The use of oilseed cake for supplementation of bakery products

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Abstract. The issue of rational use of secondary raw material resources as a waste-free production is important today. The possibility of using oilseed meal (rapeseeds and camelina seeds) in the production of bakery is discussed in the article. The researches and analysis of the effect of oilseed meal on the formation of quality indicators and nutritional value of bakery were carried out. It was revealed that the introduction of rapeseed cake into the recipe composition of yeast dough up to 5% and camelina cake up to 10% of the weight of wheat flour has a similar character and a positive effect on the process of dough fermentation, formation of sensorical aspects. Finished products with rapeseed and camelina cake have a pleasant yellowish-mustard color with insignificant impregnations, good dimensional stability, porosity, and in terms of physical and chemical parameters, it meets the requirements of regulatory documents. An increase in the nutritional value of new types of bakery products is associated with a significant increase in their composition of the total amount of protein, dietary fiber, iron, and B vitamins. Taking into account the taste, it is proposed to use products with rapeseed cake as bread for toasts, products with camelina cake as buns for hamburgers and sandwiches.

1. Introduction
One of the most important strategic tasks facing the agro-industrial complex of the Russian Federation is meeting the needs of the population for high-quality food products. In order to address this issue, it is necessary to develop food products enriched with functional ingredients, including polyunsaturated fatty acids, dietary fiber, complete protein and other essential nutrients [1].

Cruciferous oil crops (rapeseed, camelina) are promising and affordable sources of these substances. Currently, these crops are acquiring great agrotechnical, food, fodder and ecological significance. The cultivation of oilseeds in Krasnoyarsk Region tends to grow due to an increase in domestic demand for seeds and their processed products, as well as due to the good export potential of these crops.

Camelina is a biennial cruciferous plant belonging to the group of oilseeds. Due to its unpretentiousness and a wide range of applications, camelina has been purposefully cultivated throughout Russia, including Siberia. The cultivation of camelina is of interest in connection with its use for food and technical purposes, as well as in medicine, due to the biochemical composition of oil seeds. In addition, the value of camelina seeds lies in the possibility of using them as a source of protein; camelina seeds contains up to 30-35% of protein [2].

Rape is a yearling herbaceous plant of the cruciferous family of cabbage. Its closest relatives are wild rape herb and cultivated cabbage. Rape seeds are used as raw materials for the production of rapeseed
oil for various purposes, including food, since the oil is a supplier of valuable polyunsaturated fatty acids, complete proteins and dietary fiber to the body [3].

Currently, the production of rapeseed and camelina oil is actively expanding, including at small enterprises, private farms and backyards for sale as a natural healthy food product.

After the extraction of oil from the seeds of rapeseed and camelina, such secondary products as oilcakes are formed. The largest share in their composition falls on proteins (29.0 ... 45.3%), fiber is the second by the number of components (10.3 ... 15.0%).

Traditionally, oil production wastes - oilcakes and meal - are widely used as a feed additive for farm animals. However, the potential for using them as sources of functional food nutrients for enriching various types of food is enormous. As research shows, camelina oil cake contains up to 12% of fiber, 35% of protein, 7-10% of fat [4, 5]. Rapeseed cake has high functional properties in terms of protein content (37% and more), fat with a high-quality fatty acid composition (7-8%), fiber (12-13%) [6].

The issue of using rapeseed cake and camelina cake in the production of bakery products, one of the main food products of the entire population of the Russian Federation, is relevant. Currently, the development of the bakery industry is focused on expanding the range of bread and bakery products of a functional orientation. A development strategy of the industry indicates the growth of the range as innovative directions healthy food products, grain bakery products with high fiber, ω-3 fatty acids, low cholesterol, salt, and fat [1].

Scientific research results in the search for new types of functional components for bakery products are promising areas and make it possible to expand the range of products for various groups of the population [7, 8].

The quality of bakery products depends on many factors at all stages of the production of yeast dough and bakery food from it. The introduction of fillers with a varied chemical composition into the dough affects the fermentation activity of yeast, acid accumulation, and therefore on the structural and mechanical, physical and chemical, and organoleptic characteristics, what must be taken into account when developing new types of products.

