Wafer products with non-traditional raw materials

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Abstract. Fortification of recipes for products containing only refined raw materials, such as ice cream wafer cups, is a modern trend for such products. The use of soy okara in wet and dry form for these purposes allows you to unlock the potential of this raw material as an improver in the quality of wafer products. In the cup recipe, soy okara was added instead of flour dry matter in the amount of 10–30% in increments of 5%. In the wafer dough the mass fraction of moisture and spreadability were determined, in finished products - the mass fraction of moisture and wettability. It has been established that the use of wet and dry soy okara instead of the dry matter of flour in the formulations of wafer cups for ice cream allows increasing the moisture content of the dough by 2.3–4.9% and 3.6–8.8% and reducing its spreadability by 2–13 mm and 2–7 mm, respectively. In finished wafer cups, the introduction of wet and dry soy okara contributes to an increase in the mass fraction of moisture by 0.1 - 0.4% and 0.1 - 0.9%, a decrease in wetness by 2 - 22% and 2 - 15%, respectively, compared with the control sample. Rational dosage was taken 15% of dry soy okara and 20% dry soy okara instead of flour dry matter in the wafer cup recipe. At the same time, the wettability of finished products is reduced by 5–6%, which will positively affect the consumer properties of finished products when stored with ice cream. In experimental products, the amount of carbohydrates decreases by 4.9 - 5.9%, cellulose - increases by 78 and 87 times, calcium - by 1.5-1.8 times, the energy value decreases by 1.4 - 1.7%, and the biological value increases by 2.9 - 3.4% compared with control sample.

1 Introduction

Wafer cups are a variant of wafer products designed to be filled with any fillers. They serve as edible packaging that sells a variety of ice creams and frozen desserts. The waffle cup should be strong enough and at the same time fragile, have crispy properties. Classic recipes for wafer cups include only refined raw materials: wheat flour, starch, butter or vegetable oil,

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egg products, soda and salt [1]. Based on this, these types of products need to be corrected in the chemical composition in the direction of increasing the content of essential amino acids, mineral elements, dietary cellulose reducing gluten and energy value. To enrich wafers with cellulose polyphenols and minerals, researches have been conducted on the use of grape seed flour [2], rye and corn flour [3], for enrichment with flavonoids and anthocyanins, it is proposed to add raspberry cake [4], to improve the physicochemical parameters of the quality of wafers and to reduce production costs, it is proposed to replace the fungal protease enzyme with kiwi and fig extracts as sources of protease [5].

However, the prospects of using new sources of food raw materials - soy okara - in the formulations of wafer products, such as wafer cups for ice cream, to improve their composition, reduce calorie content, save the main raw materials and expand the range of wafer products for a healthy diet remain relevant.

Soy okara is a product obtained from the production of soy milk and soy tofu. It contains in its composition a high-quality protein, which contains 16 amino acids, including all essential ones [6]. In addition, the protein has a water-retaining and fat-binding ability [7]. The dietary cellulose of soy okara have sorbent properties, which favourably affects the work of the intestines [8]. Soy okara also contains antioxidants such as isoflavones, which are a prophylactic against cancer [9].

The aim of the study was to use wet and dry soy okara instead of flour in the formulations of wafer cups for ice cream to improve their quality, nutritional value, reduce energy value, technological costs for production, expand the raw material base and use non-traditional raw materials.

2 Materials and methods

The following raw materials were used in the work: wheat flour, sugar, sunflower oil, salt, egg powder, soda, corn-starch, soy okara.

Soy okara is a moist, friable yellowish friable mass with a neutral smell and taste with a moisture content of 54%. For research, okara was subjected to additional grinding to a particle size comparable to flour. Due to the high humidity of soy okara and its susceptibility to microbiological deterioration, the product was stored in a freezer at a temperature of -18ºC, and thawed out before use.

