Application of non-traditional raw materials in the production of low-humidity bakery products

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Abstract. Recently, the use of non-traditional plant components as a functional ingredient in the development of fortified products for healthy and therapeutic nutrition has been very relevant. An analysis was carried out of the influence of the type of functional additive from brown algae and blackcurrant pomace powder on the organoleptic and physico-chemical properties of bakery products of reduced importance - wafer bread. A decrease in dough density, an increase in humidity and wetness of finished products was established when functional ingredients were added to the wafer bread recipe. An increase in the acidity of the experimental samples of enriched wafer breads was noted in comparison with the control sample. An increase in the acidity of the experimental samples of enriched wafer breads was noted in comparison with the control sample with a slight change in their organoleptic characteristics. A high content of iodine and dietary fiber in new types of bakery products with reduced humidity has been established.

1 Introduction

Recently, the development of recipes for enriched bakery products has been very promising, because bread and bakery products are products of everyday demand and are present daily in the diet of the vast majority of consumers. One of the non-traditional plant components increasingly used in the development of new bakery products for healthy and therapeutic nutrition is brown algae [1-3].

Brown seaweed is a valuable source of biologically active substances that have preventive and therapeutic effects. In terms of the content of macro- and micronutrients, brown algae are significantly superior to terrestrial plants, and are also the only source of a number of polysaccharides (alginates, carrageenan, laminarin, fucoidan), which have bacteriostatic, bactericidal, anti-inflammatory, immunomodulatory, antioxidant and wound-healing effects [4-6]. The polysaccharide components of algae help correct lipid metabolism, reduce body weight, have a pronounced antidiabetic effect, have antihypertensive and antitumor effects,

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can prevent the development of oxidative stress in living organisms or reduce its intensity, etc. [7-11].

Domestic and foreign studies of the biological activity of both individual compounds isolated from brown algae and drugs based on them confirm the medicinal properties and preventive effects and explain the widespread use of brown algae in the development of medicines and biologically active food additives [6, 11-13].

Brown algae have found application in the creation of healthy and functional food products as a source of bioactive food components, including iodine, which help prevent iodine deficiency conditions [14-20]. Numerous scientific studies on the development of technologies for processing brown algae, the development of recipes and technologies for creating food products enriched with bioactive nutrients from algae, especially based on mass consumption products (dairy, meat products, bakery products, etc.) confirm the relevance of work in this direction.

The prospects for the use of resource-saving, waste-free technologies in the food industry also explain the recent increased interest in the use of by-products of juice production (vegetable and berry pomace) in the formulations of functional food products in order to enrich the latter with biologically active substances (mineral elements, dietary fiber) [21, 22]. The use of juice production by-products in the development of new food products makes it possible to increase the economic efficiency of processing enterprises by converting production waste into food ingredients.

The development of food products using renewable natural resources (brown algae), as well as waste from the production of juices and drinks (berry pomace), makes it possible to increase the nutritional and biological value of new products, the use of which in the daily diet will help to compensate for the deficiency of macro- and micronutrients caused by insufficient or an unbalanced diet, as well as excessive consumption of refined foods.

When developing recipes for food products enriched with non-traditional functional ingredients, it is advisable to study the influence of functional additives on the physicochemical and organoleptic characteristics of the finished product to avoid a decrease in its quality in comparison with the traditional one [2, 23, 24]. In this regard, the purpose of the study was to study the effect of a type of brown algae additive in combination with blackcurrant pomace powder on the organoleptic and physicochemical properties of low-humidity bakery products (wafer bread) for further optimization of the product formulation.

2 Materials and methods

At the Innovative Research Testing Center for Collective Use of the Orel State Agrarian University, a recipe for enriched wafer bread containing brown algae powder as a functional ingredient was developed and patented [25]. Previously, studies were carried out on the chemical composition and nutritional value of enriched wafer breads when Fucus vesiculosus powder was used in the recipe as an iodine-containing additive [26]. Kelp is known to contain a significantly higher amount of iodine [6], and blackcurrant pomace powder is a source of dietary fiber, macro- and microelements. In this connection, to analyze the effect of the type of brown algae additive in combination with black currant pomace powder on the quality indicators of bakery products with reduced humidity, fucus and kelp powders were used as functional ingredients in this study. Thus, the objects of the study were:

- rye-wheat waffle bread (control);
- rye-wheat waffle bread with the addition of fucus algae powder and blackcurrant pomace powder (sample No. 1);
- rye-wheat waffle bread with the addition of kelp algae powder and blackcurrant pomace powder (sample No. 2).

