

Approbation of the cookie recipe with the addition of ingredients that increase nutritional value

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Abstract. Replacing part of the wheat with flour from black cumin seeds, the introduction of freshly frozen apple pomace instead of sugar allows you to get cookies enriched with dietary fiber, vitamins E and C and a number of nutrients. The introduction of these components into the formulation affects the production technology: first, a mixture of bulk ingredients is prepared, then thawed apple pomace is introduced and then table margarine. Kneading lasts 5-7 minutes. at room temperature with a rotation speed of 40-60 rpm. The duration of baking cookies, in comparison with the control sample, increased by 2 times and amounted to 13-15 minutes at a temperature of 240°C. To obtain a finished product with high quality indicators, it is optimal to add black cumin flour in an amount of 7.4% and starch (in sample No. 2) in an amount of 7.4% of the total weight of all ingredients. The use of freshly frozen apple pomace in the formulation made it possible to obtain a product with a pleasant light taste, smell and color of apple raw materials. The optimal shelf life for cookie samples is no more than 30 days.

1 Introduction

Sustainable development of agricultural and food production systems can be achieved only if nutrition improvement issues are given attention at political level. In order to achieve breakthrough scientific, technological and socio-economic development of the Russian Federation, to increase the country's population, improve the standard of living of citizens, and provide the population with high-quality and safe food products, Decree No. 204 "On National Goals and Strategic Objectives of the Development of the Russian Federation for the period up to 2024" was signed. It is clear that a healthy lifestyle is impossible without proper nutrition.

Flour confectionery products are popular among the general population. They have a pleasant taste, attractive appearance and are presented in a wide range: cookies, biscuits, muffins, waffles, gingerbread and others [1].

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Cookies are a ready-to-eat flour confectionery product, traditionally consisting of flour, sugar, eggs and fats [2]. Due to their taste qualities, affordability, preservation and diverse taste qualities, cookies are widely consumed all over the world [3, 4]. The texture and taste properties of cookies are significant factors influencing the choice of consumers [5, 6].

One of the most relevant developments in creating recipes for new types of cookies is the use of innovative ingredients in traditional recipes that can increase the nutritional value of the product. This can be achieved by replacing part of the wheat flour with flour from black cumin seeds, adding apple pomace to the formulation, and excluding sugar from the formulation. Flour from black cumin seeds is not used in flour confectionery formulations due to the color change of the finished product. Cumin seeds are mainly used as a sprinkling on the surface of bakery and flour confectionery products [7-9].

Black cumin seeds have antioxidant, anti-inflammatory, chemo prophylactic and modulating properties that are beneficial to human health [10]. Black cumin has the potential to treat diabetes mellitus, respiratory diseases, hypercholesterolemia and cardiovascular diseases, chronic inflammation, immune dysfunction, etc. [11]. Black cumin seed flour contains dietary proteins (26.7%), fats (28.5%), carbohydrates (40.0%), vitamins (B1, B3, B4, C, E), minerals (K, Ca, P, Mg, Na), which perform certain functions in the human body. Also, black cumin flour has antioxidant, anti-inflammatory, bactericidal, anti-asthmatic and other types of biological activity. Its consumption increases vitality, efficiency, strengthens the immune system, stimulates digestion [12].

As sources of useful substances, it is advisable to use non-traditional raw materials of plant origin for the confectionery industry, for example, freshly frozen apple pomace obtained in the production of apple juice. At the same time, this type of raw material is affordable and does not lead to a significant increase in the cost of the finished product. Apple pomace, which is mainly used for livestock feed, can be used to produce pectin, powders or frozen for subsequent use in the confectionery, canning, and bakery industries as a filler with gelling properties. During storage, all the useful properties of a fresh apple are preserved in a freshly frozen apple squeeze. Which is one of its main advantages [13].

The aim of the study was to study the effect of flour from black cumin seeds and apple pomace on the production technology and consumer properties of cookies.

2 Materials and methods

When developing a cookie recipe using black cumin flour and apple pomace, 2 recipes for sugar cookies "Uzhkandinyai" (recipe No. 129) and shortbread pastry "Leaves" (recipe No. 160) were taken from the collection "Recipes for cookies, biscuits and waffles" edited by M.K. Smirnova. In the course of repeated laboratory baking, taking into account the adjustments made for recipe ingredients and their quantitative ratio, 2 formulations were developed, presented in Table 1.

