Investigation of the possibility of using mushrooms in wheat bread production technology

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Abstract. The analysis of the Russian population nutrition shows that it does not correspond to modern concepts. It is characterized by high calorie content, insufficient intake of macro- and micronutrients. The purpose of the paper is to study the possibility of using mushrooms in the technology of making wheat bread. The work was carried out in 2022 based on the Kursk State Southwestern University. The use of mushroom powder in the production of bread necessitates its evaluation by the main organoleptic and physico-chemical indicators to develop an effective technology to create new types of products. The most effective concentrations of mushroom powder, which improves the physical and chemical parameters without losing the organoleptic value of the products, have been determined. The substantiation of prescription-component solutions for the use of dried ground mushroom - champignon in baking wheat bread is given. The influence of mushroom powder on the organoleptic and physico-chemical parameters of the finished wheat bread has been established. It was found that the optimal amount of mushroom powder to add to the dough is 6% of the total mass of flour. The results of physico-chemical analysis showed that wheat bread with the addition of mushroom powder meets the requirements of the standard. The results obtained allow us to recommend the developed method for the production of bread at enterprises.

1 Introduction

According to experts the prospects for the bakery market in Russia are disappointing, as the production of bakery products has decreased from 5.76 to 5.58 million tons.

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According to forecasts, in 2021-2025 when the economic situation in Russia stabilizes, sales of bread and bakery products on the domestic market will continue to decline by 0.3–1.4% per year [1].

Currently, the state policy in the field of healthy nutrition of the population pays special attention to the development, production and sale of functional products in order to preserve and improve the health of the population, prevent diseases, including those caused by inadequate and unbalanced nutrition of children and adults [2].

The priority direction of the state policy of Russia in providing national food products can be the formation of domestic production of certain, most demanded types of food materials and an increase in the production of mass consumption foodstuffs (especially common varieties of bakery products) enriched with essential food components that are usually consumed by all segments of the country's population [3].

Currently, the organization of nutrition of the population on a scientific and hygienic basis is carried out in the following areas: improving the quality, biological value and taste of food products, improving the assortment, introducing new efficient production methods, taking into account the rational use of raw materials, and developing combined functional products [4].

There is need for natural universal-purpose ingredients that can provide both a technological improvement in product quality and an increase in the content of biologically active substances. Thus wild-growing fruit raw materials, various medicinal and spice plants are promising, characterized by a complex of valuable physiological properties and technological functions [5, 6,7].

Various types of non-traditional raw materials can serve as powerful sources of antioxidants in bread: vegetable and fruit purees, processed products of various cereal crops (buckwheat flour, cereal germs, etc.), green tea extract, processed products of various plants [8].

One of the topical areas of modern research is the study of the use of wild-growing raw materials (including medicinal ones) in the production of traditional food products [9, 10, 11, 12, 13].

The use of wild-growing medicinal raw materials provides the products with functional properties [14].

In this regard, there is a steady trend of growing interest around the world in the use of cultivated and wild-growing medicinal, spicy-aromatic plants, both in health authorities and in other industries. In the food industry, the demand for this raw material in the world over the past 10 years has increased by almost 6 times, and its production volumes are increasing annually by 20–30% [15].

In addition, a very important positive result of the use of wild medicinal and spicy-aromatic plants is the possibility of reducing the chemical load on the human body by reducing or eliminating the use of improvers and other food additives in the production of such a significant and popular product as bread [16].

In addition, at present there are enough scientific research works on the introduction into the technology of bread and bakery products, as an additional raw material of various herbal supplements: pectin extract, various powder components - mushroom flour, pumpkin flour, pea, yacon, sorghum, amaranth, thistle [17].

The advantage of enriching bakery products with natural vegetable raw materials is the complexity of its chemical composition and, as a result, the possibility of complex enrichment of bakery products with vitamins, proteins, polyunsaturated fatty acids, minerals and trace elements, dietary fiber and other equally important biologically active substances.

Given the wide distribution of mushrooms in the Russian Federation, the use of their processed products, including powders, to produce bakery products is an urgent problem for

the industry, the solution of which will not only expand the range of bread and bakery products for a healthy diet, but also increase their nutritional value.

From these positions, the improvement of technology, the use of mushrooms is an urgent problem for the industry, the solution of which will not only expand the range of bread and bakery products for a healthy diet, but also increase their nutritional value.

Experimental studies were carried out in accordance with the tasks set in the laboratories of the Department of Commodity Science, Technology and Examination of Goods of the Southwestern State University.

2 Materials and methods

Generally accepted and special methods were used for assessing the properties of raw materials.

