New types of biscuit products with improved amino acid composition

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Abstract. This article presents the results of development of biscuits with new taste and improved amino acid composition. Soy and buckwheat flours were chosen as functional additives, as raw materials with a high protein content and a more perfect amino acid composition, compared to premium wheat flour. Introduction of buckwheat flour allows you to diversify taste and aroma of finished products. Introduction of soy flour helps to obtain a softer, fluffier and more porous consistency. An increase in content of the total protein and the amino acid rate of flour composition shows that use of buckwheat and especially soy flour in biscuit dough recipe is advisable.

1. Introduction

Flour confectionery goods have a pleasant taste, aroma, attractive appearance, they are very popular among all social groups.

A porous, fluffy, soft biscuit is the basis for a wide variety of cakes, pastries and cookies with cream, fruit, and jam. But even without filling, a baked biscuit sprinkled with powdered sugar is a ready-made tasty product for tea and coffee.

However, due to the high content of carbohydrates, primarily due to premium wheat flour, sugar, the biscuit itself is already a well-digestible product, and in combination with sweet fillers, it is a high-calorie product, which frequent use can harm health.

Increasing nutritional value of flour confectionery products and reducing their calorie content is an urgent issue today. Degree of usefulness of food products, determined by their ability to meet human need for nutrients, is an integral part of their quality characteristics.

Increasing nutritional value of biscuits is carried out in various ways, including using various types of additives; correcting carbohydrate, fat or amino acid composition.

The analysis of scientific sources shows that introduction of various functional additives into biscuit products recipe increases their nutritional value and quality indicators to varying degrees [1, 2, 3, 4, 5, 6]. Another topical issue is expansion of finished products taste, which is currently defined by consumer demand.

Within the framework of this scientific work, soy and buckwheat flour were selected as recipe components for biscuits. The choice of these types of flour is justified by higher protein content and lower starch content, compared to premium wheat flour. This implies an improvement in protein
composition due to the content of essential amino acids, primarily lysine, methionine, tryptophan, and a decrease in caloric content of new types of biscuits.

Health benefits of soy flour, in comparison with wheat flour, are evident. The amount of total protein in skim soy flour exceeds protein composition of wheat flour by 4.7 times, dietary fiber - 4.1 times. In terms of biological properties, soy protein is close to animal proteins. Having high lysine content, soy foods are a useful supplement to other vegetable protein. Limiting amino acid in soy proteins is methionine; protein content of this amino acid is 56%. The amount of starch in soy flour is 4.4 times lower, energy value is 1.2 times lower than that of wheat flour [7]. Flour has a light flavor with nuttiness. Important point is that flour does not contain gluten, which means that people with celiac disease can consume it.

Buckwheat flour is 1.3 times more protein-rich than wheat flour. In terms of fats, carbohydrates (including starch), dietary fiber content, it has a similar composition. A significant amount of minerals increases the nutritional value of buckwheat flour: content of calcium is 2.3 times higher, magnesium and phosphorus - 3.0 times, iron - 3.3 times; vitamins B₁ and B₂ - 2.5 times. Caloric content does not differ significantly [7]. Flour has a pleasant aroma. The most important area of using buckwheat flour is its use in baby and diet food.

The aim of the study is to substantiate increase in the biological value of biscuits using soy and buckwheat flour, to determine optimal quantitative replacement of wheat flour for soy or buckwheat in biscuits recipe, to analyze amino acid composition and to calculate amino-acid score of flour mixture of products.

2. Materials and methods
Biscuit dough (control sample according to the traditional recipe); biscuit dough with soy flour; biscuit dough with buckwheat flour; baked biscuits (control sample, samples with soy or buckwheat flour).

In new types of biscuits, premium wheat flour was replaced with soy or buckwheat flour in the amount of 5-20% of total flour mass. Starch has been added to the recipe. During the research, qualitative characteristics of all types of biscuit dough were determined: height of egg-sugar mixture, height of foam, and foam stability were measured. Quality characteristics of finished biscuits were determined. Organoleptic quality indicators were assessed on a five-point scale, in accordance with GOST R 53104-2008. Determination of mass fraction of moisture in biscuit semi-finished products was carried out on an ELVIZ-2S device. Wetness of biscuit semi-finished products, which characterizes porosity of the mass, was determined in accordance with GOST 10114-80. The method for determining wetness is based on establishing an increase in the mass of biscuit products when immersed in water at t = 20°C for a certain time. Wetness is characterized by the ratio of the mass of products after wetting to the mass of dry products and is expressed as a percentage. Porosity of biscuit semi-finished products was determined in accordance with GOST 5669-96. The results were statistically processed using Microsoft Excel software.

3. Results and discussion
The influence of additives on the quality of biscuit dough was investigated: the volume of dough (Fig. 1-2); the density of dough (Figure 3-4).

