Obtaining of gluten-free pizza dough based on flaxseed flour

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Abstract. Flaxseed flour is a promising raw material as a base or additive ingredient for producing of gluten-free production. It has got high sensory characteristics, and it is also a valuable source of several nutrients (including vitamins and minerals). Thus, food products enriched with flaxseed flour may have functional properties. Based on the results of researches on using flaxseed flour in bakery products formulations, there was revealed the advisability of complete replacement of wheat flour in classic pizza dough formulation with flaxseed flour. The advantages of flaxseed pizza dough are time reduction of the fermentation process from 24 h at 2…6 °C to 1 h at 15…25 °C, increased nutritional value and high sensory properties. The obtained dough formulation was used in the developed technology of mushroom pizza on flaxseed flour and can be implemented at the existing food industry enterprises, including catering enterprises.

1. Introduction

Development of new types of gluten-free products and their practical implementation on existing enterprises are one of the actual trends in modern food industry. First, gluten-free production is needed for specialized nutrition for people with celiac disease (gluten enteropathy). Besides, it can be used in diet for consumers who adhere to a gluten-free diet on their own will.

Gluten-free food products require special conditions for their production, which consist in the complete absence of gluten on the enterprise territory. Despite this, gluten-free products can be obtained on food industry and catering enterprises. This is because of the presence of gluten traces in ready food products in not a dangerous factor for people who do not suffer from plant protein intolerance.

Flaxseed flour is a promising plant raw material for gluten-free products obtaining. It is well-known, that it has got high sensory characteristics, and it is also considered as a source of dietary fibers, essential amino acids, vitamins (B1, B2, B6, B9, PP, choline), mineral substances (macroelements: Ca, Mg, Na, K, P; микроэлементы: Fe, Zn, Cu, Mn) and polyunsaturated fatty acids [1-5]. Flaxseed products can be used for the prevention and treatment of several diseases [4]. There were carried out the researches on the use of flaxseed flour and other products in formulations of wheat flour products [2-4, 6-13], and also in gluten-free flour mixes [2, 4, 14-16]. At the same time, there is no information on the use of flaxseed flour as the main or additional ingredient in pizza dough, which determines the relevance of ongoing research.
The purpose of the research was the development of formulation and technology of pizza dough based on flaxseed flour, and the expediency definition of its practical implementation.

2. Experimental research

The research on the obtaining of flaxseed pizza dough were carried out at the Technology and Organization of Food Industries Department of Novosibirsk State Technical University. As a base formulation, the classic pizza dough based on high-grade wheat flour was used. In turn, wheat flour was completely replaced with flaxseed flour in the experimental dough formulation.

2.1. Materials

The main raw materials for base and experimental dough formulations were high-grade wheat flour of “Aleika” trademark (Russia, Altay region, Aleisk) and flaxseed flour of “S. Pudov” trademark (Russia, Rostov region, Taganrog).

The additional raw materials were fine-ground sea salt, dry yeast and olive oil, which were purchased from local retail network in Novosibirsk.

2.2. Obtaining of pizza dough samples based on wheat flour and flaxseed flour

For the obtaining of base dough formulation, sifted wheat flour and dry yeast were placed into the mixing bowl of kneading machine. Then the dough kneading process started, and gradually within 20 s the larger amount of potable water with a temperature of 20 °C was introduced into the mixing bowl. After that, the dough was kneaded within 1…1.5 min. Then the olive oil was gradually introduced into the mixing bowl and the dough was kneaded again within 1.5 min. After that, the sea salt and remaining water were gradually added into the dough, and the remaining time of dough kneading until homogeneous and elastic dough consistency was 5…7 min. The total dough kneading process time was 10 min.

The obtained wheat dough had a rest within 15…20 min at 15…25 °C. After that, it was divided into portions. From the portioned dough pieces, the balls were formed. These balls were staggered in sealed dough trays and fermented within 24 h in the cold store at 2…6 °C. Before working with dough balls after their cold fermentation, they were withstood within 2…3 h until the temperature of 15…21 °C was reached.

In the experimental dough formulation, high-grade wheat flour was completely replaced by flaxseed flour, which was chosen as a functional ingredient. Wherein, the flour amount decreased, and water amount increased because of stronger water retention properties of flaxseed flour in comparison with wheat flour. Therefore, in the flaxseed dough the kneading time increased. The fermentation process was carried out under normal conditions at 15…25 °C. The optimal fermentation time was chosen from 1, 3, 6, 12 and 24 h time intervals. It was noted that sensory properties were identical in all dough samples. So, it was concluded that the fermentation time of 1 h was enough for obtaining dough of desired quality.

The flowchart showing the flaxseed pizza dough preparing process is presented on figure 1.

2.3. Sensory evaluation

For sensory properties evaluation, the pizza dough samples were unrolled until the thickness of 4…5 mm and baked in the oven at 250 °C within 8 min. After that, they were cooled down to the ambient temperature of 20…25 °C. The samples were evaluated on their appearance, consistency, color, taste and scent according to Russian national standard GOST 31986-2012 “Public catering service. Method of sensory evaluation of catering products”. Every sensory characteristic was evaluated on the 5-point scale (5 indicates the best and 1 implies the worst) by 5 semi-trained panelists.

As a result of the evaluation, the average points for each characteristic were obtained. Based on these points, the profilograms, which clearly reflected comparative sensory characteristics of two dough samples, were built.
Olive oil 
Dry yeast 
Flaxseed flour 
Potable water 
Sea salt 

Sifting 
Mixing 
Dough kneading 2...4 min
Dough kneading 2...4 min
Dough kneading 5...7 min
Dough rest 15...20 min
Balls forming
Fermentation 1 h at 15...25 °C

~80...90%
1...3 °C
~10...20%
1...3 °C

Flaxseed pizza dough

Figure 1. Flaxseed pizza dough preparing process.

