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Bread with sesame seeds for gerodietetic nutrition

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Abstract

This article substantiates and experimentally confirms the composition of the recipe of bakery products for heroic nutrition based on the use of sesame flour and natural milk whey, allowing to obtain a bread with high consumer properties. By chemical composition the developed product contains 60.1 g of protein and carbohydrates, 5.0 g of fat and 1.7 g of ash. The protein part is represented by all essential amino acids, the content of which is higher than in the control sample. Vitamin composition is dominated by vitamin PP (4.42 mg/kg), folic acid (25.36 mg/kg) and riboflavin (3.14 mg/kg). The content of mineral substances in the developed bread exceeds the content of mineral substances in the control sample. The production of bread according to a recipe with the addition of sesame flour and natural milk whey allows to obtain bread with high nutritional and biological value.

Key words: sesame seed, bread porosity, bread crumb, gerodietetic nutrition, whey, food value

Introduction

Nutrition is one of the most important determinants of public health. A healthy diet contributes to the prevention of various diseases, prolongs people's lives and improves their ability to work. Bread has always occupied a special place in the diet of the population of Kazakhstan, because bread is the product of daily consumption [1].

However, traditional bread varieties have no therapeutic effect on the human body due to the lack of biologically active additives, imbalance of proteins and carbohydrates [2]. The study of public health revealed a significant number of people who needed a dietary nutrition. In gastroenterology diet is one of the main therapies for stomach ulcer, chronic gastritis, etc. From this point of view, it is promising to create special-purpose bakery products with prophylactic properties due to the introduction of various additives into the recipe [3].

It is not a secret that with age, a person's physiological transformation takes place, the need for energy and other substances changes, and therefore it should be taken into account in the diet. Bread products provide about one-third of the human energy requirement. In addition, regular consumption of bread plays a very important role in the physiology of nutrition, because bread makes the food consumed favorable consistency and structure, contributing to the most efficient operation of the digestive tract and the most complete wetting of food with digestive juices [4, 5].

The use of non-traditional sources of food materials in bakery and confectionary production is a perspective direction. Partial replacement of basic ingredients will make it possible to enrich finished products with fat-soluble vitamins A, D and E, vitamins of group B, mineral substances and dietary fibres [6, 7].

Sesame seed products are promising plant ingredients for developing functional food products. The most valuable substance contained in sesame is sesamine, which is a powerful antioxidant. Sesamine - an excellent tool for the prevention of cancer. It reduces blood cholesterol levels and improves nails and hair [8]. Sesame seeds also include carbohydrates, amino acids, proteins and vitamins A, B, C and E. Sesame seeds also contain a lot of calcium, potassium, magnesium, iron, phosphorus, phytin, which is responsible for the mineral balance of the body, riboflavin and thiamine. Thiamine helps to normalize metabolism and improve the nervous system [9].

The aim of the work was to study the nutritional and biological value of baton with the addition of sesame flour and natural whey as an ingredient.

Materials and methods

The method includes mixing dough from wheat flour, baked pressed yeast, table salt, dough fermentation, cutting, proofing dough pieces and baking bread. When dough is mixed into wheat flour, grated sesame seeds are added in an amount of 10.0 % to the mass of the flour and milk natural whey in an amount of 30.0 % to the mass of the flour. Knead dough at the following content of the formulation components, kg per 100 kg of flour:

First grade wheat flour - 100.0,
wiped sesame seeds - 10.0%,
bakery yeast pressed -5.0,
table salt - 1.5,
natural milk whey - 30.0,
water - by calculation up to dough humidity 45,5-46,0 %.

Determination of bread porosity

Bread porosity is determined by using the Zhuravlev device which consists of the following parts:

a) a metal cylinder with an inner diameter of 3 cm and a pointed edge on one side;

b) wooden sleeve;

c) a wooden or metal tray with a transverse wall and a slot with 1.5 cm deep positioned at a distance of 3.8 cm from the wall [10].

