IRSTI 65.09.30

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https://doi.org/10.55956/WFLM8391

THE IMPACT OF BULGUR FLOUR ON THE QUALITY OF WHEAT DOUGH

Abstract. The paper is devoted to the study of the possibility of using perspective material for baking - bulgur flour, which has a valuable chemical composition, high nutritional and biological value. In the course of experimental studies, it was found that the addition of bulgur flour improves the quality of baking flour and semi-finished products. Studies of the impact of bulgur flour on the indicators of gas-forming and gas-holding capacity of wheat dough were conducted using the device Reofermentometer F3, which allows controlling the rate of pressure change of forming carbohydrate dioxide during fermentation.

Keywords: bulgur flour, bakery products, nutritional and biological value, gas-forming and gas-holding capacity.

Zhanysbek, A.Zh., Mynbaeva, A.B., Ivannikova, N.V. The impact of bulgur flour on the quality of wheat dough // Mechanics and Technology / Scientific journal. – 2023. – No.2(80). – P.80-86. https://doi.org/10.55956/WFLM8391

Introduction. Improving the technology, improvement of quality indicators of bread and bakery products are the main task for the technologist of the modern bakery enterprise. Currently, it is impossible to imagine bakery production without expanding the segment of bakery products group. This direction is very prospective in the food industry, as bread refers to socially important food products. Positive trends can be seen in the enrichment of bread with non-traditional raw material sources, specifically of plant origin. In this regard, flour derived from bulgur can be considered a very promising raw material for baking [1]. Even though recent years are characterized by intensive research of certain aspects of technology of bread preparation using non-traditional raw materials, so far only a few works are devoted to the study of special research methods of baking and rheological characteristics of dough: such as changes in pressure rate of formed carbon dioxide amount during fermentation, hydration capacity, water absorption capacity, elastic deformation indices, etc. Thus, the area of the present scientific research was the study of the effect of bulgur flour on the processes of gas formation during dough-making.

The technology of cooking bulgur allows you to save the whole clade of grain

nutrients: the full germ, endosperm, bran particles. One portion of bulgur covers the daily needs of the body in minerals and vitamins [2]. In bulgur groats, due to the heat treatment reduces the caloric content, which makes it attractive for people who adhere to the diet. Fine nutty taste will not leave indifferent connoisseurs of delicious food. Bulgur is suitable for the prevention of diseases of the cardiovascular system, diabetes, contributes to the proper operation of the gastrointestinal tract (GIT), reducing inflammation and normalizing weight, which attracts the attention of people who adhere to the right diet. According to the literature, the use of bulgur in the daily diet reduces the risk of cardiovascular disease by 20%. Compared to pureed grains, bulgur lowers blood sugar levels, thereby reducing the risk of developing type II diabetes. Bulgur has a balanced amino acid composition. Table 1 shows the amino acid composition of bulgur.

Table 1

Amino acid composition of bulgur

Amino acid	Composition,%
Tryptophan	23.8
Isoleucine	22.8
Leucine	18.0
Lysine	8.3
Methionine	10.8
Phenylalanine	13.2
Valine	22.2
Proline	28.3
Alanine	6.6
Aspartic acid	5.2
Glutamic	28.5
Glycine	14.1
Histidine	13.6
cystine	15.8
Serine	7.0
Tyrosine	8.1

In comparison to buckwheat, bulgur contains almost twice as much fiber as buckwheat and eleven times as much as rice [3]. It contains more nutrients than buckwheat, such as thiamine, folic acid and vitamin B. It also aids in digestion because it is easy to digest. Moreover, this cereal promotes the digestive process, as it is easily digested by the body. In terms of composition and properties, it is more useful than wheat flour, so it is successfully used in the preparation of products from various types of dough. At the same time products acquire a special nutty taste, attractive color and flavor. In addition, bulgur flour is used in the preparation of pancakes, porridges and ponies. Bulgur flour is made by grinding bulgur grits. Partial replacement of wheat flour with bulgur flour will improve the quality characteristics of bread, increasing the nutritional value.

Research methods and conditions. The purpose of the present study was to study the effect of partial replacement of wheat flour with different amounts of bulgur flour and the impact of such an additive on the quality characteristics of the dough. At the initial stage, the effect of added bulgur flour on the gas-forming and gas-holding capacity of baking flour was analyzed. Rheofermentometer F3 was used to register the characteristics. In accordance with the goal of the research, the

research objectives were defined: to substantiate the feasibility of using bulgur flour as a non-traditional raw material in the production of bakery products. The objects of scientific research were dough (semi-finished product) from wheat flour of the first grade, dough from a mixture of wheat flour and bulgur flour.

