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Preparation Of Bread By Using Mix Of Gluten Free Flours And Various Hydrocoloids

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Abstract: Three types of flours - from rice, millet and chickpeas, which are found to be mixed in a certain proportion, are selected and analyzed as a suitable raw material for the production of quality gluten-free bread, bakery and confectionery products with pleasant taste and aroma. The chemical composition and energy value of the mentioned flours and ready-made bread as well as the rheological properties of the gluten-free dough obtained were determined. Lack of gluten makes the doughs sticky, non-elastic, with low stretchability and hardness, without mold resistance.

Unique formula formulas have been created with a mix of the three types of flour and the involvement of various hydrocolloids - carboxymethylcellulose, guar gum, xanthan and beta-glucans to produce gluten-free bread. Gluten content in flour and bread is below 20 mg / kg, which according to the Codex Alimentarius identifies them as gluten-free and suitable for consumption by people with specific health needs. The finished product is characterized by objective methods and organoleptic, and it is established that the guar gum and beta-glucan added bread has the largest volume, well-developed, rising medium and lowest energy value. The three types of bread have a high ash content (from 2.15 to 2.78%). they are enriched with mineral substances.

Keywords: rice, millet, chickpeas, flours, gluten-free bread, additives, mix, hydrocolloids

1. INTRODUCTION

In recent years, demand for gluten-free products has increased, as the number of people suffering from celiac disease (intolerance to gluten) has steadily increased.

Gluten proteins have a unique composition with approximately 15 % proline and 35 % glutamine residues that limit proteolysis from gastrointestinal enzymes, thus generating toxic peptides (1). When prolamins from gluten-containing cereal raw materials are ingested by a person with celiac disease, these proteins damage the lining of the small intestine, leading to nutrient absorption.

More methods based on the principle of electrophoresis, liquid chromatography and immunochemical reactions are used for the analysis of cereal proteins.

Celiac disease is an autoimmune disease (enteropathy) that is triggered by ingestion of gluten into genetically susceptible individuals. The only safe and effective treatment for those suffering from celiac disease is lifelong avoided foods containing gluten (2). This problem was studied in Bulgaria in 1982, when scientists developed a recipe and technology for the production of low-protein and gluten-free bread based on corn starch. The gluten-free bread is enriched with the addition of dry milk and soy flour, which greatly increases preservation of freshness during storage. Pregelatinized or pre-steamed starch is used as a binding additive in the manufacture of gluten-free bread (3).

For production of gluten-free foods, other raw materials that are grown in different regions of the world can be used. Grain-free cereal foods are: millet (e.g., *Panicum miliaceum*); rice (*Oryzae sativa*) and maize (*Zea maize*). They are used to produce bread, bakery and confectionery. Chickpeas is a gluten-grain-free culture used to enrich flour. Gluten-free pseudo-cereal foods are: *Amaranthus hypochondriacus*; buckwheat (*Fagopyrum*

esculentum) and *Chenopodium quinoa*. *Manihot esculenta* is a tropical bush, an important root crop.

The listed raw materials are gluten-free foods that do not cause allergies to patients with celiac disease. *The admissible content of gluten in these foods according to Codex Alimentarius is below 20 mg/kg.*

Lack of gluten hinders bread technology with good quality and organoleptic performance. For this reason, structuring hydrocolloidsorated into the recipe. Emulsifiers are used to improve the quality and rheological properties of low-gluten bakery products (4, 5). In the case of food production, it is necessary in certain cases to change their rheological properties and to obtain the desired structure. Additives are used for this purpose. In the food industry, gelling agents, thickeners and structural components of gluten-free textures and their formation are used predominantly water-soluble polysaccharides which are used in the hydrocolloid group – xanthan, cellulose, pectins, β-glucans, guar gum and their mixtures (5, 6, 7).

It has been found that gluten-free products have a lower fiber content than gluten-containing products. The chemical composition of these foods has a lower nutritional value than traditional foods. Therefore, studies have been conducted on the use of food and dietary supplements in production.

2. METHODS

2.1. Organoleptic assessment

Organoleptic evaluation of the raw materials – appearance, color, taste, aroma (8). The breads developed were organoleptically evaluated on the 9-th Bald Hedonic Scale (9).

2.2. Physico-chemical methods

Determination of the rheological properties of the dough (10).