Before kneading the dough, wheat flour was first sifted through a sieve. Powders from brown algae were obtained by grinding crushed fucus and crushed kelp (TU 03.11.63-005-41669896-2019, manufacturer Arkhangelsk Algae Plant LLC) to a particle size of no more than 0.3 mm. Powder from blackcurrant pomace was obtained by grinding pre-dried blackcurrant pomace remaining after extracting the juice by pressing to a fine state.

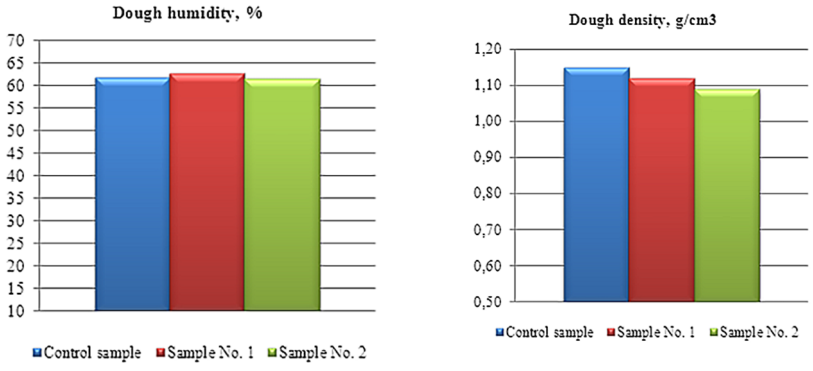
In the recipes for waffle breads, peeled rye baking flour and premium-grade wheat baking flour were used in a ratio of 2:1. Salt, sugar and sunflower oil were added to the recipe in amounts of 1.5%, 3% and 8.3% by weight of flour, respectively. When producing experimental samples of wafer bread, powders from brown algae and blackcurrant pomace were added to the recipe in an amount of 1% of each component by weight of flour.

The moisture content of the dough was determined by drying a sample of the semi-finished dough product (4–5 g) in an oven at a temperature of 105°C to constant weight (about 4–5 hours). In this case, drying was completed when the difference between the last two weighings did not exceed 0.01 g.

Dough density was calculated as the ratio of dough mass to volume, expressed in g/cm3 (measurements were carried out at a temperature of 20ºC). Determination of the moisture content of wafer breads was carried out according to GOST 8494-96, acidity - according to GOST 5670-96, the content of the mass fraction of fat was determined according to GOST 5668-68, the mass fraction of sugar - according to GOST 5672-68, wetness was studied according to GOST 10114-80. The fiber content was determined using a Fibertek 1020 device (Foss), the iodine content was determined by the titrimetric method according to MUK 4.1.1106–02.

3 Results and discussion

The results of the study of the moisture content of the test of control and experimental samples of rye-wheat waffle bread showed that the test humidity of all the studied samples was the same within the margin of error, the difference was less than 1% (Figure 1). The density of the rye-wheat bread dough when using the addition of brown algae powder decreased by 1.74% compared to the control sample and 4.35% when adding fucus and kelp additives to the recipe, respectively.



a) b)

Fig. 1. Density (a) and humidity of dough (b) samples of waffle loaves.

The results of the study of the effect of the type of brown algae additive and blackcurrant powder on the physico-chemical parameters of finished waffle rye-wheat loaves are presented in Table 1.

Table 1. Physico-chemical parameters of rye-wheat waffle bread.

Indicators	Control sample	Sample No. 1	Sample No. 2
Moisture content, %	5.19±0.02	6.52±0.04	6.24±0.06
Acidity, degrees	2.30±0.10	3.97±0.08	3.56±0.06
Mass fraction of sugar in terms of dry matter (weight), %	4.02±0.10	4.24±0.14	4.19±0.12
Mass fraction of fat in terms of dry matter (weight), %	7.57±0.19	7.93±0.21	7.55±0.22

When adding brown algae powder (regardless of the type of algae) and blackcurrant pomace powder to the recipe for rye-wheat wafer bread, an increase in the moisture content of the finished products was noted in comparison with the control, which is probably due to the swelling of hydrocolloids contained in functional additives and having high moisture-holding capacity. This prevents the free removal of moisture during baking and leads to an increase in the moisture content of the finished product. The acidity of the experimental samples of wafer breads increases by 1.67 degrees compared to the control sample. and by 1.26 degrees. when using kelp and fucus powder in the formulation, respectively. The results obtained are due to the high acidity of blackcurrant pomace powder due to the high content of organic acids in blackcurrant berries and their processed products.

In terms of sugar and fat content, the experimental samples of rye-wheat waffle bread did not differ significantly from the control sample, which showed that the presence of the selected amount in the recipe, as well as the type of functional additive, did not influence the content of these macronutrients.