Practical and scientific interest is the use of dry soy okara. Drying of wet okara to a mass fraction of moisture of not more than 14% was carried out in a VES Electric dryer at a temperature of 80 ºC for 3 hours. The specified drying mode does not reduce the quality of the final product [10].

The preparation of wafer cups was carried out under production conditions at the OJSC «Livensky Cheese-Making Plant». The addition of wet and dry soy okara in the preparation of wafer dough was carried out in a mixture with flour. Soy okara was added instead of the dry matter of flour in the amount of 10–30% in increments of 5%. Due to the fact that okara increases the viscosity of the dough, which makes it difficult to produce waffle cups, it has been experimentally established that in order to reduce the viscosity of test samples, it is necessary to increase its moisture content. To do this, when making wet and dry okara, additional water was added in the amount of 0.2% and 0.4% for each percentage of the applied okara from the control sample, respectively.

In the wafer dough, the mass fraction of moisture in the dough and finished products was determined by drying in a laboratory oven heated to a temperature of 130 ± 2 °C to constant weight. To determine the spreadability of the wafer dough, a portion of the dough was poured onto a plate at a temperature of 20 ± 2 °C and the diameter was measured as the average of two mutually perpendicular diameters. The wettability of finished products was determined as the ratio of the mass of products after wetting to the mass of dry products expressed as a

percentage. The method is based on establishing an increase in the mass of flour products when immersed in water at a temperature of 20 ± 2 °C for a certain time [11].

3 Results and discussion

The quality indicators of wafer dough and finished wafer cups with wet and dry soy okara are shown in tables 1 and 2.

Table 1. Quality indicators of wafer dough and finished wafer cups with moist soy okara.

The name of indicators	Control	Experimental samples with the replacement of flour with soy okara, % of dry matter				
		10	15	20	25	30
Mass fraction of dough moisture, %	64.0±0.2	66.3±0.2	66.9±0.1	67.6±0.1	68.3±0.2	68.9±0.2
Spreadability of wafer dough, average diameter, mm	103±0.8	103±1.0	101±0.9	98±0.9	96±0.8	90±0.9
Mass fraction of moisture in wafer cups, %	4.5±0.2	4.6±0.2	4.7±0.2	4.8±0.2	4.9±0.2	Products failed to get
Wetness of wafer cups, %	350±1.5	348±1.3	345±1.2	332±1.3	328±1.5	

The data presented in table 1 show that the introduction of 30% wet soy okara instead of flour dry matter in the recipe for wafer cups does not allow to obtain products. This is due to the high viscosity of the dough and at the same time the lack of its coherence. Finished products with such a dosage of wet soy okara did not retain their shape and crumbled.

Table 2. Quality indicators of wafer dough and finished wafer cups with dry soy okara.

The name of indicators	Control	Experimental samples with the replacement of flour with soy okara, % of dry matter				
		10	15	20	25	30
Mass fraction of dough moisture, %	64±0.2	67.6±0.2	68.9±0.2	70.2±0.2	71.5±0,2	72.8±0,2
Spreadability of wafer dough, average diameter, mm	103±0.8	103±0.8	103±0.8	101±0.8	98±0.8	96±0,.
Mass fraction of moisture in wafer cups, %	4.5±0.2	4.6±0.1	4.9±0.2	5.0±0.1	5.1±0.1	5.4±0.2
Wetness of wafer cups, %	350±1.5	348±1.5	346±1.2	342±1.2	338±1.1	335±1.1

It was determined that the applying of an additional amount of water to the recipe of wafer cups to reduce the viscosity of the dough contributed to an increase in its moisture content by 2.3–4.9% and 3.6–8.8% when wet and dry okara were added, respectively.

The spreadability of the wafer dough with wet and dry soy okara is 2-13 mm and 2-7 mm lower compared to the control sample even though the dosage of water is increased. This is due to the increased content of dietary fibers and proteins in soy okara, which have an increased water-binding capacity compared to wheat flour. Soy okara dough samples had a

flaky texture due to the properties of okara. In accordance with the recommendations, developed by All Union Research University of Corn [12], for the formation of the quality of wafers according to the rheological properties of the wafer dough, based on determining the spreadability of the wafer dough by the average diameter, a satisfactory quality of wafer products can be obtained with a spreadability of more than 96-98 mm depending on the strength of the flour.