Determination of the amount of gluten with R5 ELISA RIDASCREEN (11)

Determination of total protein content – Kjeldahl method (12).

Determination of fat content "Soxtec" (13).

Determination of total ash content (14).

Determination of Fiber Content (15).

Energy value of 100 g of product, kcal/100 g – calculation based on chemical composition by the formula: Energy = (% protein x 4.1 + % carbohydrate x 4.1 + % fat x 9.1 + % fiber x 2).

The non-nitrogenous extract content is calculated indirectly by the formula:

Carbohydrate = 100 - (moisture + fat + protein + fiber + ash), %

The analyzes were carried out at the Central Grain and Feed Grading Laboratory at the Bulgarian Food Safety Agency – Sofia, in the Institute of Animal Breeding Sciences – Kostinbrod and Institute of Cryobiology and Food Technologies- Sofia.

3. EXPERIMENTAL PART

To conduct experiments, the main purpose of which is to obtain quality gluten-free bread, a suitable combination of three types of flours - rice, millet and chickpeas is used as the main raw material. The following additional ingredients and additives are also included in the formulation: corn starch, crystalline sugar, cooking salt, dry yeast, potable water, carboxymethylcellulose, guar gum, and xanthan gum and beta-glycan.

Preliminary preparation of the hydrocolloids carboxymethylcellulose, guar gum, and xanthan gum consists in hydrating them with 50 ml of 38 ° C drinking water for 15 minutes.

Of all the raw materials in the formulation, dough is mixed with the single-phase method. The fermentation was carried out in a thermostat for 35 minutes at 30 ° C, after 15 minutes the dough was mixed. The final fermentation of the dough is 25 minutes at 30 ° C. The dies are formed by placing them in molds as they have low mold resistance due to the lack of gluten. It is difficult to form dough, it spills.

Bake is done for 35 minutes at 200 ° C.

Analyzes were carried out to determine the chemical composition and the energy value of the starting flour and the finished bread. The rheological properties of the test are determined. Formulas have been developed and gluten free bread is obtained. Bread is intended for consumption by people with specific health needs.

4. RESULTS

4.1. Physico-chemical composition of the gluten free flours

Table 1 presents the physico-chemical composition of the flours used for incorporation into the formula for the production of gluten-free bread intended for specific health needs.

Table 1. Physico-chemical composition of the gluten free flours

Type of flour	Moisture %	Protein %	Fat %	Fiber %	Ash %	Carbohydrates %	Gluten mg/kg	Energy kcal/100 g
Rice	11.90	6.72	0.92	1.40	1.00	78.06	14.90	358.9
Millet	11.65	13.68	2.24	3.40	0.58	68.45	19.90	363.9
Chickpeas	10.20	25.68	5.81	4.70	3.39	50.22	16.80	373.4

The highest protein content is chicken flour (25.68%), and the lowest - rice flour (6.72%), the difference being significant. The same is true for the fat in the chicken flour in the quantity of 5.81% and in the flour of rice - 0.92%. Fiber content ranges from 1.40 to 4.70%, with rice flour at its lowest, and highest in chaffinch. As for the ash content, it is highest in chickpeas flour (3.39%), which implies mineral enrichment, and the lowest in millet flour (0.58%).

The highest BOV content was found in rice flour (78.06%), respectively, the lowest in chicken flour (50.22%).

The gluten content of rice flour is lowest (14.90 mg / kg) and in millet flour the highest (19.90 mg / kg). The gluten values in the three types of flour are below 20 mg / kg, according to the Codex Alimentarius (118/79, amendment 1983 and 2008) they are defined as gluten-free.

The three types of flour have a fairly equal energy value.

PREPARATION OF GLUTEN-FREE BREAD

4.2.Recipe for dough texture

Table 2 presents the recipe for dough texture for the production of gluten-free bread intended for specific health needs.

