Development of bread recipes based on natural fortifiers

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Abstract. New recipes that include natural ingredients that supplement the main product with the substances necessary for the body can contribute to improving consumer properties. The aim of the research was to develop a bread recipe using flour from naked oat grain, flax seeds and spirulina microalgae powder as natural fortifiers. The recipes used wheat flour of the highest grade, wallpaper flour from the grain of naked oats, spirulina microalgae powder and flour from the seeds of oilseed flax. Laboratory baking of bread was carried out according to the method of the State Commission for Variety Testing (per 100 g of flour: pressed yeast - 3 g, sugar - 2.5 g, salt - 1.3 g). The humidity, acidity and porosity of bread were determined according to the methods set out in the State Standards. Two promising formulations have been identified: with the ratio of wheat flour of the highest grade and wallpaper flour from the grain of naked oats and-90% : 10%; with the ratio of wheat flour of the highest grade and flour from flax seeds - 95% : 5% with the addition of spirulina powder of 0.5%.

1. Introduction

The formation of a system of healthy nutrition of the population is one of the most important directions of the State policy of Russia. This is reflected in the Food Security Doctrine of the Russian Federation, where the development plan for scientific research includes increasing the production of new enriched, dietary and functional food products.

Bread is a widespread food product in our country. Consumer properties of bread largely depend on the quality of grain and flour [1-4]. At the same time, new bread recipes may be of great importance, which include natural ingredients that supplement the main product with substances necessary for the body [5-8].

E. I. Ponomareva with authors report on the development of a new recipe for a bakery product with sprouted flax seeds with the addition of 4% corn oil to the mass of flour. The addition of a natural concentrator provided an increase in the specific volume of the product by 14%, as well as an improvement in the physical properties of the dough. It was found that the ratio of omega-3 and omega-6 fatty acids in the product was within the optimal limits. The authors characterize the bakery product as balanced with polyunsaturated fatty acids and recommend using it for functional nutrition [8].

The Voronezh State University of Engineering Technologies has developed a baking mixture based on bioactivated cereals with the addition of soy protein isolate in an amount of 11 %. As a result, the
content of essential amino acids in the product increased 1.7-2.4 times and the biological value increased by 13.7. It is noted that the use of a baking mixture with soy protein isolate in the composition of grain bread will increase the content of protein, calcium, iron, and phosphorus in the product and in the future produce of functional food products [5, 6].

Belyavskaya I. G. with authors [7] recommend recipes of bakery products based on spelt whole-grain flour with the addition of vegetable ingredients and vitamin-mineral premix to expand the range of healthy food products. As a result, the product is enriched with vitamins and iron.

The possibility of using flour from various plant species in bread recipes has been studied [9]. New recipes of increased nutritional and biological value are recommended. The influence of whole-grain spelt flour mixed with lupine, flax and Jerusalem artichoke flour on the reduction of the glycemic index, increase in the content of dietary fiber, protein, increase in amino acids, vitamins and minerals was established.

Special attention in the world and in our country is paid to the development of biotechnologies for gluten-free bakery products. Biological fermenters are used, which increase the quality of finished products and their resistance to microbial spoilage. In the work of Kuznetsova L. I. with authors [10], it was shown that gluten-free starter cultures have a positive effect on the physico-chemical and organoleptic quality indicators of gluten-free bread, slow down staling and microbial spoilage. Biotechnologies of hypoallergenic gluten-free sourdough bread using dairy and soy products have been developed to ensure the high quality of finished products and their resistance to microbial spoilage.

A valuable component of wheat flour is considered wallpaper flour from grain of naked varieties of barley and oats [11-13]. A recipe for bread using wallpaper flour from grain of naked pigmented barley of the Granal 32 variety, which has increased antioxidant activity, has been developed. For research, variants with the addition of high-grade barley wheat to flour in the amount of 10, 20, 30, 40% were used. A variant with the addition of 10% wallpaper flour from grain of naked pigmented barley of the Granal 32 variety to wheat flour of the highest grade is recommended for implementation [11].

The possibilities of obtaining bread using mixtures of wheat flour of the highest grade, wallpaper flour from grain of naked barley of the Nudum 95 variety and wallpaper flour from triticale grain of the Tsekad 90 variety are considered [14]. As a result of the evaluation of mixtures of wheat, barley and triticale flour, the most optimal ratio was found – 70 : 10 : 20. This option is recommended for introduction into production for the enrichment of wheat flour with the nutritional components of barley grain and triticale.

Currently, the use of microalgae, which contain biologically active substances that have very valuable properties, including antioxidant properties, is expanding. The microalgae spirulina is most widely used in the food industry. Its value is determined by the quality of proteins, their amino acid composition, the presence of vitamins, macro- and microelements [15]. When adding spirulina microalgae to the flour, the bread is enriched with proteins, vitamins, minerals, dietary fibers and other food components. It was found that the addition of spirulina powder to the recipe improves a number of indicators of bread quality [16].

The purpose of the research is to develop bread recipes using flour from naked oat grain, flax seeds and spirulina seaweed powder as natural fortifiers.

2. Material and methodology

Options for laboratory baking of bread with the addition of flour from the grain of naked oats to the recipe included: 1. control - wheat flour of the highest grade - 100%; 2. wheat flour - 90%: oat flour - 10%; 3. wheat flour - 80%: oat flour - 20%; 4. wheat flour - 70%: oat flour - 30%.