The introduction of wet and dry soy okara contributes to an increase in the mass fraction of moisture in wafer cups by 0.1 - 0.4% and 0.1 - 0.9%, a decrease in wetness by 2 - 22% and 2 - 15%, respectively, compared with the control sample. For wafer cups, the reduction of wetness is a positive factor, because of increased wetness can cause such a defect as peeling of ice cream from the wafer cup.

The organoleptic evaluation of wafer cups was carried out in accordance with the scoring scale shown in Table 3.

Table 3. Waffle cup quality scoring scale.

Product quality index	Weight factor	Quality level	Characteristics of quality levels depending on the type of product
1. Taste and smell	2.0	5 4 3 2 1	Peculiar, expressed brightly. Expressed, typical for waffles. Weakly pronounced, typical for waffles Fresh, slightly sour, insipid. Outside sour, unpleasant
2. Structure	2.0	5 4 3 2 1	Evenly porous, with crispy properties. Quite porous and crispy. Presence of non-porous areas. Dense. Rigid.
3. Colour	1.0	5 4 3 2 1	From cream to light brown, the colour is uniform, burn spots are not allowed. Uniform characteristic of this species. Characteristic of this species, slightly darkish. Yellowish or grayish. Unevenly colored.
4. Appearance	1.0	5 4 3 2 1	Corrugated surface with a clear pattern, without smudges. Corrugated surface with a clear pattern with slight wrinkling. Corrugated surface with a clear pattern with significant wrinkling. Surface with an indistinct pattern, wrinkled with voids. The surface is uneven and wrinkled, with a significant number of voids.

The results of studies conducted with the participation of 20 tasters allowed us to obtain the data shown in Figure 1.

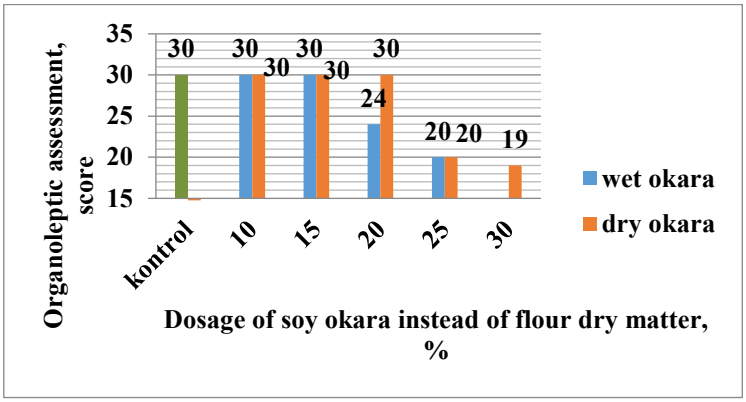

Fig. 1. Effect of soy okara on the organoleptic characteristics of wafer cups.

It has been established that the introduction of soy okara instead of the dry matter of flour in the recipes of wafer cups in the amount of up to 15% of wet soy okara and up to 20% of dry soy okara does not adversely affect the organoleptic evaluation of finished products. Large dosages contribute to the formation of a wrinkled surface, the accumulation of a large number of sags, seals and defects in finished products due to loss of shape. The appearance of wafer cups with soy okara is shown in Figures 2 and 3.

