1% in favor of sample No. 2, and with the normative value the difference is about 4.7%, due to technological losses.

Table 2. The content of nutrients in the studied samples.

Nutrients	Samples			Normative value
	control	№1	№2	
Proteins	14.5	20.5	21.8	13.7
Fats	7.7	7.3	7.2	7.6
Carbohydrates	5.5	8.1	9.6	14.3

The content of amino acids in the composition of the new plant functional supplement is shown in Figure. According to the data presented in Figure 1, it can be concluded that methionine is the limiting amino acid in the composition of the new plant functional supplement. Methionine is most often the limiting amino acid in many foods, the reason for this is currently undergoing a number of scientific studies [4, 9].

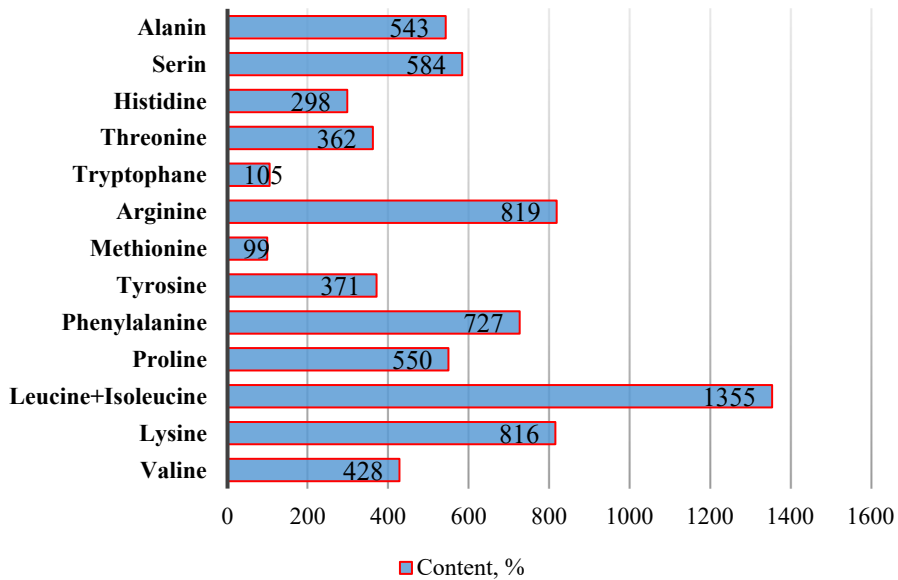


Fig. 1. Amino-acid score, %.

The content of amino acids such as histidine, tryptophan, tyrosine, threonine is slightly higher. Histidine affects the excitation of the adrenal medulla by reflex influence, thanks to its action, epinephrine is released, the heart rate increases. Tryptophan is an essential amino acid involved in the construction of body proteins, and is also a source of serotonin, which is formed in the brain and has a neurotransmitter effect on the regulation of behavior [5,7,8].

Tyrosine affects the neurophysiological processes of the body, such as mood, memory, energy, etc. Threonine is an essential amino acid and enters the human body only with food. The highest concentrations of threonine are found in the heart muscle, skeletal muscles, and CNS cells. Promotes the production of serotonin and dopamine in the body, which are neurotransmitters.

The average content of such amino acids as alanine, serine, proline, valine is recorded in the new herbal supplement. The highest content in the new plant functional supplement, determined experimentally, of the following amino acids: leucine + isoleucine, arginine, lysine. Leucine promotes the development of immunostimulating and anabolic effects in the human body. Also, leucine participates directly in cellular and humoral immunity, contributes to the enhancement of phagocyte function, regulates the launch of the synthesis of amino acids, participates in the regulation of metabolic disorders caused by the effects of prolonged stress on the body.

Isoleucine, contained in the product together with leucine, is the main building material for ketone bodies and glucose. This is why it is involved in the regulation of blood sugar levels. In addition, it takes an active part in the synthesis of hemoglobin and protects the body from increased serotonin production. Arginine, and its L-isomer contained in the product, is the most important amino acid that directly affects cardiac activity, as well as the activity of the vascular system by maintaining optimal cholesterol levels in the blood. Lysine actively affects the formation of collagen in the body, thereby contributing to the strengthening of the vascular wall, and also participates in the formation of carnitine. Due to this, it contributes to the regulation of the cycle of fatty acids involved in energy metabolism [6, 10].

According to the results obtained, it can be concluded that frozen chopped semi-finished products with the addition of a new plant functional additive contain 14 amino acids out of the known 20.

4 Conclusion

Summing up the above, it can be noted that a new functional vegetable supplement containing chickpeas and buckwheat has an effective effect on the amino acid and protein-fat composition of frozen chopped semi-finished products. The studies present deviations of the protein, fat and carbohydrate content in laboratory samples of the product from the standard values, and also describe the quantitative content of amino acids in the additive.

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