A slice of bread with a width of at least 7 - 8 cm is cut from the center of the bread. From the crumb of the piece at a distance of at least 1 cm from the bread heel, the device is dredged with a cylinder. The sharp edge of the cylinder is pre-lubricated with vegetable oil. The cylinder is penetrated into a piece of crumb by rotation. The cylinder filled with the crumb is placed on the tray so that its rim fits snugly into the slot on the tray. Then the bread crumb is pushed out of the cylinder with a wooden sleeve for 1 cm and cut off at the edge of the cylinder with a sharp knife. A cut off slice of crumb is removed. The crumb left in the cylinder is pushed out to the wall of the tray and also cut off at the edge of the cylinder. To determine the porosity of wheat bread, 3 cylindrical cavities of 27 cm^3 each are made. The cut-off slices of the crumb are weighed with an accuracy of 0.01 g [11].

The bread porosity is calculated by Equation 1:

$$x = \frac{(V - \frac{G}{p})}{V} \times 100 \quad (1)$$

where: V — total volume of cut-off crumbs, cm^3; G — weight of cut-off crumb, g; p — density of bread.

Determination of acidity

Bread acidity depends on the acidity of the flour from which it is baked. In addition, during the fermentation of the dough, lactic and acetic acids are also formed. The presence of organic acids in bread gives a taste and dietary value.

1. To determine the acidity, 25 g of crushed crumb is placed in a dry wide neck bottle (500 ml) with a well-fitted stopper.
2. A volumetric flask (250 ml) is filled with distilled water and ¼ is poured into a bottle with crumb.
3. The crumb is mixed with glass rod with a rubber into smooth homogenous paste, periodically adding distilled water.
4. The bottle is closed with the stopper and shaked vigorously for 2 minutes, then let rest for 10 minutes.
5. After this, the bottle is shaken again and left for 8 minutes.
6. The pooled top layer of liquid is poured into a dry beaker through gauze. Then 50 ml of liquid is pipetted into a 100 ml flask, 3 drops of phenolphthalein are added and then titrated with 0.1 N sodium hydroxide solution until slightly rosy coloring [12].

Acidity (X) is calculated according to Equation 2:

$$X = \frac{V \cdot V_1 \cdot a}{10m \cdot V_2} \cdot K \quad , (2)$$

V – volume of 0,1 mole/dm^3 molarity of sodium hydroxide solution or potassium hydroxine, used during the titration of the test solution, cm^3;
V_1 – volume of distilled water required for acid extraction from the tested sample, cm^3;
α - conversion factor for 100 g of sample;
K - coefficient of correction of sodium hydroxide or potassium hydroxine to the 0.1 mole/dm^3 solution

1/10 - coefficient of correction of sodium hydroxide or potassium hydroxine of 0.1 mole/dm^3 molarity to 1.0 mole/dm^3.
m- weight of sample, g;
V_2 - volume of test sample, cm^3.

Results and discussion

The quality of the bread covers a number of its characteristics. The overall assessment of consumer properties of the developed product by the set of organoleptic, physico-chemical indicators is given in tables 1 and 2. The condition of the crumb is characterized by mixing state, baking, elasticity, and porosity. Bread crumbs should not have lumps of mixed flour and pieces of salt. These impurities cause an unpleasant sensation when chewing bread and worsen the colour of the crumb. The bread crumb should be completely baked, not sticky and not wet to the touch [13, 14].

Table 1 – Organoleptic indicators of bread

Indicator	Description
Appearance: shape and surface	elongated shape
Color	Light yellow
Crumb state	Baked, elastic, not moist to the touch
Taste and smell	Peculiar to this type of products without foreign taste and smell

Table 2 - Physico-chemical indicators

Indicator	Value
Moisture, %	35
Porosity, %	73
Acidity, °T	3.0

The result revealed that the loaf was in accordance with the normative and technical documentation. The food and biological value of bakery products of batons for heroic nutrition was studied. The results are given in Table 3.