2.4. Comparative evaluation of nutritional and energetical value
Nutritional and energy values of the dough samples were determined and analyzed because of their calculations according to reference data from “Chemical Compositions and Calorie Content of Russian Food Products” (2012). The calculated data were compared to normative indicators from “Norms of physiological requirements in energy and nutrients in various groups of population in Russian Federation” (MR 2.3.1.2432-08).

3. Results and discussion

3.1. Sensory properties of wheat and flaxseed pizza dough
The description of sensory evaluation results of dough pizza samples is presented in table 1.

Primarily, the sensory characteristics varied because of different chemical composition of wheat and flaxseed flours and the rheology properties of the dough obtained from them. The main differences of baked flaxseed pizza dough from baked wheat pizza dough is its slightly plasticine-like consistency and the presence of light fruity flavor in its taste and scent. Nevertheless, these differences did not cause a decrease in the sensory characteristics of the developed flaxseed dough.
### Table 1. Sensory characteristics of wheat and flaxseed pizza dough.

| Sensory characteristics | Wheat pizza dough                                                                 | Flaxseed pizza dough                                      |
|-------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Appearance              | Almost perfectly round pizza base, with almost uniform thickness of 3 mm, in some places there are bumps and small swellings | Slightly plasticine-like, no voids                        |
| Consistency             | Elastic, uniformly porous, no voids                                                | Slightly plasticine-like, no voids                        |
| Color                   | Golden yellow                                                                     | Chocolate brown                                           |
| Taste                   | Pleasant, typical for baked dough                                                  | Pleasant, typical for baked dough, with light fruity flavor|
| Scent                   | Pleasant, moderately salty, typical for baked dough                                | Pleasant, moderately salty, typical for baked dough, with light fruity flavor |

The results of sensory evaluation of pizza dough samples are shown in figure 2.

![Figure 2. Sensory evaluation of pizza dough samples.](image)

Despite of small decrease of appearance and consistency characteristics of flaxseed pizza dough, high point values for them are kept. For taste and scent flaxseed dough sample has got the highest point values, and points for its color characteristic are higher than for wheat dough.

#### 3.2. Comparative evaluation of nutritional and energetic value

The results of nutritional and energetic value calculations of wheat and flaxseed dough are shown in table 1.

According to obtained data, wheat dough has got functional properties (substance content is more than 15% from daily norm) by sodium and vitamin B₁ content, which are not scarce for human body. It is also enriched (substance content is more than 5% from daily norm) with potassium, magnesium, phosphorus, iron and vitamin PP.
Table 2. Comparison of nutritional and energetic value of wheat and flaxseed pizza dough.

| Nutritional substances and energy value | Daily norm | Nutritional substances content |  |
|----------------------------------------|------------|---------------------------------|------------------|
|                                        |            | Wheat pizza dough | Flaxseed pizza dough |
|                                        |            | Content in 1 serving (250 g) | Percentage of daily norm, % | Content in 1 serving (250 g) | Percentage of daily norm, % |
| Proteins, g                           | 75         | 16.31                   | 21.75              | 35.17                   | 46.89              |
| Fats, g                               | 83         | 4.24                    | 5.11               | 12.23                   | 14.73              |
| Carbohydrates, g                      | 211        | 110.34                  | 52.29              | 1388.24                 | 57.84              |
| Na, mg                                | 2400       | 190.64                  | 5.45               | 291.85                  | 29.19              |
| K, mg                                 | 3500       | 45.19                   | 4.52               | 420.56                  | 105.14             |
| Ca, mg                                | 1000       | 26.67                   | 6.67               | 687.69                  | 68.77              |
| Mg, mg                                | 400        | 1.98                    | 6.14               | 6.22                    | 44.43              |
| P, mg                                 | 1000       | 0                       | 0                  | 0                       | 0                  |
| Fe, mg                                | 70         | 1.87                    | 9.35               | 3.24                    | 16.2               |
| Vitamin A, mcg                        | 1000       | 0                       | 0                  | 0                       | 0                  |
| Vitamin B1, mg                        | 1.5        | 0.27                    | 18                 | 1.75                    | 116.67             |
| Vitamin B2, mg                        | 1.8        | 0.06                    | 3.33               | 0.17                    | 9.44               |
| Vitamin PP, mg                        | 20         | 1.87                    | 9.35               | 3.24                    | 16.2               |
| Vitamin C, mg                         | 70         | 0                       | 0                  | 0.64                    | 0.91               |
| Energy value, kcal                    | 2500       | 545.54                  | 21.82              | 286.4                   | 11.46              |

In turn, flaxseed dough has got functional properties on sodium, potassium, calcium, magnesium, phosphorus, iron, vitamins B1 and PP. Wherein the needs for magnesium and vitamin B1 are fully covered. For vitamin B2 content, flaxseed dough is enriched product.

Based on the properties of flaxseed pizza flour, there were developed the formulation and technology of mushroom pizza on flaxseed flour. Its flowchart is shown in figure 3.

Figure 3. Mushroom pizza on flaxseed flour preparing process.
4. Conclusion
It is substantiated that pizza dough, where wheat flower is completely replaced with flaxseed flour, has got several advantages before classic pizza dough. These advantages are similar uncomplicated parameters of the preparing process, reduction of fermentation time from 24 h to 1 h without keeping at the cold store, high sensory characteristics, increased nutritional value with functional properties. It can be recommended for implementation on existing food industry and catering enterprises and for further research on evaluation on physico-chemical, rheological and functional properties.

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