The purpose of the work is to develop a recipe composition and study the quality indicators of bakery products from wheat flour with the introduction of oilcake from rapeseed and camelina into the recipe composition.

2. Materials and methods
Oilcake from rapeseed and camelina was ground into powder, added to the yeast dough recipe instead of the total amount of wheat flour, gradually increasing the dosage. The traditional recipe was taken for control. The work used the generally accepted organoleptic, physicochemical, biochemical methods for assessing the quality of bakery products in accordance with regulatory documents, statistical methods for processing experimental data.

In the process of kneading, fermentation and maturation of the dough, such indicators as acidity, dough lifting force were analyzed; after baking products, form-holding capacity, and specific volume of products were analyzed. The specific volume of bakery products was determined by dividing the volume of bread by its weight, dimensional stability as the ratio of height to diameter of the product. The main indicator of quality was the organoleptic assessment of finished products. The overall scoring of yeast dough was carried out on a 5-point scale, finished bakery products were determined on a 100-point scale, taking into account the weight coefficients of each indicator. The safety of the raw materials used for the production of bread complied with the requirements of regulatory documents [9].

Statistical processing of the research results was carried out using the “Statistica” applied software package. When comparing the mean values, the difference was considered significant at the 95% significance level (p <0.05).
3. Results
Rapeseed cake is a crumbly hygroscopic powder of dark green color. When wet, the powder darkens to a dark brown color and becomes soft, has a slight specific odor, insoluble in water. The grind size is 0.3 mm; the mass fraction of moisture is 9.0%.

The camelina cake is a crumbly powder of yellow-olive color with a neutral odor, insoluble in water. The grind size is up to 0.3 mm. Mass fraction of moisture is 12.0%.

The effect of oil cake on the formation of yeast dough was investigated and analyzed in terms of such indicators as acid accumulation, the activity of dough rising during fermentation (figure 1, 2, 3, 4).

Analysis of the data showed that the character of dough fermentation with the introduction of rapeseed and camelina cake is identical. A positive effect on the formation of high-quality yeast dough is exerted by the introduction of rapeseed cake or camelina cake in an amount up to 10% of the flour mass. The acidity of the dough increases, which reflects the active fermentation process. The fermentation activity is reflected in the height of the samples during each stage of fermentation: after 30 minutes - on average by 6%, after 90 minutes - on average by 9%. The introduction of 15% cake inhibits the rise of the dough.

From all the studied samples of yeast dough, baked goods were molded and baked; the quality was analyzed in terms of organoleptic, physicochemical indicators (2 hours after baking).
Comparative organoleptic assessment of product quality is shown in figure 5.

Figure 5. Organoleptic scoring of finished products made from yeast dough with rapeseed and ginger cake. Note: (M±m) (n=6), * - difference from control, multiple comparison of means, p<0.05.

The values of dimensional stability and specific volume of finished products are presented in figures 6, 7.

Figure 6. Dimensional stability of products with different contents of rapeseed and ginger cake.

Figure 7. The specific volume of products with different contents of rapeseed and ginger cake.

Note: (M±m) (n=6), * - difference from control, multiple comparison of means, p<0.05.

With the introduction of 5 and 15% rapeseed cake and camelina cake into the composition of yeast dough products, the dimensional stability of the finished product corresponded to the control sample, with the introduction of 10% oil cake, they were higher than the control by 4.5 and 6.0%, respectively. Similar changes were observed in the formation of the specific volume of finished products.
4. Discussion
The introduction of rapeseed cake and camelina cake has a positive effect on the fermentation process, the formation of the structure of yeast dough, but not more than 10% of the flour mass. The acidity of the dough increases, which reflects the active fermentation process. With the introduction of this amount of cake, the acidity of the fermented dough is 3.5 degrees, which does not exceed the standard indicators (GOST R 52462-2005).