Table 2. Recipe for dough mixing

raw materials and additives	Quantity,%		
	Bread-mix 1	Bread-mix 2	Bread-mix 3

Rice flour	78.6	78.6	78.6
Millet flour	16.1	16.1	16.1
Chickpeas flour	5.3	5.3	5.3
Dry yeast	2.1	2.1	2.1
Salt	2.9	2.9	2.9
Sugar	7.1	7.1	7.1
Maize starch	7.1	7.1	7.1
Carboxymethylcellulose	1.1	-	-
Guar gum	-	1.1	-
Xanthan gum	-	-	1.1
Beta-glycans	-	0.4	0.4

4.3. Characteristics on the dough texture

An analysis of the rheological properties of gluten dough texture was performed on the aerograph, where it was found that the lack of gluten leads to the absence of elasticity (0 %) and resistance (0 %), as the stretch ability (7.4 mm) and the hardness of the test are very lower (11 mm H_2O).

Mix 1 – the dough is of normal texture, the color is creamy due to the ingredients.

Mix 2 – the dough is of normal texture, the color is creamy, due to the ingredients, the most sticky compared to mix 1 and mix 3, rushing.

Mix 3 – the dough is of normal consistency, the color is creamy, the best is compared with mix 1 and mix 2.

The dies are placed in molds because the die-hardness of the gluten-free dough is weak, it is difficult to form a dough and spills. The fermentation was carried out for 15 minutes, mixing and another 20 minutes. The final fermentation is 25 minutes. Baking was done for 35 minutes at 200 ^{o}C.

4.4. Characteristic and sensory evaluation of bread

Figure 1. Cutting of bread. From left to right: mixs 1, 2 and 3

Figure 1. presents the cutting of gluten-free bread intended for specific health needs.

Mix 1 – rectangular bread with regular shape and cracking of the upper bark. The color of the bark is a golden to a reddish tinge of normal thickness. The color of the medium is creamy. The porosity is small, in places with large single blasts. The taste is sweet. The flavor is typical of this type of bread.

Mix 2 – a rectangular bread roll with a regular shape and tearing the top surface. The top bark is golden to reddish, with normal thickness, no burns. The color of the medium is creamy. The medium is well baked under pressure to restore its original volume. The porosity is thick-walled with big balls, more developed than mix 1 and mix 3. The taste is sweet. The aroma is typical and typical of the composition of the bread.

Mix 3 – rectangular bread with correct shape. The top bark is golden, with normal thickness, no burns. The color of the medium is creamy. The medium is underdeveloped,

under pressure it is difficult to restore its original volume. The porosity is thick, compact. The taste is sweet, without flavor, when chewing gums. The fragrance is pleasant and characteristic of the composition of the bread.

Table 3. Quality assessment of bread

Type of bread	Mass g	Specific volume cm^3/g	Volume cm^3	Length mm	Height mm	Width mm	Moisture of the medium %
Mix 1	236.9	1.58	375	117	43	75	38.81
Mix 2	253.2	1.51	385	121	45	74	41.97
Mix 3	255.0	1.17	300	117	45	71	41.18

The weight ranges from 236.9 to 255.0 g, the heaviest is mix 3, the lightest mix 1. The specific volume varies from 1.17 to 1.58 cm^3/g, with mix 3 being the lowest, and the mix 1 is the highest.

In terms of volume, mix 3 is the lowest (300 cm^3) and mix mix 2 is the highest (385 cm^3). The moisture content of mix 2 is the highest (41.97 %), respectively, with mix 1 being the lowest (38.81 %).

Table 4. Physico-chemical composition of the gluten-free bread

Type of bread	Gluten mg/kg	Protein %	Fat %	Fiber %	Ash %	Carbohydrate %	Energy kcal/100 g
Mix 1	14.50	6.63	3.17	2.60	2.78	46.01	249.9
Mix 2	14.50	6.72	2.92	2.49	2.15	43.75	238.5
Mix 3	14.50	7.40	2.67	2.67	2.34	43.74	239.3

The table shows that the gluten content of the three types of bread is the same (14.50 mg / kg), i.e., below 20 mg / kg, which according to Codex Alimentarius, the bread is gluten-free. With respect to proteins, the highest content is the mix of bread 3 (7.40%), and the lowest - from mix 1 (6.63%), the difference being insignificant. The highest is the fat content of the mix of bread 1 (3.17%), and the lowest is from the mix 3 (2.67%). The fiber content of the three types of bread is fairly uniform, ranging from 2.49% for the mix mix 2 to 2.67% for mix 3. As for the ash content, it is the highest in mix 1 (2.78%) bread , and lowest - for mix 2 (2.15%), which determines the resulting three types of bread as mineral enriched.

