On the issue of enrichment of bakery products with functional components

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Abstract. The enrichment of food products with natural protein components of plant and animal origin is an important task of the food industry. The problem of lack of protein in the diet is observed among different segments of the population. This is due to the wrong choice of products, commitment to fast food restaurants, metabolic disorders. Bakery products are in high demand. They provide the basis for the energy component of the daily diet due to the high content of carbohydrates. In addition, bread contains B vitamins, essential minerals and fiber. Nutritionists advise giving preference to whole grains and rye bread. However, the popularity of short products remains at a high level. Enrichment of wheat bread with biologically valuable components will increase the level of consumption of nutrients important for humans. The article presents the results of studies of the quality of bakery products when making up to 8% protein peanut mass in the recipe. A technology is proposed for preparing peanut beans before being added to the dough, as well as a sponge method for producing fancy bread. Organoleptic characteristics, acidity and porosity of the crumb were evaluated in the product, the mass fraction of protein was determined, which amounted to at least 12.5% in the experimental samples. The research results prove an increase in the protein content in finished products, as well as the beneficial effect of the additive on the sensory and technological properties of the product. The addition of peanut mass to the composition of bakery products led to an increase in the energy value of the product, which amounted to 325 kcal in the experimental samples.

1. Introduction
The desire of the consumer at the present stage to adhere to a healthy lifestyle and eat right is reflected in the formation of the assortment of consumer goods.

The problem of the lack of important micro- and macronutrients, including protein remains despite the large number of developed functional enriched products. At the same time, the amount of meat and dairy products consumed - the main sources of high-grade protein, directly depends on the material well-being of customers. In this regard, relatively inexpensive bakery products as objects of enrichment are of undoubted interest.

There are many ways to solve the above mentioned problem. Thus, methods have been developed to enrich bread with additives from grain legumes, subjected to enzymatic modification. Seeds of beans, soy, peas, lentils, chickpeas and other crops are traditionally used as a source of vegetable protein. Soya is the richest in protein, but it requires complex enzymatic processing [1].

Studies of the effect of chickpea flour in a baguette recipe have shown that the taste, aroma and condition of the crumb in the finished products deteriorate when replacing more than 20% of wheat flour. In experimental samples, the protein content increased by 1.2 times [2]. The results of adding bean
additives to wheat bread made it possible to obtain a product superior to control samples in protein content by 16.5%. In addition, the product increased the content of such essential elements as calcium, magnesium, potassium, sodium, manganese, etc. [3].

Wheat germ makes it possible to enrich flour products not only with the protein component, but also with biologically active components: unsaturated fatty acids, vitamins, fiber. This makes it possible to use them in the production of dietetic foods [1].

One of the additional sources of protein is dry gluten [1]. It also plays an important role in shaping the quality of finished products, especially from lower grades and in the production of whole grain bread. Farida Smolnikova et al. (2020) found that enriching bread from buckwheat flour with both dry gluten and dried apples allows getting a product with a high content of protein (up to 9%) and minerals (up to 2.5 g per 100 g of product), while the quality of the crumb and the freshness of the product increase. A significant difference was observed in the mineral composition. The content of magnesium, iron and manganese increased [4].

Recently, researchers are increasingly attracted to unconventional sources of protein. These include protein concentrates of sunflower seeds, lupine flour and rice bran. Studies conducted by Taha F S, Attia M, Shehata N A showed their beneficial effect on the nutritional value of bread and allowed obtaining an acceptable product according to sensory indicators when using additive in the amount of 5% [5]. Sources of animal origin are of interest: whey [6], concentrated fish protein [5], chicken [7]. Authors Hulya Cakmak et al. (2013) added both fresh meat and powder based on it to various samples in an amount of 10 to 30%. At the same time, the protein content increased to more than 18%. Despite the decrease in indicators by such sensory attributes as the state of the crumb, crust and general porosity, the quality of bread remained acceptable [7]. There is data on the use of insect processing products, in particular, flour worm powder, as an additive [8]. The authors found that the addition of the latter in the amount of 5 and 10% of the total mass of flour led to a significant increase in protein and essential amino acids in bakery products and did not affect the technological properties of the dough and the finished product. However, the necessity of introducing baking powder was noted, deterioration of sensory characteristics was shown; potential microbiological safety problems were identified.

In literature sources there are data on the use of peanuts in the form of peanut paste as a protein component. A patent has been registered for a method of producing bread by a straight dough method with the addition of 3-4% protein peanut mass. Sugar and margarine are additional ingredients in the recipe [9]. In the studies of Vershinina, O L et al. (2009), the use of peanut mass obtained by cold extrusion and crushed to a grain size of 20–30 μm in the production of bread from wheat flour was proposed. Moreover, the proportion of the introduced component did not exceed 5%. An increased content of protein, essential amino acids is determined in the finished product: isoleucine, leucine, lysine, methionine, threonine, phenylalanine and tryptophan; as well as high quality characteristic of crumb. Dough production was carried out in an accelerated manner [10].

Peanut processing products are of high biological value and contain not only complete proteins (up to 23%), but also valuable lipids rich in unsaturated fatty acids and vitamins [11]. It is of interest to expand the assortment of small-piece rich bakery products enriched with protein peanut mass (PPM).

2. Objects and methods of research
The development of recipes and production technology for bakery products with a high PPM content was carried out in the laboratories of the department of the Department of technology for the production and processing of agricultural products of Yaroslavl-the-Wise Novgorod State University and at the enterprise AO “Novgorodkhleb”.

The object of the study were prototypes of short bread with the addition of PPM.