Options for laboratory baking of bread with the addition of flour from flax seeds oilseeds and spirulina powder to the recipe included: 1. premium wheat flour - 100%; 2. wheat flour - 100%; spirulina powder of 0.5%; 3. wheat flour - 95%; spirulina powder - 0.5%; flax seed flour - 5%; 4. wheat flour - 90%; spirulina powder - 0.5%; flax seed flour - 10%. Laboratory baking of bread was
carried out according to the method of the State Commission for Variety Testing (per 100 g of flour: pressed yeast - 3 g, sugar - 2.5 g, salt - 1.3 g). The humidity, acidity and porosity of bread were determined according to the methods set out in the State Standards.

3. Research results

One of the most important indicators of the quality of bread is its volume, expressed in cm³ per 100 g of flour. The volume of bread depends on the gas-forming and gas-holding capacity of the flour. In our experiment, a decrease in the volume of bread was observed with an increase in the proportion of oat flour in the mixtures (Table 1). The highest volume of bread was obtained in the control version – 510 cm³. The variant with the addition of oatmeal in an amount of 10% (470 cm³) was distinguished from the studied ones.

The overall assessment of bread is the result of an organoleptic assessment of bread according to the following indicators: appearance (shape, color, condition of the crusts, surface), crumb condition (pores, porosity, baking, elasticity), smell and taste. The bread score based on the above criteria provided an overall score of 4.4 points in the control version, 3.9 points in the version with the addition of oat flour in the amount of 10%, 3.6 points – with the addition of 20% oat flour and 2.6 points – with the addition of 30% oat flour. According to the general assessment of the bread studied, the best option was the one with the presence of 10% oat flour in the mixture. The acidity and moisture content of the bread in this version were at the control level, the porosity decreased slightly (by 5%).

Table 1. Indicators of the quality of bread in variants with mixtures of wheat and oat flour

| Variants                  | Bread volume, cm³ | Total bread score, points | Bread moisture content, % | The acidity of the bread, deg. | Porosity of bread, % |
|---------------------------|-------------------|---------------------------|---------------------------|-------------------------------|-----------------------|
| 1. Control - wheat flour -100% | 510               | 4.4                       | 44.0                      | 3.0                           | 70                    |
| 2. Wheat flour - 90%: oat flour - 10% | 470               | 3.9                       | 44.0                      | 3.2                           | 65                    |
| 3. Wheat flour - 80%: oat flour - 20% | 390               | 3.6                       | 43.5                      | 4.2                           | 65                    |
| 4. Wheat flour - 70%: oat flour - 30% | 370               | 2.6                       | 43.8                      | 4.3                           | 50                    |

Thus, of the studied variants enriched with flour from the grain of naked oats, the best consumer properties were characterized by bread baked from a mixture: wheat flour - 90%: oat flour - 10%. The volume of bread in this version was 470 cm³, the overall rating of bread - 3.9 points, humidity - 44%, acidity - 3.2 deg., porosity - 65 points.

Table 2 shows the quality indicators of bread in variants with mixtures of wheat, flaxseed flour and spirulina powder. The volume of bread in all the studied variants is quite high (490-515 cm³). There was a variant with the inclusion of spirulina and 5% flaxseed flour - 515 cm³ in the recipe. The overall score of bread on the control and in the version with the addition of spirulina powder was the highest - 4.2 points and decreased to 3.7 points in the version with the addition of 5% flaxseed flour to the recipe and to 3.5 points with the addition of 10% flaxseed flour.

Bread in the variants with the addition of flaxseed flour was characterized by a higher acidity, which, apparently, is due to the presence of fatty acids in flax seeds. There was a tendency to reduce the porosity of bread in variants with the addition of flaxseed flour to the recipe. According to the
research results, the most promising option can be identified with the ratio: wheat flour - 95%; spirulina - 0.5%; flax seed flour - 5%. Bread in this version is enriched with useful substances for the human body microalgae spirulina and flax seeds. The volume of bread in this version is $515 \text{ cm}^3$, the overall rating of bread is 3.7 points, the moisture content of bread is 43.9%, the acidity is 3.7 degrees, and the porosity is 68%.

Table 2. Bread quality indicators in variants with mixtures of wheat, flaxseed flour and spirulina powder

| Variants                              | Bread volume, cm$^3$ | Total bread score, points | Bread moisture content, % | The acidity of the bread, deg. | Porosity of bread, % |
|---------------------------------------|----------------------|---------------------------|---------------------------|--------------------------------|----------------------|
| 1. Control - wheat flour - 100%       | 500                  | 4.2                       | 44.5                      | 3.2                            | 70                   |
| 2. Wheat flour - 90%: oat flour - 10% | 505                  | 4.2                       | 45.2                      | 3.3                            | 70                   |
| 3. Wheat flour - 80%: oat flour - 20% | 515                  | 3.7                       | 43.9                      | 3.7                            | 68                   |
| 4. Wheat flour - 70%: oat flour - 30% | 490                  | 3.5                       | 43.2                      | 3.9                            | 66                   |

4. Conclusion
Thus, the development of recipes for the purpose of enriching wheat bread with natural fortifiers allowed us to identify two promising recipes. The first is with the ratio of wheat flour of the highest grade and wallpaper flour from the grain of naked oats and - 90% : 10%. And the second is with the ratio of wheat flour of the highest grade and flour from flax seeds - 95% : 5% with the addition of spirulina powder 0.5%.

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