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Using the Flour of Sorghum from Kazakhstani Varieties in the Production of Wheat Bread

[1]Moldir T. Yerbulekova, [1]Auelbek I. Iztayev, [1]Dina R. Dautkanova,
[2]Nurlan B. Dautkanov, [2]Botagoz O. Toxanbayeva and [1]Baurzhan A. Iztaev
[1]Almaty Technological University, 100 Tole Bi Street,
[2]Eurasian Technological University, 109 Tole Bi Street, 050012 Almaty, Kazakhstan

Abstract: The study presents the results of the research made on baking wheat bread from nontraditional raw materials adding flour from sweet sorghum. An amount of 15% and above reduces the resistance of the dough during kneading and increases its degree of dilution. This reduces the water absorption capacity rate of the flour by 4.0; 5.9; 12.2; compared with control sample. The baking results showed that the bread crust with sorghum flour has much color intense than control sample. As a result, we can see that the bread with 10% sorghum flour by volume on the same level with wheat bread (control sample) when cut we can observe soft crumb condition which is not jammed unlike prototypes with 20% sorghum flour. During the research, we determined the energy value of the bread with addition of sorghum flour in an amount of 10% by the weight of flour and found that the test sample contains 9% more of starch, 1.1% of sucrose than the control sample. Calorie in the prototype is 230 which is 3% less than the control sample.

Key words: Sorghum flour, nontraditional raw materials, wheat bread, control sample, kneading

INTRODUCTION

Foods an important source of energy in human life, the basis of health, one of the factors affecting its mental actions (Iztayev *et al*., 2013).

Currently, one of the directions of healthy nutrition development is the production and consumption of products of functional purpose using plant raw material which is a valuable source of vitamins, minerals, antioxidants and dietary fiber.

Today development of treatment and prophylactic products is one of the directions of innovative development of food technologies which are indispensable for the search for new additives that can enrich products of useful substances with different chemical nature (Izembayeva *et al*., 2014).

The use of non-traditional vegetable raw materials allow not only to improve the quality, nutritional value and expand the range of food products but also to rationalize the usage of local resources. One of the sources of non-traditional raw material in the production of wheat bread is the flour from sorghum gran of domestic breeding (Efremova, 2014).

A wide variety of non-wheat grains including rice, sorghum, maize, tef and buckwheat are used in the production of non-wheat breads. Sorghum (*Sorghum bicolor* L. Moench) is one of the most important crops in Africa, Asia and Latin America. Traditionally, sorghum has been consumed as porridge, pancakes, flat bread, couscous, alcoholic and non alcoholic beverages. Sorghum is a significant source of polyamines (Paiva *et al*., 2015).

Sorghum is a gluten free grain that has potential to be used as an alternative to wheat flour for the Celiac Sprue Market (Liu *et al*., 2012).

Now a days, society is concerned about the food processing industry: there is lack of products made from natural raw materials and the products available do not meet the requirements for the amount of minerals and vitamins.

To supplement the diet with necessary elements, people use dietary supplements and vitamins. Sorghum flour provides the human with proteins which features are more favorable comparing to animal proteins. Sorghum sugar comprises sucrose, fructose, glucose, Ca, P, Mg, K, Na, Cu, Zn, Co, Mn, Fe, S, protein, all essential amino acids, vitamins B1, B2, PP, E and C. Sorghum protein reduces the level of cholesterol in blood and normalize human digestive system load. Sorghum oil contains of many essential unsaturated fatty acids (83-88%),

Corresponding Author: Moldir Yerbulekova, Almaty Technological University, 100 Tole Bi Street, 050012 Almaty, Kazakhstan

including linoleic 38-42 mg and linolenic 3-4 mg per 100 g of grain. These fatty acids are an important source of pro-prevention of atherosclerosis, heart disease and blood vessels. In addition, significant content of vitamin E in sorghum fat involves the use of this flour in human diet necessary (Petrov *et al*., 2012).

MATERIALS AND METHODS

In order to perform the research, we used Kazakhstani varieties of sorghum flour, grown in Almaty region: Kazakhstan 20 and wheat flour of Kazakhstani grades: Cessna 1 grade.

In assessing the quality of flour were determined the humidity, acidity, gluten content and its features, color, taste, smell, crunch, water absorption capacity of flour, bread organoleptic characteristics in points, porosity and volume of bread conventional techniques.

In developing recipes and cooking mode of wheat bread with sorghum flour as basis we took a cooking method of wheat bread with steam (Table 1) into the sifted mixture of wheat and sorghum flour add salt and yeast solutions. Knead the dough for 10-15 min. Fermentation test performed for 30-40 min at a temperature of 38-40°C.

Forming of the dough was carried out by hand; the work piece was weighed on the bench scales and put in greased forms for proofing. Temperature in proving cabinet is 38-40°C. After stagnant product is sent to the oven and baked at a temperature of 180-230°C for 25-30 min. For the control the bread was prepared from wheat flour first grade without sorghum flour.

Features of dough were determined an accordance with State Standard Republic of Kazakhstan 51404-99 (ISO 5530-1-97) on the Brabenders' Farinograf. During the study of the properties of dough on Farinograf Water Absorption Capacity was determined (WAC), the time formation of the dough, its stability and the degree of dilution.