The properties of the finished laboratory samples of bread were evaluated by organoleptic and physico-chemical parameters, which were determined in accordance with the methods.

Determination of the mass fraction of moisture and solids (%) in products was carried out by the standard method according to GOST 21094.

Titratable acidity (deg) was determined according to GOST 5670-96.

The organoleptic characteristics of the finished bread samples were evaluated according to GOST 5667-65.

The porosity of bread was determined using a Zhuravlev probe, consisting of a metal cylinder with an internal diameter of 3 cm, with a pointed edge on one side; wooden sleeve; a wooden or metal tray with a transverse wall, in which there is a slot 1.5 cm deep at a distance of 3.8 cm from the wall.

It is proposed to add mushroom powder in the amount of 3%, 6% and 10% of the amount of flour in the recipe as an additive in the recipe for wheat bread (Table 1).

To study the possibility of using mushrooms in the preparation of wheat bread, the following samples were used:

- sample No. 1 without the addition of mushroom powder (control sample);
- sample No. 2 with the addition of 3% mushroom powder from the total amount of flour;
- sample No. 3 with the addition of 6% mushroom powder from the total amount of flour;
- sample No. 4 with the addition of 10% mushroom powder from the total amount of flour.

To obtain mushroom powder mushrooms were purified from foreign impurities of plant origin, mineral impurities, and damaged areas were cut out. Fruiting bodies were selected by size (large ones were cut into pieces), laid out and withered at a temperature of 45 °C. After the surface of the mushrooms dried up and they stopped sticking, the temperature was raised to 65-70°C and dried to a moisture content of no more than 12% (for 3 hours). The grinding of dried champignon mushrooms was carried out at home, in a coffee grinder. To obtain mushroom powder from mushrooms, grinding was carried out in one stage, grinding dried champignon mushrooms with a particle size of 0.2-1.0 mm to a powder state. The mushroom powder was sifted on silk fabric sieves No. 19 and No. 25 according to GOST 4403-91.4.5.

3 Results and discussion

The addition of mushroom powder from champignons in an amount of 3% does not improve the external characteristics of the bread (Fig. 1). The addition of 6% mushroom powder from champignons to the recipe makes it possible to obtain bread with a golden crust, without cracks, elastic crumb and uniform porosity. The introduction of 10% mushroom powder worsens the quality of bread made from wheat flour, cracks and undermining appear.

Table 1. Recipes and modes of preparation of dough with the addition of mushroom powder from champignons

Raw materials	**Sample No 1**	**Sample No 2**	**Sample No 3**	**Sample No 4**
Wheat flour, premium, g	250	242,5	235	225
Baker's yeast, g	6	6	6	6
Food salt, g	7	7	7	7
Sugar, g	7	7	7	7
Mushroom powder, g	-	7.5	15	25
Water, ml	200	200	200	200

Thus, studies have proven the expediency of using mushroom powder from champignons to produce bread that surpasses the control sample in its consumer qualities. Namely, to obtain bread with the highest quality indicators, it is advisable to add mushroom powder from champignons (in dry form) in an amount of 6%.

