Gluten-free products from chickpea flour

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Abstract. The paper discusses the possibility of the expansion of the range of flour culinary products for a gluten-free diet using chickpea flour. The analysis of the chemical composition of wheat and chickpea flour, as well as the glycemic index of all components of the recipe of the developed flour culinary product is presented. The possibility of partial and complete replacement of wheat flour with chickpea flour with the addition of caraway, lemon peel and potato starch is studied. It is found that the inclusion of lemon peel in the composition of chickpea flour pancakes improves not only the organoleptic characteristics of products, but also reduces its total energy content, while expanding the range of products included in a gluten-free diet.

1. Introduction
Today there are many people in the world who follow a gluten-free diet, mainly those who suffer from a celiac syndrome. This disease is associated with intolerance to gluten protein, which causes the development of atrophic changes in the mucous membrane of the small intestine under the influence of specific proteins of the endosperm of the grain of certain cereals. A strict diet is the most effective way to normalize intestinal activity and relieve celiac disease. People with this disease are not advised to eat food that contains gluten, both explicit and latent [1-4]. The market for gluten-free products in Russia is not sufficiently formed. Domestic producers offer pasta, biscuits and breads [5].

Flour culinary products are one of the most frequently consumed food products, which have recently occupied a special place in dietology. Due to these products, the human body partially covers its needs in calcium salts, phosphorus, potassium, magnesium, iron. They contain not only carbohydrates, but also proteins, valuable in their amino acid composition, which have a number of essential amino acids [6, 7].

However, each person requires a particular approach and an individual diet under the strict supervision of treating professional doctor or nutritionist. Today, scientists have developed a lot of diets. Some of them are therapeutic ones; others are intended for weight loss. There are general nutrition technologies, such as, for example, a gluten-free diet that can relieve the suffering of patients with celiac syndrome, autism and a number of other diseases, as well as normalize weight [4].

Initially, a gluten-free diet was developed for people with celiac syndrome, a chronic intestinal disorder caused by certain types of cereals that contain gluten protein. If this problem had been known only to a few before, today 1% of the population worldwide has gluten intolerance.

Gluten is a natural protein found mainly in cereals such as wheat, rye, barley and oats. In addition, very often gluten is added to food to give them new properties [1, 3].
In this regard, a gluten-free diet, which offers to completely eliminate foods with gluten from the diet, has become the only way to normalize intestine function and prevent the development of other diseases associated with gluten intolerance. For patients with celiac syndrome, gluten-free products are recommended, such as corn, buckwheat, rice legumes and millet.

A gluten-free diet offers a wide range of food, but the range of flour culinary products is not diverse enough. Taking this into account, the purpose of the paper was to simulate the recipe and technology to prepare a flour culinary product, namely pancakes from chickpea flour.

Chickpea flour is a fairly popular product which occupy important place in culinary field. The benefits of chickpea are undoubted. This is evidenced by at least the fact that it contains about 80 valuable nutrients. Regular consumption of food with the addition of chickpeas strengthens the cardiovascular system, improves digestion and also normalizes blood sugar levels. Chickpea prevents the development of skin diseases and improves eyesight. It is an excellent remedy for the prevention of cataracts and glaucoma. It has been proven that eating chickpea meals 2-3 times a week significantly lowers blood sugar [2, 4].

The purpose of the research is to expand the range of food products included in a gluten-free diet based on affordable and inexpensive raw materials.

2. Materials and methods
The study is based on the analysis of scientific works of Russian and international authors on the research topic. During the experiments, modern research methods are used.

3. Results and discussion
In order to develop a flour culinary product for a gluten-free diet, a comparative analysis of the chemical composition of wheat and chickpea flour was carried out. The results are presented in Table 1.

| Indicator             | Content, in 100 grams | Wheat flour | Chickpea flour |
|-----------------------|-----------------------|-------------|----------------|
| Proteins, g           | 10,7                  | 20,1        |
| Fat, g                | 1,3                   | 4,3         |
| Carbohydrates, g      | 69,8                  | 46,2        |
| Unsaturated fatty acids, g | 0,61                | 2,9         |
| Saturated fatty acids, g | 0,3                  | 0,7         |
| Ash, g                | 0,5                   | 3,0         |
| Starch, g             | 67,8                  | 43,2        |
| Mono - and - disaccharides | 1,0               | 3,0         |
| Water, ml             | 14                    | 14          |
| Dietary fiber, g      | 3,5                   | 9,9         |
| Calorie content, kcal | 333,7                 | 303,9       |

In Table 1, we can see that the calorie content of wheat flour is 29.8 kcal higher than that of chickpea flour. The content of dietary fiber in wheat flour is 6.4 g lower. In comparison with wheat flour, chickpea flour contains more proteins by 9.4 grams, fat by 3 grams and carbohydrates by 23.6 grams less. The advantage of chickpea flour over wheat is that most of the carbohydrates in it are complex. Therefore they can be a source of energy for a long period of time. Complex carbohydrates have a low glycemic index, which is an indicator of the impact of food after consumption on blood sugar and depends on the type of carbohydrates, the amount of fiber it contains, the way it is cooked and the protein and fat content.
The glycemic index is usually divided into low (10-40), average (40-70) and high ones (over 70). The glycemic index is rarely indicated on the packages of Russian food, in contrast to European countries.

Table 2 shows the glycemic index of ingredients used in the development of gluten-free pancakes.