Table 1: Recipes and cooking mode for wheat bread with adding sorghum flour

Name of the raw material	Control samples	Test samples with adding sorghum four in percentage to the weight of flour		
		10	15	20
Wheat flour, 1 grade	100.0	90.0	85.0	80.0
Sorghum flour	0.0	10.0	15.0	20.0
Salt	2.0	2.0	2.0	2.0
Sugar	2.3	2.3	2.3	2.3
Yeast for bakery	1.0	1.0	1.0	1.0

RESULTS AND DISCUSSION

Influence of sorghum flour Kazakhstani 20 on the features of the flour with the addition of the wheat flour on its quality indicators are shown on table defined by Farinograph and the qualitative indicators of the finished product are given in Table 2.

Adding sorghum flour to the recipe of wheat bread contributed to the change of indicators of dilution of the dough from 120-170 units device in comparison with control sample (100 units device).

The results showed that the use of sorghum flour in an amount of 15% or more reduced the stability of dough during the kneading and increased the degree of dilution. Where in reduces the rate of water absorption capacity by 4.0, 5.9, 12.2, compared to the control sample (Table 2).

The reduction in stability of the dough and the increase in degree of dilution due to the fact that the experimental dough samples contained more sugars because of using sorghum flour.

The results of effect of adding sorghum flour on qualitative indicators of bread are shown in Table 3 and Fig. 1.

Baking results showed that the crust of the bread with sorghum flour has ore intense coloring than the control sample. As a result, we can see that the bread with addition of 10% sorghum flour by volume on the level with wheat flour (control sample) when cut we can observe soft crumb condition which is not jammed unlike prototypes with 20% sorghum flour.

Bread, obtained with the addition of sorghum flour due to the contained amino acids, vitamins, minerals,

Table 2: Influence of sorghum flour Kazakhstani 20 on the features of the dough and the quality of the bread

Name of indicators	Control samples	Prototypes with addition of sorghum flour in percentage to the weight of flour		
		10	15	20
Protein content (%)	14.2	14.2	14.0	13.8
WAC (unit device)	63.4	59.4	57.5	51.2
Acidity (degree)	3.5	3.7	3.8	4.2
Humidity (%)	13.0	14.0	14.0	13.5

Table 3: Quality indicators of prototypes

Name of indicators	Control samples	Prototypes with adding of sorghum flour in percentage to the weight of flour		
		10	15	20
Volume of the bread (g/cm^3)	750.0	650.00	610.0	455.0
Appearance	4.0	4.00	3.0	3.0
Porosity (unit device)	3.0	3.00	2.5	2.5
Grade (point)	3.2	2.66	2.0	3.2

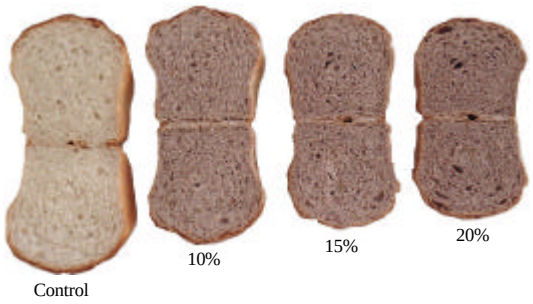

Fig. 1: Prototypes of wheat bread with addition of sorghum flour

Table 4: Physic-chemical indicators of bread

Physic-chemical indicators (%)	Control samples	Prototype with adding sorghum flour in amount of 10 (%)
Proteins	7.9	4.11
Starch	46.2	55.20
Saccharose	2.1	3.20
Fat	1.0	1.20

Table 5: The indicators of safety with norm regulation and results

Name of the indicators (units)	Norm on regulations	Actual results
Indicators of safety; toxic elements not more than (mg kg^{-1}):		
Lead	0.35	0.013
Cadmium	0.07	Not found
Arsenic	0.15	Not found
Mercury	0.015	Not found
Microbiological indicators:		
Number of mesophilic aerobic and facultative anaerobic microorganisms	1×10^3	3×10^2
Colony forming not more than (units/g):		
Coliform bacteria (cus form) in 1 g	Not allowed	Not found
St.aureus in B 1 g	Not allowed	Not found
Mold, colony forming not more than (units/g)	50	25

dietary fiber and other nutrients has a high nutritional value. On the basis of experiment, the best organoleptic characteristics during baking wheat bread were observed in the sample with 10% sorghum flour (Table 4). Porosity in the prototype with 10% sorghum flour was developed, uniform, unsealed, crumb-elastic with pleasant aroma, increased specific volume pan bread. Due to the absence of gluten in the sorghum flour, we recommend to bake the wheat bread with the addition of just 10% of sorghum flour. Availability of vitamins and minerals in sorghum flour stimulated the activity of the yeast cells, thus accelerating the process of fermentation and reducing the maturation of dough to 20 min comparing to the control sample.

In the course of study, we determined the energy value of the bread with addition of sorghum flour in an amount of 10% by weight of the flour and found that in test samples contains 9% more starch and 1.1% more Saccharose than the control sample. Calorie in test samples is 254.331 which is 9% more than the control sample. Prototypes with addition of sorghum flour were investigated for indicators of safety (Table 5).

By investigated indicators of safety we found the correspondence of prototypes of bread to regulatory requirements.

Findings: Thus, there is a possibility of using sorghum flour in production of wheat bread and its positive impact on the quality parameters of bread.

CONCLUSION

Researchers recommended to use sorghum flour in an amount of 10% by weight of the flour in production of wheat bread.

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