Increasing the dosage up to 15% leads to a significant increase in acidity (up to 3.9 degrees), however, the intensity of fermentation of the dough decreases, the rise of the dough stops.

With the organoleptic assessment of the test on a 5-point scale, samples with a content of 10% rapeseed and camelina oil cake received a high organoleptic assessment (5.0 points). These samples were well loosened, increased in volume compared to the control. The dough had a pleasant aroma, a light mustard hue, and rare splashes. With the introduction of 15% cake, there was an excessive yeast (sour) odor, dark color (3.8 points). With the introduction of 5%, the dough differed from the control sample only by minor inclusions (4.9 points).

Samples of bakery products with the introduction of 5% cake were obtained the highest score (96.0) for finished products with rapeseed cake. An increase in the cake content up to 10% led to the appearance of a bitter aftertaste, up to 15% - formed a dense crumb, a dark color of the products, a more pronounced taste and smell of rapeseed, which worsened the quality of the products.

Samples of bakery products with the introduction of 5 and 10% of cake were obtained the highest score (97.0) for samples of camelina cake. An increase in the cake content up to 15% led to the appearance of a bitter aftertaste, a denser crumb, and a more pronounced specific aftertaste.

The values of the specific volume, dimensional stability of finished products with these types of cake corresponded to the control sample (at 5 and 15%) or were higher (at 10%).

The final recipes of the finished products were established, taking into account that the organoleptic characteristics are decisive: 5% of rapeseed cake and 10% of camelina cake from the total flour mass.

In new types of products, the most significant indicators of nutritional value were experimentally determined (table 1).

Table 1. Comparative characteristics of the most significant components of the nutritional value of experimental samples (100 g).

| Name/Indicators | Control sample | Sample of rapeseed cake | Sample of camelina cake |
|-----------------|----------------|------------------------|------------------------|
| Protein, %      | 12.91±0.3      | 14.28±0.44             | 14.61±0.3              |
| Fat, %          | 4.48±0.05      | 4.71±0.022             | 5.77±0.05              |
| Assimilable carbon (mono- and disaccharide), % | 10.36±0.41 | 10.26±0.66 | 10.26±0.3 |
| Starch, %       | 80.03±0.56     | 76.05±0.62             | 74.44±0.3              |
| Fiber, %        | 4.12±0.01      | 4.63±0.01              | 4.68±                  |
| Calcium, mg     | 32.85±0.32     | 31.87±0.22             | 32.23±0.3              |
| Ferrum, mg      | 1.38±0.03      | 4.67±0.01              | 4.82±0.002             |
| Thiamine, mg    | 0.16±0.09      | 0.22±0.07              | 0.23±0.01              |
| Riboflavin, mg  | 0.16±0.006     | 0.24±0.002             | 0.28±0.09              |
| Caloric content, kkal | 453.48     | 444.75                | 457.13                |

When comparing the nutritional value, it was noted that in a bakery product with rapeseed cake, the quantitative protein content, in comparison with the traditional sample, increases by 10.6%, fiber content increases by 12.4%, the amount of ferrum goes up 3.5 times than vitamins B1 and B2. At the same time,
the caloric content is slightly reduced due to a decrease in the amount of starch - by 2.3%, which is also a positive result.

The amount of fat rich in polyunsaturated fatty acids in the product of camelina cake increases by 28.8%, the protein content increases by 13.2%, the fiber content increases by 13.6%. There is a significant increase in vitamins B1 and B2. The amount of starch is reduced by 7%. However, the caloric content does not decrease, since a higher amount of fat is added to the recipe.

5. Conclusion
As a result of comprehensive research, the possibility and expediency of using rapeseed and camelina oil cake as an enriching additive in bakery products has been proved. In the work, the recipe ratios of wheat flour and oilcake are determined, which make it possible to obtain products with high quality indicators.

The use of oilseed crops will make the production of valuable oil waste-free, efficiently use secondary raw materials, expand the range of bakery products, and increase their nutritional value.

Taking into account the taste, the authors suggested using rapeseed cake products as bread for toasts, products with camelina cake as buns for hamburgers and sandwiches.

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