Table 1. Recipes of the developed cookies.

Name of the ingredient	Quantity, %	
	Sample No. 1	Sample No. 2
Premium wheat flour	34.1	26.7
Black cumin flour	7.4	7/4
Apple squeezes	34.8	34.8
Potato starch	-	7.4
Margarine	22.2	22.2
Soda	1.0	1.0
Salt	0.5	0.5

Total	100.0	100.0
For sprinkling salt and sesame seeds		

Due to the complete absence of sugar and sweeteners in the cookie samples, they cannot be attributed to either sugar or rich shortbread cookies. The sweet taste of the finished product is given by fruit sugars, which are part of apple pomace. In the formulations of the developed samples, apple pomace is introduced in an amount of 30-35% of the total mass of raw materials. Wheat flour of the highest grade was replaced with black cumin flour in the amount of 7.4% of the total mass of raw materials. The amount of this component was determined experimentally taking into account the organoleptic quality indicators of the finished product, since black cumin flour has specific organoleptic properties.

The preparation of the dough begins with the preparation of a mixture of bulk ingredients: premium wheat flour, black cumin seed flour, potato starch in a ratio of 18:5:5, salt and soda. Replacing part of wheat flour with potato starch gives the finished product a more crumbly and airy structure and reduces its humidity. After that, freshly frozen apple pomace is added to the mixture of bulk ingredients and everything is thoroughly kneaded for 1-2 minutes. Pre-frozen apple pomace at room temperature 22 ± 2 ° C is defrosted and rubbed through a sieve to remove seeds and partitions. After that, softened table margarine of 60% fat content is added and everything is thoroughly kneaded again. This sequence of introduction of ingredients allows you to eliminate the formation of lumps in the dough. The dough kneading lasts 5-7 minutes. at room temperature with a rotation speed of 40-60 rpm. Using table margarine of 60% fat content instead of butter allows you to speed up the rise of the dough and get a product with a soft and loosened structure. The prepared dough is rolled into a layer 4-6 mm thick and round biscuits weighing 40-50 g are formed. A mixture of sea salt and sesame is pre-prepared until the components are evenly distributed. Then the surface of the cookie is smeared with egg white to give a shiny surface to the liver and fix the mixture of sea salt and sesame. Cookies are baked at a temperature of 240 ° C for 13-15 minutes in a preheated oven with convection. Baked cookies are cooled on mesh pallets at room temperature and packed after complete cooling.

Studies of organoleptic and physico-chemical parameters, the establishment of expiration dates were carried out on the basis of the Department of Commodity Science, Technology and Examination of Goods of the Southwestern State University.

3 Results and discussion

The developed cookie samples must meet the quality requirements of GOST 24901-2014 "Cookies. General technical conditions". The assessment of the quality indicators of the baked samples was carried out using expert and organoleptic methods. The expert method is based on the fact that each of the 5 experts participating in the survey assigns a certain score to each of the criteria. The tasters, using their senses, assessed the quality of the organoleptic parameters of the developed samples.

The evaluation of the appearance of the finished cookie is carried out by inspection. At the same time, the compliance of the samples is revealed by the absence of deformed products, fractures, swellings, cracks, shell recesses, burnt biscuits, the correctness of the stamped pattern on the surface, and the undisturbed shape. When visually inspecting cookies in a fracture, first of all, the presence or absence of voids, non-mixing of dough, hardening, baking of products, uniformity of porosity are revealed. The taste and smell should be typical for this type of cookie, and also determine the presence and / or absence of unusual odors and flavors.

The results of the study of organoleptic quality indicators of cookie samples are presented in Table 2.

Table 2. The results of the study of organoleptic indicators of the quality of cookie samples.

The name of the indicator	Sugar cookies "Uzhkandinyai"	Shortbread pastry "Leaves"	Sample No. 1	Sample No. 2
Surface	5.0	5.0	4.8	4.8
Form	5.0	5.0	5.0	5.0
Colour	5.0	5.0	5.0	4.6
View in the break	5.0	5.0	5.0	5.0
Taste	5.0	5.0	5.0	5.0
Smell	5.0	5.0	5.0	5.0
Total	30.0	30.0	29.8	29.4

Cookie samples taken as control samples correspond to the maximum score according to the point scale for all organoleptic parameters [13].

