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BISCUITS WITH VEGETABLE FAT FOR A GLUTEN-FREE DIET

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ABSTRACT

This work studies the effect of a composite mixture of coconut, buckwheat, and corn-flour and coconut oil on the organoleptic and physicochemical parameters of the gluten-free biscuit. The optimal ratio of the selected ingredients was selected and the preparation technology developed for the developed gluten-free biscuit from the composite mixtures of coconut, flaxseed, corn at 10:30:60; coconut, linseed, corn at 8:25:67; and coconut, buckwheat, cornmeal at 8:25:67.

Physical and chemical studies showed that for the developed sample, the solids content was 66.9%, the mass fraction of moisture was 33.1%, 0.8% ash, 44.4% sugar, and 10.6% fat.

The per developed product 100 g has nutritional and energy value 11.38g protein, 15.14g fat, 51.59g carbohydrates, energy 375.2 kcal, and the biscuit is enriched with macro- and microelements, such like iron, calcium, magnesium, vitamins B1 and E. These substances are necessary for people suffering from gluten intolerance due to metabolic disorders in the gastrointestinal tract in large quantities.

Disciplinary: Food and Nutrition Sciences, Health Sciences.

1. INTRODUCTION

Confectionery production is one of the leaders in the food industry. Although the range of confectionery products is very diverse, however, in most cases, consumers are healthy people. Although in recent years, more and more people suffer from various types of diseases, which leads to the restriction or prohibition of the consumption of confectionery products based on wheat flour, so the development of such products for dietary and specialized purposes is an urgent task.

A large proportion of consumers with dietary restrictions are people suffering from intolerance to

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cereal protein - gluten. At the same time, the most common and traditional raw materials are wheat, rye, barley, oats, which are just prohibited in a gluten-free diet. To solve this problem, manufacturers and scientists suggest searching for alternative raw materials, for example, flour from rice, corn, buckwheat, flax, pumpkin, coconut, etc.

According to the information outlined in the National Technology Initiative (STI) of December 4, 2014, supported by the President of the Russian Federation V.V. Putin has proposed two innovative modern directions in areas related to human health and nutrition. First, HealthNet [1] aims to create a market for personalized medical services and medicines that provide growth and longevity, as well as obtaining new effective means of prevention and treatment of various diseases.

The second direction, Foodnet's [20] trend is the development of the production and sale of nutrients and final types of food products (personalized and general, based on traditional raw materials and its substitutes), as well as related solutions (for example, providing logistics and individual nutrition selection services). The national idea to address these initiatives is the creation by 2035 of smart services and products that will become competitive in the world market due to the best technological solutions for human food security. According to the forecasts of the Government of the Russian Federation, domestic companies should occupy significant shares of the world market and makeup from 5-15% depending on the segment [1].

Currently, in most developed countries, the development and production of gluten products are at a high level and widespread. At the same time, in Russia - this direction is at the initial stage. In most trading enterprises, food products with the gluten-free marking, which are produced abroad, are offered to potential consumers, which in turn affects the price. Of course, if these products would be produced in Russia, then they would be in demand and available to a wide range of consumers, including those with different income levels. Thus, domestic experts are faced with the urgent need to create a wide line of confectionery products from gluten-free types of flour, new technological solutions that provide high-quality, competitive products.

The work [21] experimented on gluten-free flour mixes and fat powders to produce gluten-free biscuits and the products' quality was observed. A study [22] tested enriched biscuit using gluten-free tiger nut to inspect nutritional value and sensory profile. An evaluation [23] was to observe the storage-associated changes in the fatty acid profile of oat-based gluten-free cookies.

For the first time about the disease "Celiac disease" or "Gluten enteropathy" was described in 1888, and in 1951 it was proved that cereal products containing gluten are part of the products that cause enteropathy - celiac disease. In Russia, they became interested in celiac disease in the 90s. However, there are still whole regions in which screening of this disease is not carried out. It should be emphasized that celiac disease is not an allergic disease, but belongs to the group of diseases associated with food intolerance, and products due to enzyme deficiency [2].

According to statistics, the prevalence of the celiac disease in many countries of Europe and America is about 1% of the total population. At the same time, an increase in the diagnosis of the disease became possible due to the widespread use of immunological methods allowing epidemiological studies of the population and screening of risk groups [3]. It should be noted that as a result of screening studies, it was shown that most patients with celiac disease have a low-symptom or asymptomatic course of the disease.

