OPTIMIZATION OF THE COMPOSITION AND PROPERTIES OF BAKERY PRODUCTS

Abstract

The article is devoted to the study of the properties of bakery products, in particular the choice of the optimal concentration of flaxseed cake in baguettes in order to ensure maximum caloric content. It is known that bakery products are necessary for a person to ensure his health and ability to work. The range of food products, in particular bakery products, is constantly growing. The analysis of the range of bakery products makes it possible to ensure the normal growth and development of the human body, its health, efficiency and creative activity [2-4].

Such products have a high biological value, i.e., have a balanced content of essential amino acids, polyunsaturated fatty acids, lipoids, polyphenolic compounds, vitamins and minerals. It is the presence of functional foods that makes it possible to ensure the normal growth and development of the human body, its health, efficiency and creative activity [2-4].

The development of modern industrial production in some way has a negative impact on the environment and, consequently, on the normal functioning of the human body. Emissions from industrial plants contain various hazardous substances with potentially carcinogenic effects, including heavy metals, radionuclides, food contaminants (dioxins, organochlorine compounds, mycotoxins), so human food must contain substances that would perform protective functions. Currently, more than 500 plant components have been identified, the ability to inhibit the development of tumor processes in the body. Characteristics of anticancer substances in food are presented in table 1 [5].

Currently, work is underway to find vegetable raw materials that can increase the nutritional value of bakery and confectionery products, improve their quality and caloric content due to the additional introduction of high-protein products: cake and meal (FM). The introduction of flax seeds and products of their processing in the formulation of bakery and confectionery products will increase their biological value and physiological efficiency due to the content of anticancer substances, fibers, micro- and macroelements, proteins and essential amino acids. Trial laboratory baking of baguettes showed that the optimal content of linseed cake is 5% by weight of wheat flour, which allows you to get bread that meets the standards and does not require changes in technological parameters, which are set for the product without additives.

Key words: functional food products, bread, flax seeds, flaxseed cake (FC), flaxseed meal (FM).

Introduction

Bakery products are necessary for a person to ensure his health and efficiency. The range of food products, including bakery products, is constantly growing [1].

Human health is determined primarily by the consumption of products that are able to regulate physiological processes in the body. To this end, every year the raw material base of the baking industry expands through the use of various types of non-traditional raw materials, including products of flax seed processing, as a source of fats, proteins, dietary fiber. According to the latest data, in order to fully meet the needs of life, a person's diet should contain more than 20 thousand different food components of plant, animal and microbial origin. Functional foods are foods that are part of the normal human diet, which in addition to nutritional properties have the ability to positively affect certain body functions, so that their regular use reduces the risk of chronic diseases. Such products have a high biological value, i.e., have a balanced content of essential amino acids, polyunsaturated fatty acids, lipoids, polyphenolic compounds, vitamins and minerals. It is the presence of functional foods that makes it possible to ensure the normal growth and development of the human body, its health, efficiency and creative activity [2-4].
Table 1 – Characteristics of anticancer substances in food

| Group of substances | Examples of compounds or groups of compounds | The main food sources |
|---------------------|---------------------------------------------|----------------------|
| Phytosterols        | β-sitosterol, stigmasterol, campesterol       | All unrefined vegetable oils, soy, oats, amaranth; vegetables fruits |
| Isoflavones         | Ginestein, formanonetin                      | Soybeans and other legumes, sunflower seeds, dates, cabbage, hops |
| Lignans             | Matairesinol, secoisolacyresinol             | Seeds of flax, sesame, pumpkin, bran, rye, nuts, cherries, apples, parsley, carrots, garlic |

Flax seeds are characterized by a sufficient content of proteins and fat, the total amount of which is 66-68% of the total mass (chemical composition is presented in Table 2).

Table 2 – Chemical composition of flax seeds, %

| Indicators     | Contents, % |
|----------------|-------------|
| Humidity       | 9.2±0.08    |
| Fat            | 36.55±0.09  |
| Protein        | 30.65±0.22  |
| Sugar          | 4.43±0.11   |
| Hemicellulose  | 7.80±0.15   |
| Cellulose      | 13.30±0.22  |
| Ash            | 4.18±0.32   |

Flax seeds contain lignans - most of them are contained in the shell of flax seeds (800 μg / g). Lignans differ in many functional properties, such as: antiviral, antibacterial, antifungal, antioxidant (more powerful than vitamin E), phytoestrogenic and oncoprotective. The human intestinal microflora converts plant lignans into two substances - enterolactone and enterodiol, which are means of protection against cancer [5].