During the organoleptic evaluation of the developed samples, it was revealed that the surface of the samples is rough, not burnt, without blisters. The upper part is without a pattern, but has a finish in the form of a sprinkle of sea salt and sesame seeds. During transportation, the sprinkle of sesame seeds crumbles. To prevent this defect, it is necessary to lubricate the surface of the cookie with egg white more abundantly before baking and sprinkling. The bottom surface is smooth. According to the "surface" indicator, the developed cookie samples scored 4.8 points each.

The shape of the samples of the developed cookies is round, flat, without dents, blisters, without a damaged edge. The structure is not fragile, there is no damage in the form of fractures when the products come into contact with each other or other surfaces. When evaluating the "shape" indicator, the samples scored 5.0 points each.

Black cumin flour has an anthracite color (black with gloss), therefore its content in the formulation of sample No. 1 was 21.8% and sample No. 2 was 27.8% of the amount of wheat flour. The introduction of this ingredient affected the color of the dough: it has acquired a dark gray color, close to the color of cumin flour. In sample No. 1, experts noted a dark brown color (chocolate), which was influenced by the introduction of freshly frozen apple pomace into the formulation, which has a reddish-brown color. According to this indicator, the sample received 5.0 points. The color of the cookie sample No. 2 was estimated at 4.6 points. Due to the introduction of potato starch into the formulation, it became dark brown with a gray tinge.

When evaluating the type in the fracture, attention was paid to the baked products, the uniformity of pores, the presence of voids, non-mixing, tempering. The cookie samples No. 1 and No. 2 showed moderate porosity, there were no voids, and no dough mixture was found in the finished products.

In sample No. 2, due to the introduction of potato starch into the formulation, a crumbly structure characteristic of shortbread was noted, in sample No. 1, the structure was layered. Despite the differences in the fractured cookie samples, both samples were rated with a maximum score of "excellent".

All the developed cookie samples have a harmoniously balanced taste, none of the components included in the cookie recipe stood out. There was a pleasant light taste of apple raw materials. The smell is pronounced, characteristic of the smell of apple pomace included in the formulation. The presence of black cumin flour in the recipe did not affect the flavor of the cookies. According to the organoleptic indicators, the developed samples were evaluated with a maximum score of 5.0 points for each indicator.

In general, according to the results of the organoleptic evaluation, the developed cookie samples using black cumin flour and apple pomace scored high: 29.8 points for sample No.

1 and 29.4 points for sample No. 2 and were subsequently recommended for physico-chemical studies.

The quality of the finished cookie samples was evaluated by such physico-chemical parameters as the mass fraction of moisture and alkalinity (Table 3).

Table 3. The results of the study of physico-chemical indicators of the quality of cookie samples.

The name of the indicator	Sugar cookies "Uzhkandinyai"	Shortbread pastry "Leaves"	Sample No. 1	Sample No. 2
Mass fraction of moisture, %	7.1	7.2	8.00	5.80
Alkalinity, degree	1.4	1.2	0.65	1.18

The physico-chemical indicator "mass fraction of moisture" of products, determined by the standard method, in all samples corresponded to the values acceptable for this type of product and the characteristics of formulations. According to GOST 5900-2014 "Confectionery products. Methods for determining moisture and solids" the moisture content should not exceed 10.0%.

According to GOST 24901-2014 "Cookies. General technical conditions" alkalinity should not exceed 2.0 degrees. According to this indicator, all the studied samples correspond to the values of this normative document.

To establish the shelf life, baked cookie samples after cooling were subjected to storage under standard conditions (normal tests) in accordance with the methodology presented in GOST R 70412-2022 "Confectionery products. Guidelines for the establishment and confirmation of expiration dates." The studies were conducted on organoleptic parameters (taste and smell, surface, appearance in the fracture) and the mass fraction of moisture. The results are presented in Table 4.

Table 4. Data on the establishment of expiration dates.