The determination of enriched short products was carried out in accordance with the current standards: organoleptic indicators – according to GOST 5667; mass fraction of protein – according to GOST 10846-91; acidity – according to GOST 5670; porosity – according to GOST 5669.
3. Results and discussion
The study was conducted in order to obtain wheat shortening with a high content of protein and biologically active components that meet the quality requirements according to regulatory documents. Two versions of the protein peanut mass were prepared - from raw and pre-roasted fruits, peeled from the soft shell.

The amount of PPM introduced varied at levels of 4 and 8% by weight of wheat flour. In this case, when making peanut mass, the fat component, margarine, was reduced or completely eliminated. Three experimental formulations were developed to test the product (table 1).

| Raw materials            | Control sample | Sample № 1 | Sample № 2 | Sample № 3 |
|--------------------------|----------------|------------|------------|------------|
| Premium baking wheat flour | 100           | 100        | 100        | 100        |
| Margarin                 | 8              | 4          | -          | -          |
| White sugar              | 10             | 10         | 10         | 10         |
| Protein peanut mass      | -              | 4          | 8          | 8<sup>a</sup>|
| Pressed yeast            | 2              | 2          | 2          | 2          |
| Edible salt              | 1.5            | 1.5        | 1.5        | 1.5        |

<sup>a</sup> – In the third sample, the protein peanut mass is prepared from pre-roasted peanuts

Protein peanut mass was prepared under laboratory conditions by grinding peeled raw or roasted peanuts in a UIM-2 laboratory mill to a fraction size of 100–150 μm. The average temperature of the mass at the end of grinding was 50 °C.

The manufacture of samples was carried out in a sponge dough manner in order to obtain the specified indicators of porosity. The dough was prepared under the following conditions: t 30–31°C; fermentation duration 6–7 hours; the acidity of the finished dough is 3–3.5 deg. The duration of the production cycle will take from 9 to 10 hours.

The dough was kneaded on dough until a uniform consistency at a temperature of no more than 31°C; the components were added in the following sequence: wheat flour (to a predetermined amount according to the recipe), white sugar, margarine, PPM, edible salt. Fermentation of the dough was carried out to a final acidity of 2.5–3 degrees for an average of 25-30 minutes. Experimental samples were baked in a laboratory oven at a temperature 250±5 °C.

Properties of the crumb play an important role in the evaluation of bakery products. In addition, the protein content in the experimental products was determined (table 2).

| Indicator          | Control sample | Sample № 1 | Sample № 2 | Sample № 3 |
|--------------------|----------------|------------|------------|------------|
| Acidity of the crumb, deg. | 2.5±0.19       | 1.6±0.15   | 2.4±0.20   | 2.0±0.21   |
| Porosity of the crumb, %     | 72.0±0.06      | 78.0±0.10  | 75.5±0.11  | 77.6±0.09  |
| Protein content, %       | 8.0±0.20       | 11.1±0.23  | 13.1±0.18  | 12.9±0.22  |

All samples according to defined indicators met the requirements of regulatory documents. However, there was a slight increase in crumb porosity in the test samples. An inverse relationship was established between the acidity of the crumb and its porosity.
The protein content, when adding 4% PPM, increased by an average of 38%, and with a dose of 8% PPM - by 62%, respectively. Differences in protein content between the second and third test samples are within the statistical error. In addition, the complete replacement of margarine with peanut protein in the recipe made it possible to exclude modified fats from the product and enrich short products with polyunsaturated fatty acids.

The nutritional and energy value of short bakery with peanuts was calculated based on the obtained experimental data, as well as the chemical composition of the components (table 3).

Table 3. Nutritional and energy value of enriched wheat short bakery.

| Product                      | The content of nutrients in 100 g, g | Energy value |       |
|------------------------------|-------------------------------------|--------------|-------|
|                              | proteins   | fats | carbohydrate | kCal | kJ  |
| Short bakery                 | 8.0        | 5.3  | 53.7         | 294.5 | 1231.0 |
| Short bakery with peanuts    | 12.5       | 5.7  | 56.1         | 325.7 | 1361.4 |

Thus, the use of 60 g of short bakery per day will provide 15% of the daily need for vegetable protein.

No sensory deficiencies were detected when assessing the organoleptic properties of enriched products. The additive did not affect the quality of the appearance and surface of the crust. The crumb color was noted from white in the control sample to pronounced cream in the third test sample. At the same time, the latter had a pleasant pronounced taste and aroma of peanuts.

A sensory profile of enriched rich bakery products was compiled based on the results of the tasting evaluation of the samples (figure 1). The following indicators were analyzed: the shape and condition of the surface, the color of the crust and crumb, degree of baking and porosity. The assessment was carried out by an expert commission of six people, which included experts from NovSU and AO “Novgorodkhleb”.

All samples presented to the tasting commission had high quality indicators. The highest average score – 4.75 – was received by samples number 1 and number 3. In the third sample, tasters noted a pronounced pleasant taste and aroma of peanuts, the saturated color of the crumb.
4. Conclusion
As a result of studies on the introduction of high doses of protein peanut mass in the recipe for rich bakery products, the technology of preparing peanut mass was developed and the sponge dough method of producing short bakery was selected.

An inverse relationship between the increase in the acidity of the crumb in the finished products as a result of the introduction of PPM and their porosity was noted.

It was found that the introduction of PPM in the amount of 8% by weight of wheat flour will increase the protein content in the finished product by 62% compared with the control. Roasting of peanuts before grinding leads to a product with high technological and taste properties: evenly developed porosity, pronounced color, taste and favor.

It is enough to use one product of short bakery with peanuts, having a mass of 60 g to ensure a 15% daily requirement for vegetable protein.

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