**Table 2. Glycemic index of ingredients of the recipe of flour culinary product**

| Product                  | Glycemic index |
|--------------------------|----------------|
| Wheat flour, premium     | 86             |
| Chickpea flour           | 30             |
| Sugar                    | 77             |
| Olive oil                | 15             |
| Potato starch            | 96             |
| Lemon peel               | 20             |

Table 2 shows that the glycemic index of products such as chickpea flour, olive oil and lemon peel is low, respectively, a flour culinary product prepared from these products will also have a low glycemic index, which is important for the nutrition of people with diabetes.

The production technology of a new type of flour culinary product provides the purification from impurities, after which the dough is prepared with the addition of all components, according to the recipe of the product. The finished dough is placed in a proofing chamber (oven) for 15-20 minutes and the product is baked.

During the creation of the recipe of chickpea flour pancakes, the traditional recipe (control sample) of a flour product was taken as a basis. Developing the recipe, the possibility of partial replacement of wheat flour with chickpea flour was studied - sample No. 1. In sample No. 2, wheat flour was completely replaced by chickpea flour and caraway (6 gr) was added. In sample No. 3 lemon peel (25 g) was added and in sample No. 4 potato starch (21 g) was added. The developed recipe for high grade chickpea and wheat flour pancakes is shown in Table 3.

**Table 3. Developed recipe for pancakes**

| Ingredient, gr | Control sample | Sample No. 1 | Sample No. 2 | Sample No. 3 | Sample No. 4 |
|----------------|----------------|--------------|--------------|--------------|--------------|
| Wheat flour    | 416            | 208          | -            | -            | -            |
| Chickpea flour | -              | 208          | 416          | 416          | 416          |
| Water          | 1040           | 1040         | 1040         | 1040         | 1040         |
| Eggs           | 83             | 83           | 83           | 83           | 83           |
| Sugar          | 25             | -            | -            | -            | -            |
| Salt           | 8              | 8            | 8            | 8            | 8            |
| Caraway        | -              | -            | 6            | -            | -            |
| Lemon peel     | -              | -            | -            | 25           | -            |
| Olive oil      | 16             | 16           | 16           | 16           | 16           |
| Potato starch  | -              | -            | -            | -            | 21           |
| Dough weight   | 1539           | 1539         | 1539         | 1564         | 1539         |
| Yield of finished products | 1000            | 1000         | 1000         | 1025         | 1000         |

According to the data of the organoleptic assessment carried out by the method of blind tasting, it can be concluded that out of all samples of flour culinary products, including the control one, the
highest indicators was in the sample No. 3, i.e. the pancakes made from chickpea flour with the addition of 25 grams of lemon peel. In this regard, further research was carried out on sample No. 3.

As a result, it was found that for 1564 g of dough for gluten-free pancakes, the best dosage would be 416 g of chickpea flour, 16 g of olive oil and 25 g of lemon peel. A further increase in the amount of lemon peel impairs the organoleptic characteristics of the finished product. The addition of caraway seeds and starch to the pancakes recipe does not cause significant changes in the product.

Table 4. Nutritional and energy value of studied pancakes (100g of product)

| Indicator             | Control sample | Sample No. 3 |
|-----------------------|----------------|--------------|
|                       | Daily requiremen t of adult | Chemical composition in 100 g of the product | The degree of satisfaction of the daily requirement, % | Chemical composition in 100 g of the product | The degree of satisfaction of the daily requirement, % |
| Proteins, g           | 75             | 5,5          | 7,3          | 9,4          | 12,5          |
| Fat, g                | 83             | 2,9          | 3,5          | 4,2          | 5,1           |
| Carbohydrates, g      | 365            | 31,6         | 8,6          | 13,1         | 3,6           |
| Dietary fiber, g      | 20             | 1,5          | 7,5          | 4,4          | 22            |
| Vitamin C             | 70             | -            | -            | 3,3          | 4,7           |
| Beta carotene         | 5              | -            | -            | 0,04         | 0,8           |
| Choline, B4           | 500            | 46,0         | 9,2          | 24,6         | 4,9           |
| Vitamin B5            | 5,0            | 0,25         | 5            | 0,4          | 8             |
| Potassium             | 2500           | 62,2         | 2,5          | 418,1        | 16,7          |
| Calcium               | 1000           | 12,1         | 1,2          | 88,3         | 8,8           |
| Sodium                | 2400           | 13,0         | 0,5          | 41,9         | 1,7           |
| Phosphorus            | 800            | 52,2         | 6,5          | 201,4        | 25,2          |
| Iron                  | 13             | 0,6          | 4,6          | 1,2          | 9,2           |
| Sulfur                | 1000           | 13,3         | 1,3          | 92,7         | 9,3           |
| Energy value, kcal    | 2500           | 174,5        | 6,9          | 127,8        | 5,1           |

In Table 4, we can see that the energy content of pancakes made from chickpea flour is 127.8 kcal, which is 46.7 kcal lower than the product made from premium wheat flour.

In flour culinary products, vitamins are usually contained in small amounts or are completely absent. In sample No. 3, in comparison with the control sample, there is Vitamin C (3.3 g) and a small amount of beta-carotene. The mineral composition of the products has a significant difference, and according to all indicators, the greatest amount is found in pancakes made from chickpea flour.

4. Conclusion

Consequently, the pancakes made from chickpea flour will cover the daily requirement for phosphorus by 25.2%, potassium by 16.7%, iron by 9.2% and calcium by 8.8%.

Thus, the research shows that pancakes made from chickpea flour with the addition of lemon peel not only have a reduced energy content in comparison with products made from wheat flour, but are also gluten-free and have a number of new benefits for human body.

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