Name of the characteristic s of the test object	Test start date (24.03.24)	1 week	2 week	3 week	4 week	5 week	Regulatory document
Sample No. 1							
Taste	5.0	5.0	5.0	4.8	4.8	4.6	GOST 24901-2014
Smell	5.0	5.0	5.0	4.8	4.8	4.6	GOST 24901-2014
Surface	4.8	4.8	4.8	4.8	4.8	4.6	GOST 24901-2014
View in the break	5.0	5.0	5.0	5.0	5.0	4.2	GOST 24901-2014
Mass fraction of moisture, %	8.0	8.0	7.78	7.1	6.52	5.12	GOST 5900-2014
Sample No. 2							
Taste	5.0	5.0	5.0	4.8	4.8	4.6	GOST 24901-2014
Smell	5.0	5.0	5.0	4.8	4.8	4.6	GOST 24901-2014
Surface	4.6	4.6	4.6	4.6	4.6	4.2	GOST 24901-2014
View in the break	5.0	5.0	5.0	5.0	5.0	4.4	GOST 24901-2014

Mass fraction of moisture, %	5.8	5.8	5.72	5.64	5.43	5.26	GOST 5900-2014
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Studies on the establishment of expiration dates were carried out for 5 weeks. This is due to the fact that initially, when developing the formulation, an expiration date of at least 30 days was given.

The formulations did not use any preservatives that contribute to an increase in shelf life. During the conducted studies, it was revealed that the developed samples had no deviations from the initial value for two weeks (control points for 7 days) in terms of taste, smell, surface, and appearance in the fracture. After the second control point, a slight change in the mass fraction of moisture was noted in sample No. 1 by 0.22%, in sample No. 2 by 0.08%. At subsequent control points (3 and 4 weeks), organoleptic parameters changed slightly, with the exception of the type in the fracture, both in sample No. 1 and sample No. 2 by 0.2 points. The fracture appearance of the developed samples was the same as at the start date of the tests: a uniform porous structure, without voids and lumps - in sample No. 2, a layered structure - in sample No. 1. With an increase in the shelf life of the developed cookie samples, the mass fraction of moisture decreased, the cookies became drier.

The fifth control point (week 5) is beyond the 30 days of the defined shelf life. The taste and aroma indicators changed slightly – by 0.4 points from the initial value in both samples. Small cracks appeared on the surface, indicating that the samples were drying out. In sample No. 1 (without the addition of potato starch), a slightly whitish plaque appeared on individual samples (graying).

During the storage of samples, a significant decrease was observed in the indicator "mass fraction of moisture": in sample No. 1 - by 2.88% and in sample No. 2 - by 0.54% of the initial values. A significant loss of the mass fraction of moisture is associated with the presence of apple pomace in the formulation, which has a high humidity, layered structure in the finished form of cookies. With an increase in the maturation period, the decrease in the mass fraction of moisture in this sample increases significantly, and traces of mold appear (week 7)

In general, studies show that the developed cookie sample No. 1 is not recommended to be stored and eaten after 30 days. There were no significant changes on the surface of sample No. 2. According to the results of the conducted studies, the recommended shelf life for cookie samples is 30 days.

The chemical composition of the raw materials included in the formulation affects the nutritional value of the finished product. The chemical composition and nutritional value of the finished product are mandatory for determining the newly developed product. A calculation method was used to study the nutritional value of the developed cookie samples. The control cookie sample was taken as the basic recipe – shortbread pastry "Leaves". The data of the conducted research are presented in Table 5.

Table 5. The chemical composition of the developed cookies.

The nutrient	Shortbread pastry "Leaves"		Sample No. 1		Sample No. 2	
	Quantity	% from the RSP	Quantity	% from the RSP	Quantity	% from the RSP
Calorie content (kcal)	415	32	341.1	26	339.5	26
Proteins (g)	6.2	7.8	5.6	7.1	4.9	6.2
Fats (g)	21.1	36	20.2	35	20.2	35
Carbohydrates	49.9	42	33.9	28	34.4	29