The use of non-traditional herbal additives in the recipes of low-humidity bakery products should not negatively affect the sensory characteristics of the finished product, and therefore, an organoleptic evaluation of samples of rye-wheat waffle bread was carried out (Table 2).

Table 2. Organoleptic evaluation of rye-wheat wafer breads.

Indicator name	Characteristic		
	Control	Sample No. 1	Sample No. 2
Physical appearance			
form	The breads are flat, thin, round or slightly oval, without cracks		
surface	Rough with a characteristic relief from baking, without swelling or inclusions	Rough with a characteristic relief from baking, without swelling, with small dark inclusions	Rough with a characteristic relief from baking, without swelling with small light inclusions
color	Light gray to light brown	From light gray to light brown with a pinkish tint	From light gray to light brown with a pinkish tint
fragility	Products are fragile, slightly breakable		
sectional view	Baked, dry, evenly baked		
taste	Characteristic of this type of products, without extraneous taste	Characteristic of this type of product, with a slight taste of algae	Characteristic of this type of product, with a slight taste of algae
smell	Characteristic for this type of product, without foreign odor	Characteristic of this type of product with a slight aroma of algae	Characteristic of this type of product with a slight aroma of algae

The results of organoleptic evaluation of samples of rye-wheat waffle loaves showed the presence of small dark inclusions, as well as the presence of a slightly palpable taste and aroma characteristic of algae in experimental samples of waffle loaves. When used in the

formulation of waffle loaves, a functional additive of black currant pomace powder allows you to give the experimental samples a pinkish hue.

One of the properties of waffle loaves, indirectly characterizing their porosity and density and causing a delicate consistency and crunch when chewing the product, is the amount of absorbed moisture. The amount of absorbed moisture is not a regulated indicator, however, in order to study the effect of the type of functional additives introduced on the quality of the finished product, it was considered advisable to determine the change in the wetness of wafer loaves, since the wetness indirectly reflects the taste characteristics of the finished product. The results of the study are presented in Figure 2.

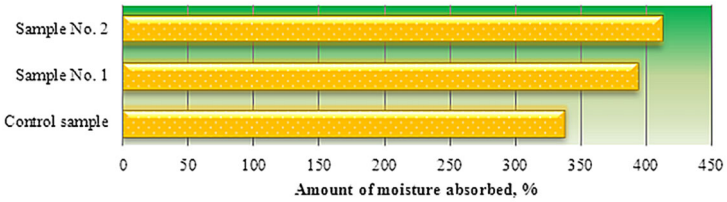


Fig. 2. Changing the amount of absorbed moisture of waffle loaves when adding functional additives.

The introduction of functional additives in the form of brown algae powder and black currant pomace powder into the formulation of waffle loaves contributed to an increase in the absorbed moisture of the prototypes compared to the control by 56% when using fucus powder and by 74% when using kelp powder. The data obtained suggested an increase in porosity and obtaining a looser texture of the prototypes with functional additives in comparison with the control sample of waffle loaves.

Along with a decrease in the density of the dough and an increase in the moisture absorbency of the finished products, it can be concluded that the introduction of functional additives from brown algae and powder from black currant pomace contributed to obtaining a finished product with a more delicate consistency.

Studies of the content of dietary fiber in the final product showed an increase in the fiber content up to 7.1% in experimental samples of waffle loaves in comparison with the control (3.17%). There was a significant increase in the mass fraction of iodine in the experimental samples to 180.9 mcg/100g and 70.5 mcg/100g in samples with fucus and kelp powder, respectively, compared with the control sample of waffle loaves (2.36 mcg/100g). With a daily intake rate of iodine from 120 to 150 mcg and dietary fiber from 20 to 25 g (for the adult population), the data obtained indicate the functional properties of new waffle loaves, and a new type of bakery products with reduced humidity is a source of iodine and dietary fiber in the diet.

4 Conclusion

The analysis of the effect of functional additives on the organoleptic and physico-chemical properties of wafer rye-wheat loaves was carried out. It has been found that when brown algae powders are added to the formulation in combination with black currant pomace powder, the density of the dough decreases, the humidity and wetness of the finished products increases. An increase in the acidity of the experimental samples of waffle loaves was noted in comparison with the control sample. The type of functional additive in the amount used does not significantly affect the content of the mass fraction of fat and sugar in the finished product. There was a slight change in the organoleptic parameters of wafer rye-wheat loaves when adding functional additives. A high content of iodine and dietary fiber in new types of bakery products with reduced humidity has been established.

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