The highest content of BEB was found in the bread of mix 1 (46.01%), and the content of BEV in the mix of bread 2 and 3 is slightly lower (by about 2.30%).

The energy value of the three gluten-free bread is comparatively the same and ranges from 238.5 to 249.9 kcal / 100 g of product.

5. CONCLUSION

For the production of gluten-free bread and pasta, it is advisable to use a mix of gluten-free flour as the main raw material, as the mixes are characterized by better baking properties. The gluten-free products are usually prepared with an increased amount of cooking salt, as the doughs are not mold-resistant. The starches that are used in the production of gluten-free bread and bakery products are poor in sugars and enzymes. Therefore, the amount of sugar in these assortments is increased in order to ensure a rapid and easy flow of the fermentation process. The addition of the hydrocolloids carboxymethylcellulose and guar gum results in an improvement in the quality of the bread obtained (mix 1 and mix 2 bread). The quality of

Bread Mix 3 (with xylan gum hydrocolloid) is unsatisfactory. This necessitates an increase in the amount of starch in the formula for the production of bread of mix 3.

6.CONCLUSIONS

1. Flour from rice, millet and chickpeas has been found to contain less than 20 mg / kg of gluten, which is why they are a suitable raw material for gluten-free bread. They are rich in fiber and mineral substances, which also enriches the bread obtained. The most rich in proteins, fats, fibers and minerals is chick peas. It also has the highest energy value (373.4 kcal / 100 g).

2. Ready-to-use formula formulations for gluten-free bread are created using a mix of three types of flour and addition of structurally-forming substances - hydrocolloids carboxymethylcellulose, guar gum and xanthan gum separately. The participation of beta-glucans in mix 2 and 3 bread enhances the health benefits of the resulting bread, which can be consumed by people with specific health needs.

3. Mixed tests are sticky, non-elastic and resilient, soft and slightly stretchy.

4. Breads obtained are of relatively high quality and low energy value.

7.REFERENCES

1. Thompson, T., To Oats Belong in a Gluten-Free Diet, Journal of the American Dietetic Association, 12 (97): 1413 – 1416, 1997.
2. Thompson, T., Folate, iron and dietary fiber content of the gluten free diet. Journal of the American Dietetic Association, 1000: 1389 – 1396, 2000 .
3. Ahlborn, G.J., Pike, O.A., Hendrix, S.B., Hess, W.M., Huber, C.S., *Sensory, mechanical and microscopic evaluation of staling in low-protein and glutenfree breads. Cereal Chemistry*, 82: 328 – 335, 2005.
4. Cev, E.Z., Pascu, O. and Taban, S., Importance of duodenal biopsy during routine upper gastrointestinal endoscopy for the diagnosis of celiac disease. Journal of Experimental Medical and Surgical Research, 1: 23 – 27, 2010.
5. Popova, V., Atanasova, E., Stoyanov, H., Stanev, P., Collection of scientific papers, vol. X, Institute of Cereals and Fodder Industries at DSN "Zarneni Hrani i froteny", 89 – 95, 1982 .
6. Korus, J., Grzelak, K., Achremowicz, B., Sabat, R., Influence of prebiotic additions on the quality of gluten-free bread and on the content of inulin and fructooligosaccharides. Food Science and Technology International 12(6): 489 – 495, 2006.
7. Sivaramakrishnan, H.P., Senge, B., Chattopadhyay, P.K., Rheological properties of rice dough for making rice bread. Journal of Food Engineering 62:37 – 45, 2004.
8. BDS 15612-83- organoleptic evaluation of the raw materials – appearance, color, taste, aroma (Bg).
9. Lim, J., A. Wood, B. G., 2009. Green Derivation and evaluation of a labeled hedonic scale, Chemical Senses, 34, 739–751(En).
10. BDS EN ISO 27971:2008- determination of the rheological properties of the dough (in Bulgarian).
11. AOAC-OMA,2012-determination of the amount of gluten with R5 ELISA RIDASCREEN(in Bulgarian).
12. BDS 13490-76- determination of total protein content – Kjeldahl method(in Bulgarian).

13. BDS 1671-89- determination of fat content "Soxtec" (in Bulgarian).
14. BDS ISO 2171-1999-determination of total ash content (in Bulgarian).
15. BDS ISO 5498-1999-determination of Fiber Content (in Bulgarian).