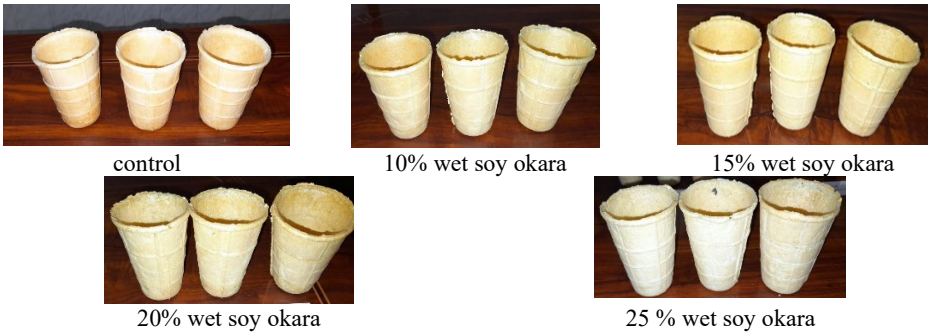

Fig. 2. Effect of wet soy okara on the appearance of wafer cups.

Fig. 3. Effect of dry soy okara on the appearance of wafer cups.

The content of the main nutrients in 100g of wafer products was calculated in accordance with the methodological recommendations [13]. The calculation results are shown in Table 4.

Table 4. Chemical composition of 100 g of wafer products with soy okara.

Name of food	control	Wafer cup with 15% wet soy okara to replace flour solids	Wafer cup with 20% dry soy okara to replace flour solids
Protein, g/100 g	11.5	11.6	11.5
Lipids, g/100 g	6.7	6.9	6.8
Carbohydrates (mono-disaccharides + starch), g/100 g	74.7	66.7	65.8
Fiber, g/100 g	0.1	7.8	8.7
Calcium, mg/100 g	34.3	52.7	61.1
Phosphorus, mg/100 g	196.9	184.9	182.6
Magnesium, mg/100 g	36.4	34.7	34.5
Energy value, kcal	398	367	363
Biological value, %	68.2	71.1	71.6

The calculation of the chemical composition of nutrients in 100 g of wafer products shows that the content of protein and lipids in experimental samples with wet and dry okara does not differ from the control, the amount of carbohydrates decreased by 4.9 - 5.9%, and the amount of fiber increased by 78 and 87 times, respectively. The calcium content in the test samples increased by 1.5-1.8 times, magnesium phosphorus slightly decreased. The energy value decreased by 1.4 - 1.7%, the biological value increased by 2.9 - 3.4% compared to the control sample.

4 Conclusions

Studies have shown that the use of wet and dry okara instead of the dry matter of flour in the recipe of wafer products made it possible to reduce their wetness, enrich them with complete protein, fiber, calcium and reduce energy value:

1. The increased water absorption capacity of soy okara necessitates an increase in the amount of water in the formulation by 0.2% and 0.4% for each percentage of okara applied from the control sample, respectively. This is necessary to reduce the viscosity of the dough. At the same time, the moisture content of the dough increases by 2.3 - 4.9% and 3.6 - 8.8% when wet and dry okara are added, respectively, compared with the control sample.

2. The spreadability of wafer dough with wet and dry soy okara is 2-13 mm and 2-7 mm lower than that of the control sample. This is due to the increased water absorption capacity of dietary fibers and proteins of soy okara.

3. The introduction of wet and dry soy okara contributes to an increase in the mass fraction of moisture in wafer cups by 0.1 - 0.4% and 0.1 - 0.9%, a decrease in wetness by 2 - 22% and 2 - 15%, respectively, compared with the control sample. For wafer cups the reduction in wetness is a positive factor, since increased wetness can cause such a defect as peeling of ice cream from the wafer cup.

4. It has been established that the introduction of soy okara instead of flour dry matter in wafer cup recipes in an amount of up to 15% wet soy okara and up to 20% dry soy okara does not adversely affect the organoleptic evaluation of finished products.

5. It was calculated by calculation that in 100 g of wafer products with optimal dosages of soy okara, the amount of digestible carbohydrates decreased by 4.9 - 5.9%, the fiber content increased by 78-87 times, calcium - by 1.5-1.8 times, energy value decreased by 1.4 - 1.7%, the biological value increased by 2.9 - 3.4% compared to the control sample.

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