Table 3 – Chemical composition of bread

Indicator	Quantity, g
Protein + carbohydrate	60.1
Fat	5.0
Ash	1.7
Water	35

The developed product is not inferior in nutritional value to the existing products in content of nutrients. Biological value reflects the quality of proteins in the product, their amino acid composition. In a broader sense, this concept also includes the content of such vital biologically active substances as vitamins, macronutrients and trace elements.

The amino acid composition of a loaf for gerodietetic nutrition is given in Table 4.

Table 4 – Amino acid composition of bread, mg/100g

Amino acid	Control sample	Developed bread
Tryptophan	83	124.54
Lysine	165	276.50
Methionine	117	168.92
Valine	330	462.23
Threonine	213	310.35
Leucine	553	766.52
Isoleucine	295	397.25
Phenylalanine	395	500.15

According to the obtained data, the prepared loaf contains more essential amino acids than the traditional loaf. The research results show that the developed loaf is a nutritionally complete food product.

The findings of the study of vitamin composition in loaf is shown in Table 5.

Table 5 – Vitamin composition of bread, mg/kg

Vitamin	Content

PP	4.42
B_1 (thiamine)	0.26
B_2 (riboflavin)	3.14
B_5 (pantothenic acid)	0.35
B_6 (pyridoxine)	0.15
B_9 (folic acid)	25.36

The loaf is rich in vitamins, which plays a significant role in human nutrition. Minerals do not have an energy value, but are essential for the vital functions of the body. The results of the determination of mineral elements are given in Table 6.

Table 6 – Mineral composition of bread,

Mineral	Control sample	Developed bread
Sodium (Na)	10.7	18.2
Magnesium (Mg)	3.3	12.6
Aluminum (Al)	-	14.2
Silicium (Si)	4.4	7.74
Phosphorus (P)	5.4	15.8
Sulphur (S)	1.9	11.2
Chlorium (Cl)	2.2	19.4
Potassium (K)	1.6	14.3
Calcium (Ca)	2.4	8.57

As can be seen from the table, the content of mineral substances in the developed loaf exceeds the content of mineral substances in the control sample.

The purpose of the study of loaf on the microbiological indicators was to determine the presence of the causative agent of potato disease. The results of studies did not reveal a B.mesentericus crop, which suggests that the loaf will not be subject to microbiological damage, namely potato disease, during storage and sale.

The content of heavy metals in the loaf is given in Table 8.

Table 8 – Concentration of heavy metals in bread, mg/kg

Heavy metal	Concentration	MAC
Lead	Not detected	0.35
Arsenic	Not detected	0.15
Cadmium	0.0002	0.07
Mercury	Not detected	0.015

The results of research showed that the content of heavy metals is very low and therefore the products are not dangerous for human health.

The specific activity of gamma emitting radionuclide cesium-137 was analyzed to determine the content of radioactive substances in the loaf. From a radiation safety point of view, the developed product poses no threat to human health. The standard regulates the maximum allowable concentration (MPC) of radioactive element ^{137}Cs not exceeding 40 Bq/kg of the product. Even traces of radiation are not found in developed loaf at all.

As a result of the conducted researches the recipe and the method of production of a loaf for gerodietetic nutrition was developed. The developed recipe of loaf is a confirmation that the use of sesame flour, natural milk whey increases the biological and nutritional value.

The new product makes it possible to fill the deficit of minerals in the body of elderly people and related health problems, improve digestion, remove toxins from the body. The use of yeast and whey is an effective and safe way to prevent microbiological deterioration of bread during storage.

Conclusion

Production of bread according to this recipe allows to improve the quality of finished products by increasing food and biological value, reduce the energy value, increase the yield of bread, increase the period of freshness preservation by slowing down the process of hardening, expand the range of products of gerodietetic direction. The production of bread according to a recipe with the addition of sesame flour and natural milk whey allows to obtain bread with high nutritional and biological value.