(g)						
Dietary fiber (g)	-	-	0.4	2	0.5	2.5
Vitamin C, ascorbic acid (mg)	-	-	0.56	0.6	0.56	0.6
Vitamin E, alpha tocopherol, TE (mg)	0.062	0.4	4.517	30	5.185	35
Potassium, K (mg)	14.92	0.6	46.58	1.9	46.58	1.9
Calcium, Ca (mg)	6.01	0.6	8.93	0.9	11.23	1.1
Magnesium, Mg (mg)	1.23	0.3	2.98	0.7	2.76	0.7
Sodium, Na (mg)	13.94	1.1	206.77	16	210.99	16
Chlorine, Cl (mg)	16.03	0.7	265.49	12	265.49	12
Iron, Fe (mg)	0.31	1.7	0.466	2.6	0.466	2.6

As can be seen from the data in Table 5, the developed cookie samples with black cumin flour have, in comparison with the control cookie sample (shortbread pastry "Leaves"), a reduced energy value: 73.9 kcal and 75.5 kcal for samples No. 1 and No. 2, respectively, lower. The developed samples also contain dietary fiber, vitamins E and C, macro- and microelements. The carbohydrate content in cookie samples No. 1 and No. 2 is 1.47 times less than in the control one.

Due to the use of black cumin flour and apple pomace in the cookie formulation, dietary fibers appear in the samples in the amount of 2% and 2.5% of the daily value in sample No. 1 and No. 2, respectively. The control sample lacks vitamin C, while its content in samples No. 1 and No. 2 was 0.56 mg per 100 g of biscuits. The appearance of this vitamin, as well as dietary fibers, is associated with the use of apple raw materials in the cookie formulation. Since apple raw materials are introduced in freshly frozen form, vitamin C is not completely destroyed during heat treatment and most of it passes into the finished product.

The vitamin E content in the developed cookie samples is 75 times higher in sample No. 1 and 87.5 times higher in sample No. 2 than in the control, which is 30% of the daily value for sample No. 1 and 35% for sample No. 2 when using 100 g of cookies. An increase in the vitamin E content in the developed samples is associated with the introduction of flour from black cumin seeds into the formulation.

Also, the developed cookie samples are richer in the content of a number of macro- and microelements than the control sample. Thus, in the developed cookie samples, the content increases: potassium - 2.7 times; magnesium - 2.3 times; sodium in sample No. 1 - 14.8 times and in sample No. 2 - 15 times. The calcium content in sample No. 1 was 8.93 mg per 100 g of the product (1.5 times more than in the control), in sample No. 2 - 11.2 g per 100 g of the product (1.9 times more than in the control). The chlorine content in the developed cookie samples is 16.6 times higher than in the control sample. Enrichment with this element occurs due to the addition of sea salt to the formulation.

According to the trace element "iron", an increase of 1.5 times was observed in comparison with the control one. Which is 2.6% of the daily value when consuming 100 g of cookies.

4 Conclusion

In the course of the conducted research on the influence of non-traditional raw materials (flour from black cumin seeds and apple pomace) in cookies on the quality indicators of the finished product, the following conclusions were made.

Adjustments were made to the technological process of making cookies, the sequence of application of all ingredients, temperature and time modes of baking were determined; the experimentally selected content of apple pomace and starch made it possible to achieve the optimal baking time of cookies (the duration of baking cookies increased by 2 times).

During organoleptic studies, it was found that in order to obtain cookies using flour from black cumin seeds with high quality indicators, it is optimal to add black cumin flour in an amount of 7.4% (no more than 7.5% is allowed) of the total amount of all ingredients; the introduction of apple pomace into the formulation allowed to obtain a product with a pleasant light taste, smell and the color of apple raw materials.

The study of the physico-chemical parameters of the developed cookie samples showed that they are within the limits allowed by the current regulatory document: the mass fraction of moisture in sample No. 1 was 8.0%, in sample No. 2 – 5.8%; alkalinity in sample No. 1 – 0.65 degrees, in sample No. 2 – 1.18 degrees.

According to the results of studies on the establishment of expiration dates, the recommended shelf life for cookie samples is no more than 30 days. The exclusion of sugar and sugar-containing raw materials from the formulation of the developed cookies, the introduction of flour from black cumin seeds and apple pomace allows you to reduce calories, increase the content of dietary fiber, vitamins E and C, potassium, calcium, magnesium, sodium, chlorine and iron.

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