Besides, the results of screening studies have identified a wide range of other diseases associated with the consumption of gluten. In a separate group, patients with extraintestinal manifestations of

celiac disease (herpetiform dermatitis, gluten ataxia) began to be assigned. Part of the patients having allergic reactions to gluten was determined.

This work aims to develop a technology for biscuit cake mix with the addition of vegetable fat for a gluten-free diet.

2. MATERIALS AND METHODS

The object of the study was a biscuit cake mix on coconut oil from a composite mixture of buckwheat, corn, and coconut flour. As a control sample was taken the recipe and technology of biscuit "Prague" No.7 [4].

Research method

1. Organoleptic studies of prototypes of gluten-free biscuits were carried out according to GOST 5897 - 90 [5];

2. The determination of the mass fraction of moisture and solids was carried out according to GOST 5900 - 2014 [6];

3. The determination of the mass fraction of fat was carried out according to GOST 10846-91 [7];

4. The determination of the mass fraction of sugar was carried out following GOST 5903-89 [8];

5. Nutrition and energy values were determined using data on the chemical composition of Russian food products [9].

Materials: corn flour "S. Pudov", Moscow. Manufacturer LLC "Khlebzernoprodukt, 347913" STO 535458590-018-2013; sugar - sand “Russian sugar” of OJSC “Valuikisahar” GOST 33222 - 2015 [10]; fresh chicken eggs C1, JSC Simonovskaya poultry farm GOST 31654 - 2012 [11]; coconut flour "econutrena" LLC "Helsi Market"; Buckwheat flour “Sorceress” of PJSC “Petersburg Mill Plant” TU 9197-023-00941903-2009 [12]; refined bleached deodorized coconut oil "Delicato" JSC "Nizhny Novgorod Oil and Fat Combine" GOST R ISO 22000 [13].

3. BISCUIT’S INGREDIENT PROPERTIES

In the course of research on personalized gluten-free food products, they began to use a new type of unconventional raw material - coconut flour, which is obtained from coconut pulp, dried, and ground [14]. The chemical composition of this flour is also remarkable. It contains more than 40% dietary fiber, it is enriched with mineral elements (per 100 g) such as: potassium 356 mg, phosphorus 113 mg, magnesium 32 mg, calcium 14 mg, iron 2.4 mg, copper 0.4 mg, zinc 1.1 mg, selenium 10.1 mg; B vitamins (B1 0.06 mg, B2 0.1 mg, B5 0.8 mg), C 1.5 mg, E 0.44 mg, PP 0.6 mg [15].

The next component that we have used is more studied is cornmeal. It has a pleasant taste and yellowish color, as it was widely used in the nutrition of some peoples, its positive properties are better known, namely, it strengthens the immune system and also has a beneficial effect on metabolism and maintaining normal balance in the body [16].

Buckwheat flour is also a gluten raw material, but basically, cereals were traditionally used in the human diet. Although buckwheat flour is noted for the presence of eighteen essential amino acids with a rich mineral and vitamin composition - iron, calcium, potassium, phosphorus, copper, iodine, zinc, boron, fluorine, molybdenum, cobalt, with vitamins B1, B2, B9 (folic acid), PP, vitamin E [17].

Because the celiac disease has the character of comorbidity, that is, combined intolerance of other food ingredients, often cow's milk protein, the use of coconut is proposed as a substitute for

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butter. Coconut oil is a vegetable fat obtained by hot or cold pressing of dried coconut pulp. Coconut oil, in its vitamin and mineral composition, is similar to breast milk and contains antioxidants and polyunsaturated fatty acids, which have beneficial effects on the skin, hair, nails, and the entire human body. The composition contains lauric acid 50%, myristic acid 20%, palmitic acid 9%, oleic acid 6%, caprylic acid 5%, capric acid 5%, stearic acid 3%, linoleic acid 1 %, caproic acid 0.5% [18].

4. RESULTS AND DISCUSSION

During the study, the following changes were made to the control formulation: the complete replacement of wheat flour with a mixture of corn, buckwheat and coconut flour in different ratios, the replacement of butter with coconut oil, while reducing it by 20%, as well as the exclusion of cocoa powder (possibly the presence of hidden gluten). Prototypes are presented in Table 1.

Table 1: Options developed gluten-free biscuits.