Flaxseed protein has the full composition of essential amino acids for the human body, because flaxseed, which is eaten, does not require pre-heat treatment, which leads to changes in the protein molecule. In this regard, it retains its biological activity and is a valuable raw material for protein products [10].

According to the data presented in the article [11], the protein fractions of flax seeds contain a complete set of amino acids, which confirms their high biological value: arginine, leucine, valine, phenylalanine and threonine.

The experimental part

Trial laboratory baking of baguettes with replacement of wheat flour with flaxseed cake (FC) was carried out under the same conditions and analyzed in quantities of 1; 2; 3; 4; 5; 10 and 15% (Table 5) obtained samples of bread.

Table 3 – Fatty acid composition of linseed oil

| Fatty acids | Contents, % |
|-------------|-------------|
| Palmitic    | 5.0         |
| Stearic     | 3.0         |
| Arachidic   | 0.7         |
| Пальметолеїнова | 0.3       |
| Oleic       | 16.0        |
| Linoleic    | 15.0        |
| Ліноленова  | 60.0        |

Flax seeds contain the following biologically and physiologically active substances: polyunsaturated fatty acids of the ω-3 family, soluble dietary fiber in the form of mucus and lignans that have a phytoestrogenic effect. The protein content in flax seeds is in the range of 20-30%, and in the proteins themselves a small amount of lysine, but they have a high coefficient of digestibility (89.6%) and biological value (77.4%). In addition, flaxseed proteins are rich in sulfur-containing amino acids – cysteine and methionine, which have antioxidant and geroprotective properties [9].

It is known that flaxseed oil is a source of polyunsaturated essential fatty acids (PNFA) - 65-90 %, of which 55-70 % is linolenic acid, which belongs to the family ω-3, and 10-20 % - linoleic acid, ω -6. The fatty acid composition of linseed oil is shown in table 3 [8].

Table 4 – Recipe for bread samples

| Ingredient      | CI | Control | 1% FC | 2% FC | 3% FC | 4% FC | 5% FC | 10% FC | 15% FC |
|-----------------|----|---------|-------|-------|-------|-------|-------|--------|--------|
| Flour           | kg | 0.350   | 0.3465| 0.343 | 0.3395| 0.336 | 0.333 | 0.315  | 0.298  |
| Flaxseed cake   | kg | -       | 0.0035| 0.007 | 0.0105| 0.014 | 0.017 | 0.035  | 0.052  |
| Salt            | kg | 0.007   | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007  | 0.007  |
| Yeast           | kg | 0.007   | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007  | 0.007  |
| Sugar           | kg | 0.004   | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004  | 0.004  |
| Oil             | kg | 0.004   | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004  | 0.004  |
| Water (10-12 °C)| kg | 0.193   | 0.193 | 0.193 | 0.193 | 0.193 | 0.193 | 0.193  | 0.193  |
Table 6 – Estimated nutritional value of bread samples

| Sample       | Control | 1% FC | 2% FC | 3% FC | 4% FC | 5% FC | 10% FC | 15% FC |
|--------------|---------|-------|-------|-------|-------|-------|--------|--------|
| Proteins     | 7.01    | 7.08  | 7.14  | 7.18  | 7.16  | 7.11  | 7.52   | 7.81   |
| Fat          | 1.52    | 1.58  | 1.63  | 1.67  | 1.70  | 1.72  | 1.98   | 2.21   |
| Carbohydrates| 47.36   | 46.80 | 46.15 | 45.34 | 44.22 | 43.12 | 40.80  | 38.23  |

Table 7 shows the estimated nutritional value of bread samples. Provided that the nutritional value of the components per 100 g is as follows: wheat flour h/g - proteins 10.3, fats 1.1 g, carbohydrates 70.0; LV - proteins 25.5 g, fats 10.0 g, carbohydrates 12, 0; salt and water - proteins 0 g, fats 0 g, carbohydrates 0 g; yeast - proteins 12.7 g, fats 2.7 g, carbohydrates 8.5 g; sugar - 0 g of proteins, 0 g of fats, 99.9 g of carbohydrates; oil - proteins 0 g, fats 99.9 g, carbohydrates 0 g.