References:

1. Altaibaeva, Z., Bauer-Kenzhebolatova, M., Zhaltyrova, O. Development of the flour-milling industry in the republic of Kazakhstan in modern times (2016) International Journal of Economics and Financial Issues, 6 (2), pp. 1-8.

2. Kablikhin S.I. Application of unconventional raw materials in bakery, flour, confectionery and pasta products. Moscow: Central Research Institute of Bread Products. - – 1992. - №3, p. 43-49.

3. Smolnikova, F., Moldabayeva, Z., Kenijz, N., Burakovskaya, N., Shadrin, M., Bykov, V., Mnatsakanian, A., Sepiashvili, E., Grunina, A., Ponomareva, L. Effect of food additives on physical and chemical properties of dietary salt free bread (2019) International Journal of Recent Technology and Engineering, 8 (3), pp. 5939-5941.

4. Kulushtayeva, B., Nurymkhan, G., Burakovskaya, N., Shadrin, M., Smirnova, T., Sagina, O., Mirgorodskaya, M., Smirnov, S. Physical and chemical profile and food safety of gluten free bread (2019) EurAsian Journal of BioSciences, 13 (2), pp. 1081-1087.

5. Kalinina I.V., Naumenko N.V., Feklicheva I.V. Formation of Baked Goods Advantages by Making Additional Raw Materials. Bulletin of the South Ural State University. Ser. Food and Biotechnology, 2015, vol. 3, no. 2, pp. 10–17.

6. Smolnikova, F., Tokhtarov, Z., Kenijz, N., Nelyubina, E., Grigoryants, I., Bobkova, E., Orlovtseva, O., Konobeeva, A., Nikolaeva, N. Technological process of germination of wheat grain under the water tincture of aloe and its physical-chemical properties (2019) International Journal of Innovative Technology and Exploring Engineering, 9 (1), pp. 184-187.

7. Camel Lagnika, Paul A.F. Houssou, Valere Dansou, Abel B. Hotegni, Abdou Madjid O. AMOUSSA, Flora Y. Kpotouhedo, Sanni A. Doko and Latifou Lagnika, 2019. Physico-Functional and Sensory Properties of Flour and Bread Made from Composite Wheat-Cassava. Pakistan Journal of Nutrition, 18: 538-547.

8. Anilakumar, K. R., Pal, A., Khanum, F., & Bawa, A. S. (2010). Nutritional, medicinal and industrial uses of sesame (Sesamum indicum L.) seeds-an overview. Agriculturae Conspectus Scientificus, 75(4), 159-168.

9. https://www.elle.ru/stil-zhizni/food/poleznyie-svoystva-kunjuta/

10. Kulushtayeva, B., Nurymkhan, G., Smolnikova, F., Okuskhanova, E., Kozubayeva, L., Abilova, M., Khayrullin, M., Kisimov, B. Technology of production, nutritional value and food safety of gluten free bread (2019) International Journal of Recent Technology and Engineering, 7 (6), pp. 1338-1344.

11. National Standard GOST 5669-96. Bakery products. Method for determination of porosity

12. Skuratovskaya OD (2001) Control of product quality by physico-chemical methods. Flour confectionery products. Moscow: DeLi print.

13. Kulushtayeva, B., Rebezov, M., Igenbayev, A., Kichko, Y., Burakovskaya, N., Kulakov, V., Khayrullin, M. Gluten-free diet: Positive and negative effect on human health (2019) Indian Journal of Public Health Research and Development, 10 (7), pp. 889-892.

14. Magomedov, G.O., Ponomaryova, E.I., Voropaeva, O.N., & Kuznetsova, I.V. (2009). Study of Changes in the Relationships between Forms of Moisture Bonding in Bread Crumb and Flour Composite Mixtures. Storage and processing of agricultural raw materials, (3), 26-27.