Sample No.	The composition of the composite mixture	The ratio of ingredients,%
1	coconut flour: linseed flour: corn-flour	10:30:60
2	coconut flour: linseed flour: corn-flour	8:25:67
3	coconut flour: buckwheat flour: corn-flour	8:25:67

As can be seen in Figure 1, the best organoleptic indicators are sample No. 3, which had a mild taste typical of a biscuit, has a slight aftertaste of corn and buckwheat flour, and a pleasant aroma. The recipes of the test samples are presented in Table 1. Defects of the test samples not selected by us include the presence of grains, friable consistency. Also, in samples with flax flour and cocoa powder, the smell of flax flour is too pronounced.

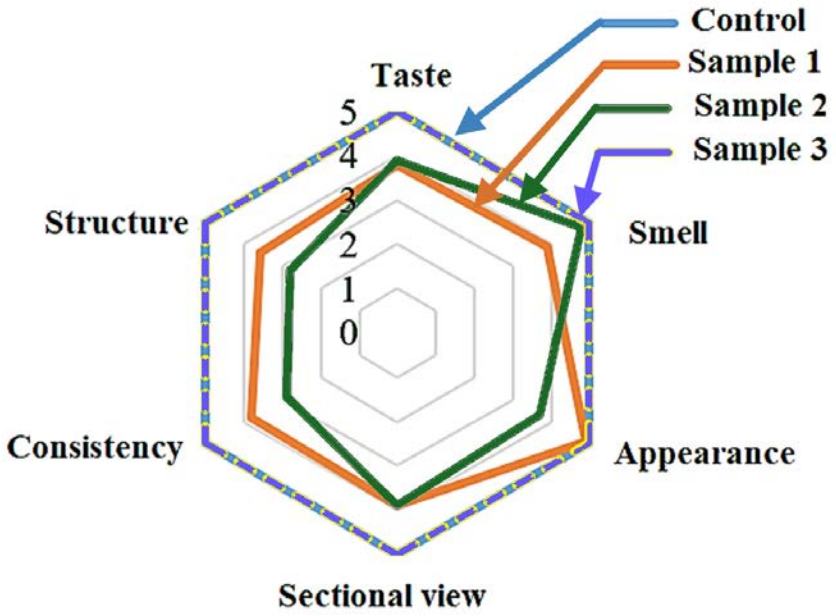

Figure 1: Organoleptic profile of the studied gluten-free biscuit samples.

In the course of the research, it is necessary to reduce the amount of coconut oil by 20%, as compared to butter, they have different chemical composition, the specific gravity of fat, and melting point.

Figure 1: Sample №1 of developed gluten-free biscuit.

Figure 2: Sample №2 of developed gluten-free biscuit.

Figure 3: Sample №3 of developed gluten-free biscuit.

As can be seen from the data in Table 2, during the studies we noted an increase in the dry matter by 6.8%, a slight decrease in the mass fraction of sugar by 0.7%, and an increase in the mass fraction of fat by 1.1%.

Table 2: Quality indicators developed biscuit Sample No.3 with a mixture of coconut, buckwheat, and corn-flour at a ratio of 8:25:67.

Indicators	Control	Sample No. 3
Proteins, g	11.6	11.4
Fats, g	14.4	15.1
Carbohydrates, g	45.6	51.6
Energy value, kcal	358.7	375.2
Mass fraction of solids,%	60.1 ± 3.0	66.9±0.4
Mass fraction of sugar,%	45.1±1.0	44.4±1.0
Mass fraction of fat,%	9.5±0.3	10.6±0.3

In the course of the study, we analyzed the fractional composition of wheat flour and the composite mixture we selected, which are presented in Table 3. According to the literature, it is known that gluten is the glutelin and prolamin fraction of cereal protein: wheat, rye, barley, oats, and

they are allergens. By the calculation method, we noted that the developed composite mixture is gluten-free since it contains glutelin and prolamin fractions in the amount of 16.2 mg/kg, which is acceptable for the gluten-free diet (no more than 20 mg/kg) [19].

Table 3: Composition of protein fractions of certain types of flour.