As the FC content increases, the protein content increases, the carbohydrate content decreases, the fat content and the amount of unsaturated fatty acids increase. This changes the ratio of various carbohydrates and fatty acids in fats, amino acids in proteins. With increasing FC content, the amount of unsaturated fatty acids increases.

Table 7 shows the caloric content of bread samples containing FC.

The introduction of FC reduces the caloric content of the finished product and improves its nutritional value due to unsaturated fatty acids, fiber, vitamins and minerals contained in the cake.

Table 8 shows the characteristics of bread samples.

According to GOST 27842-88 all samples almost correspond to norms. There should have been no cracks [13].

Table 9 shows the results of determining the moisture content of bread samples. The results show Figure 1 that the moisture content of bread increases slightly with increasing FC content, which is due to the high water holding capacity of flax cake.
Table 9 – The results of determining the moisture content of bread samples

| Sample | Control | 1% FC | 2% FC | 3% FC | 4% FC | 5% FC | 10% FC | 15% FC |
|--------|---------|-------|-------|-------|-------|-------|--------|--------|
| Humidity, % | 42.49 | 42.51 | 42.74 | 42.81 | 43.3  | 43.54 | 44.76  | 44.76  |

Table 10 – The results of determining the acidity of bread

| Sample | Control | 1% FC | 2% FC | 3% FC | 4% FC | 5% FC | 10% FC | 15% FC |
|--------|---------|-------|-------|-------|-------|-------|--------|--------|
| Sourpuss, % | 0.84  | 0.95  | 0.95  | 0.95  | 1.05  | 1.16  | 1.16   | 1.27   |

According to GOST 27842-88, the moisture content of wheat bread (from high-grade flour) should not exceed 44% [13]. Samples for the introduction of FC up to 5% inclusive meet the norm, and with the subsequent introduction of the FC humidity is slightly above normal.

The acidity of bread samples was also determined, the results of the study are shown in table 10 in figure 2.

Total acidity is characterized by the total content of acids and acid-reactive substances. The acidity of bread is due to the presence in it mainly of lactic and acetic acids, which are formed during the fermentation of the dough [14]. According to the results of determining the acidity, we can conclude that the introduction of FC has almost no effect on the acidity of bread. All samples meet the acidity standards in accordance with GOST 27842-88 (acidity for wheat bread should not exceed 3 degrees [13]).

According to the obtained characteristics of the experimental samples of bread, the optimal content of FC is 5% by weight of flour in the recipe. Studies have shown that the addition of FC in the optimal concentration reduces the caloric content of bread and improves its nutritional value due to unsaturated fatty acids, fiber, vitamins and minerals contained in flaxseed meal.

Conclusions

Bakery products are necessary for a person to ensure his health and efficiency. The range of food products, including bakery products, is constantly growing. To address this need, flax seeds and products of their processing are introduced into the recipe of bakery and confectionery products, which will increase their biological value and physiological efficiency.

Flax seeds contain anticancer substances, fibers, micro- and microelements, proteins that are necessary for the functioning of the body, as well as essential amino acids that affect the assimilation of the product by the body.

According to the results of the experiment, it can be argued that the introduction of FC in quantities not exceeding 5% by weight of wheat flour produces bread that meets the standards and does not require changes in technological parameters set for the product without additives.

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ОПТИМІЗАЦІЯ СКЛАДУ І ВЛАСТИВОСТЕЙ ХЛІБОБУЛОЧНИХ ВИРОБІВ

Анотація
Стаття присвячена вивченню властивостей хлібобулочних виробів, зокрема вибору оптимальної концентрації зерна в багетах з метою забезпечення максимальної калорійності. Відомо, що хлібобулочні вироби необхідні людині для забезпечення її здоров'я та працездатності. Асортимент харчових продуктів, зокрема хлібобулочних виробів, необхідний людinsk на збереження здоров'я та працездатності.

В статті представлено результати оптимізації складу і властивостей хлібобулочних виробів, зокрема вибору оптимальної концентрації зерна в багетах з метою забезпечення максимальної калорійності. Відомо, що зернові продукти необхідні людині для забезпечення її здоров'я та працездатності. Асортимент харчових продуктів, зокрема хлібобулочних виробів, необхідний людinsk на збереження здоров'я та працездатності.

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