Figure 1 shows that with the introduction of soy flour up to 15% of the weight of wheat flour, an increase in dough volume is observed; more than 15% - there was a decline in volume.

With the introduction of buckwheat flour 5-10% by weight of wheat flour, the volume of dough corresponded to the volume of a control (traditional) sample. With an increase in the amount of buckwheat flour in the recipe composition, a decrease in the volume of dough was observed.
Based on the data obtained, all samples were subjected to further research with the replacement of wheat flour only up to 15%.

The introduction of soy flour helps to reduce the density of biscuit dough. Density of dough with 10% buckwheat flour in dough corresponds to the density of a control sample, but with an increase in its dosage, density increases.

Biscuits were baked from all types of test samples of dough, organoleptic indicators of ready-made semi-finished products, which were of great importance for consumers, were examined.

On the basis of studies of dough indicators, organoleptic assessment and physical and chemical indicators of finished products, optimal dosage of soy and buckwheat flour in the recipe for biscuit products was determined.

Further, the analysis of amino acid composition of flour mixture of new types of biscuits was carried out and the amino acid rate was calculated for essential amino acids (Fig. 5-6).
An increase in dough volume and a decrease in mass density when whipping a biscuit mixture in comparison with a traditional sample can be associated with the chemical composition of soybean and buckwheat flour - the amount of protein, fiber, which contribute to foaming and air retention in foam system. These processes are especially intensive with introduction of soy flour.

The baked biscuits had high organoleptic characteristics. All samples of finished biscuits with soy flour (5-15%) received an organoleptic rating of 5 points, as well as a control sample.

For the samples with buckwheat flour, the biscuit with replacement of 10% flour (5.0 points) became an optimal sample. An increase in the dosage of buckwheat flour to 15% affects biscuit color, taste and smell, which lowers quality.

On the basis of comprehensive research, formulations of new types of biscuits have been developed. Comparative analysis of amino acid composition of flour mixtures of studied types of biscuits determined: with the introduction of soy flour into the recipe, a significant increase in total protein is observed by 16.8%. Replacing part of wheat flour with buckwheat flour practically does not change quantitative composition of protein.

Calculation and analysis of amino acid rate (AS) showed: with the introduction of buckwheat flour, increase in amino acid rate (for essential amino acids) averaged 5 - 7%, depending on the type of amino acid. A significant increase in AS was observed for lysine (by 28.5%) and phenylalanine + tyrosine (by 9.8%).

A more significant increase in amino acid rate was observed with the introduction of soy flour (Figure 5). A significant increase was noted for all types of essential amino acids in flour mixture of biscuits. Thus, amino acid rate of tryptophan is increased by 2.3 times, isoleucine - by 2.8 times, compared with traditional biscuit; phenylalanine + tyrosine exceeds the AC of traditional biscuit by 4.4 times.

4. Conclusion

Biological value is an indicator of food protein quality, reflecting the degree of compliance of its amino acid composition with body's needs for amino acids. An increase in the content of total protein and the amino acid rate of a flour mixture of biscuits shows that the use of buckwheat and especially soy flour is advisable.

The introduction of soy flour helps to obtain a softer, fluffier, porous consistency. The introduction of buckwheat flour allows you to diversify taste and flavor of finished products. Analysis of the cost of

![Figure 5](image1.png)  ![Figure 6](image2.png)
a raw material set showed that the introduction of buckwheat flour increases the cost of finished products by 5.0%, soy flour - by 15.1% compared to a traditional one and is an affordable price for the consumer.

References

[1] Koryachkina S Y, Lazareva T N and Kabanova T V 2015 Using unconventional raw materials in biscuit technology *Moscow Khleboprodukty* 6 44-5

[2] Tertychnaya T A 2010 Optimization of biscuit recipe parameters based on triticale flour *Healthy food* 7 31-3

[3] Ermosh L G and Kulishov A A 2017 Substantiation of the recipe composition of biscuits based on dry egg white and herbal supplements *Bulletin of KrasGAU* 2 (125) 109-14

[4] Ermosh L G, Prisukhina N V and Kazina V V 2019 Using the powder from irgi berries as a substitute for sugar in the production of flour confectionery *Bulletin of KrasGAU* 12 (153) 131-8

[5] Pashchenko V L, Magomedov G and Ermolenko T 2011 Use of wholemeal flour from hawthorn fruits in technology *Science, technology, production* 6 38-9

[6] Yanova M A and Prisukhina N V 2020 Use of textured grain products in the production of basic biscuit *Vestnik KrasGAU* 2 (155) 137-47

[7] Skurikhin I M and Tutelyan V A 2008 *Chemical composition of Russian food products* 230

[8] Amino acid composition of various types of flour URL: https://fitaudit.ru/food/135894/amo