Type of flour	Mass fraction of protein fractions, %					
	Albumin	Globulins	Glutelins	Insoluble proteins	Prolamins (gliadin)	Zein
Wheat	5.2	12.6	28.2	8.7	35.6	-
Corn	8.1	5.9	80.0	-	-	5.9
Buckwheat	21.7	42.6	12.3	-	1.1	-
Coconut	1.1	-	0.7	-	0.9	-
A composite mixture of coconut, buckwheat, and corn flour	3.1	4.2	16.1	-	0.1	-

Figure 2 presents a flow chart for the preparation of a gluten-free biscuit. Compared with the classical scheme for the preparation of oily biscuit, the developed sample has a baking time increased by 10 - 15 minutes, the temperature was 170-180°C, and in the control 205-225°C. During the kneading process, the yolks were beaten together with sugar in the test samples, while in the control sample 50% sugar was whipped together with the proteins and the remaining 50% together with the yolks. Coconut oil was added after whipping the yolks, and in the control sample, the butter was added immediately to the egg-sugar mass.

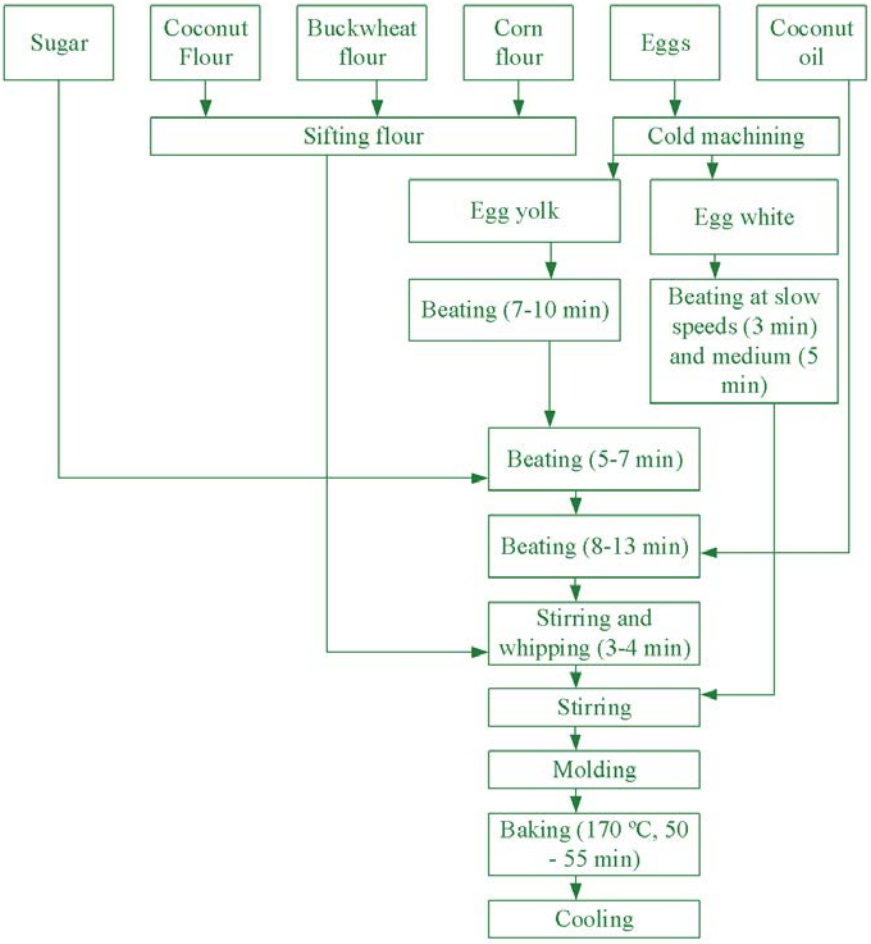

Figure 2: Technological schematic preparation of a developed gluten-free biscuit from a composite mixture.

5. CONCLUSION

From the total three biscuits composite mixtures, the formulation, and technology for the preparation of biscuit cake mix from a composite mixture of coconut, buckwheat, and corn flour with a ratio of 8:25:67 with the addition of coconut oil. Physical and chemical studies have shown that in the developed biscuit semi-finished product, the solids content was 66.9%, 0.8% ash, 44.4% sugar, fat 10.6%. The nutritional and energy value of the developed biscuit cake mix was calculated, which amounts to 11.38 g per fat product of protein, 15.14g of fat, 51.59g of carbohydrates, and 375.2 kcal of energy value.

Thus, studies have shown that the use of non-traditional types of raw materials allows you to create gluten-free products with high-quality indicators, including organoleptic, structural-mechanical, and enriched in nutritional value.

6. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding author.

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