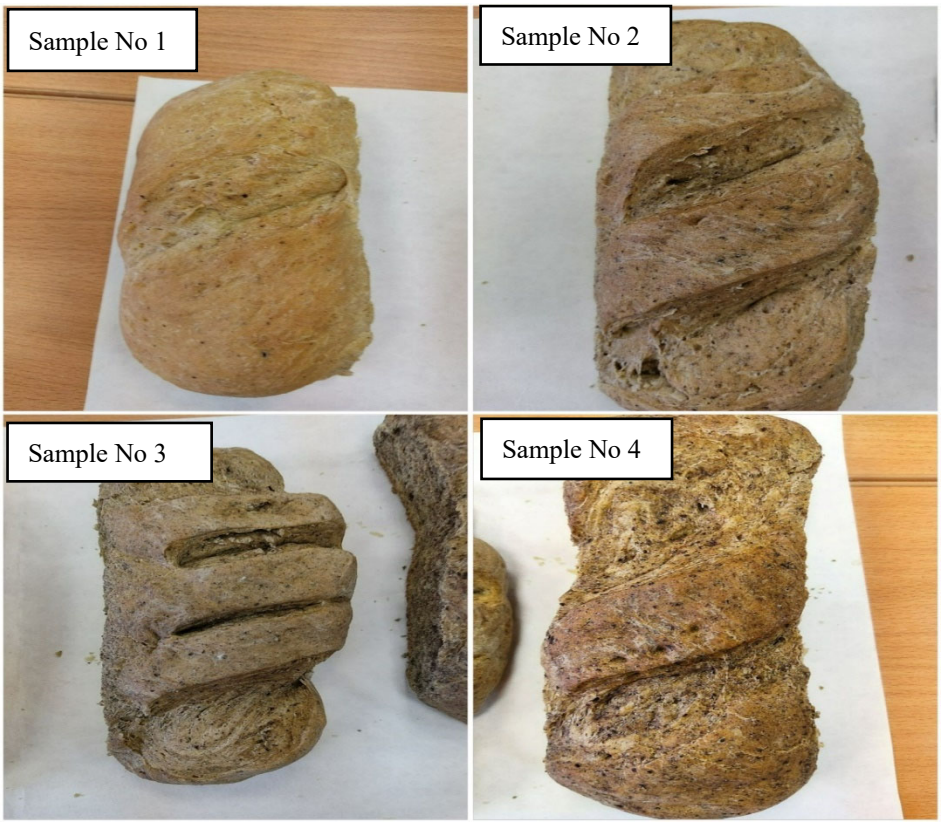

Figure 1. Bread samples

Organoleptic indicators of the quality of prototypes of wheat flour bread were evaluated on a five-point scale. The evaluation considered the following indicators: the correctness of the shape, the colour of the crusts, the condition of the surface of the crust, the colour of the crumb, its structural and mechanical properties, the structure of the porosity, aroma, taste and chewability of bread. The results of the tasting evaluation of bread from wheat flour of the

highest grade with the addition of mushroom powder from champignons in the amount of 3, 6 and 10% are presented in table 2.

Table 2. Organoleptic indicators of bread

Indicator	Sample No 1	Sample No 2	Sample No 3	Sample No 4
The correctness of the form	4.5	4.5	4.8	4.5
Coloration of crusts	4.1	4.4	4.9	4.5
Condition of the crust surface	4.5	3.7	4.3	3.6
Crumb color	4.5	3.9	4.3	3.6
Porosity structure	4.7	4.1	4.6	4.1
Crumb elasticity	4.5	4.6	4.6	4.5
The aroma of bread	4.2	4.2	4.8	4.0
The taste of bread	4.1	4.3	4.6	4.3
chewability	4.2	4.6	4.6	4.4
Sum of points	39.3	38.3	41.5	37.5

Physico-chemical indicators of the quality of finished products were obtained on the basis of four baking, which were carried out both with mushroom powder from champignons and without it, are presented in Table 3. Mushroom powder from champignons was added in an amount of 3, 6 and 10% in dry form.

Table 3. Physico-chemical parameters of experimental samples of wheat bread with the addition of mushroom powder

Indicator	Sample No 1	Sample No 2	Sample No 3	Sample No 4
Porosity, %	76.2	74.9	75.5	75.1
Humidity, %	41.5	41.1	41.3	41.4
Acidity, ºT	2.0	2.4	2.3	2.2
Mass fraction of ash, %.	15.13	16.88	16.97	17.27

The results of the study of the effect of mushroom powder from champignons on the indicators of moisture and acidity of bread show that the moisture content of all the studied samples with the introduction of dry mushroom powder from champignons changes slightly compared to the control sample of bread.

Considering the indicators of acidity of bread with the addition of mushroom powder from champignons from 3 to 10%, a dependence is visible: with a higher dosage, the acidity of bread decreases. At the same time, compared with the control sample, the acidity is higher for bread with the addition of dry mushroom powder from champignons in the amount of 3, 6 and 10% by 0.4; 0.3 and 0.2 degrees.

When making dry mushroom powder from champignons at a dosage of 3%, 6% and 10%, the porosity decreases by 1.3%; 0.7% and 1.1%, respectively. Based on the data obtained, it can be argued that the sample with the content of mushroom powder from champignons in the amount of 6% shows the best result.

4 Conclusion

It has been established that the addition of 6% mushroom powder from champignons to the dough from the total mass of flour leads to an improvement in the quality of bread in terms of organoleptic characteristics. The main physical and chemical indicators of the quality of a

bread sample with a mushroom powder content of 6% of the total flour mass: porosity, ash content, acidity, moisture content correspond to GOST.

Based on a comprehensive assessment, a prototype bread made from wheat flour with the addition of mushroom powder from champignons in the amount of 6% of the total mass of flour is superior in organoleptic parameters to the control sample of bread.

Moreover, the addition of mushroom powder from champignons leads to an increase in the content of aroma-forming substances in bread, which has a positive effect on its taste and aroma. Thus, we can conclude that the dosage of 6% mushroom powder from champignons is optimal.

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