The investigation of the baking properties of the dough, the processes of gas formation and outgassing were studied on the device Rheofermentometer F3 by Chopen (France). The maximum height of gas formation was recorded by the pressure sensor of the rheofermentometer, and the total volumetric formation of carbon dioxide was determined by means of a pneumatic circuit, which serves to measure the increase in gas pressure. The rheofermentometer helps to establish the relationship between the fermentability of the dough and the properties of the protein carcass, which ensures that the dough retains a given shape during the baking process (maintaining the dough structure during baking) [4]. The samples undergo a fermentation process in accordance with the specified conditions of the research protocol (temperature, weight, duration, etc.). The dough is prepared in the instrument chamber. The fermentation of the dough samples takes place in the conditions determined by the chosen mode of analysis at a temperature of 30°C. A special piston is placed on the surface of the dough. A microprocessor controlled instrument monitors the progress of the dough fermentation under user set conditions (temperature, amount of dough, etc.). A plunger loaded with 500 g discs is placed on the dough and rises as the fermentation progresses. The sensor analyses the rising dynamics of the dough, thus making it possible to determine the optimum time for the fermentation, the proofing of the dough piece. The results are displayed in the form of three curves - time dependences: the dough volume, the total volume of gas emitted and the total volume minus CO_2 (measured by the absorption of alkaline solution) [5,6]. For the experiment, the recipe calculated on the basis of the unified recipe for shaped bread made of wheat flour 1st grade was taken as the basis.

Research results. Determination of the level and kinetics of gas formation was carried out directly in the samples, in the dough from a mixture of wheat flour of the first grade and bulgur flour in the percentage ratio of 10%, 15%, 20% respectively. Sample No.1 - wheat flour 90%, bulgur flour 10%. Sample No.2 - wheat flour 85%, bulgur flour 15%. Sample No.3 - wheat flour 80%, bulgur flour 20%. Table 2 presents comparative data characterizing changes in a number of indicators during fermentation and maturation of semi-finished products on the F3 rheofermentometer device.

Studying the dynamics of dough rise on the device, it was found that, the maximum height of dough rise Hm as a result of gas formation changed with an increase in the added bulgur flour. The results showed that the height of dough rise in the control sample under load was (Hm=46.1 mm), the height of dough rise at the end of the analysis (h=46.1 mm). The value of the relative decrease in the height of dough rise at the end of the analysis with respect to the maximum value is respectively (Hm-h)/Hm=0). According to the readings of the device, a decrease in the duration of maximum rise of the test to 1h 52 min (T1 = 1h 52 min) was noted. The total volume of carbon dioxide formed in the process of fermentation was 2490 ml, the volume of released CO_2 - 3 cm^3, retained in the dough - 2487 ml. Duration of maximum rise of semi-finished product T1-1h 52 min. Compared with the control sample No. 2 the height of lift under load was (Hm=26.6 mm), the height of lift of the dough at the end of the analysis (h=26.6). Sample No.2 showed an increase in the duration of maximum dough rise to 2h 01 min, according to the instrument readings (T1 = 2h 01 min). Total volume of carbon dioxide formed in the process of fermentation was 3222 ml and the volume of released CO_2 was 1 cm^3, retained in

the dough - 3221 ml. The duration of maximum rise of semi-finished product T1-2h 01 min. Analyzing the data presented in Table 2 we can conclude that the addition of bulgur flour resulted in the decrease of the dough pieces lifting height with the increase of its percentage compared to the control: for sample No.2 the value decreased by 42.3%, for sample No.3 -21.3% (the height of dough piece lifting under load was for sample №3 -36.3 mm, the height at the end of analysis (h=36.3 mm). The addition of bulgur flour in an amount of 10% to the weight of wheat flour determined the height of dough rise 14.1 mm, the value of the indicated value at the end of fermentation was 13.8 mm. The value of the relative decrease in the height of test elevation at the end of the analysis with respect to the maximum value is respectively (Hm-h)/Hm=0=2.1). The amount of formed carbon dioxide was 2850 ml, the volume of released CO_2 - 5 cm^3, retained in the test - 2845 ml. Duration of the maximum rise of the semi-finished product T1-1h 16 min. Figures 1,2 show the kinetics graphs of gas formation in semi-finished products made of wheat flour and a mixture of wheat flour and bulgur flour in different percentage ratios. According to the results of the experiment, it can be stated that the maximum duration of dough rise in all samples lies within the same limits. Analysis of the nature of the graph of the kinetics of gas formation (gas accumulation and gas release) in the tested samples of semi-finished products showed that in samples number 1, 2, 3 the maximum rise of dough was observed in 2h 30, in the control sample the maximum rise of dough - 2h 00 min.

Table 2

The main indicators of fermentation and maturation of semi-finished products

	Measurement unit	Reference sample	Sample No.1	Sample No.2	Sample No.3
Maturation of semi-finished products					
Hm	Mm	46.1	14.1	26.6	36.3
h	mm	46.1	13.8	26.6	36.3
(Hm-h)/Hm	%	0	2.1	0	0
T1	h.min	3h 00 min	2h 57 min	3h 00 min	3h 00 min
Gas formation in semi-finished products					
H'm	mm	122.2	123.5	134.5	138.5
T'1	h.min	1h 52 min	1h 16 min	2h 01 min	1h 57 min
Total volume	cm^3	2490	2850	3222	3322
Volume of emitted CO_2:	cm^3	3	5	1	2
Volume of withheld CO_2:	cm^3	2487	2845	3221	3320
Retention rate	%	99,9	99.8	100	100

Discussion of the results. On the basis of studies it has been established that replacement of wheat flour with bulgur flour contributed to increase of the volume of released CO_2, which is explained by increase of total carbohydrates at the expense of bulgur. The amount of released carbon dioxide during 3 hours of fermentation increased by 1.1...2.0 times compared to the control, which is associated with an increase in the sugaring ability of dough due to introduction of large amounts of

digestible sugars together with the addition, which may be relevant when processing wheat flour with a reduced gas-forming ability.

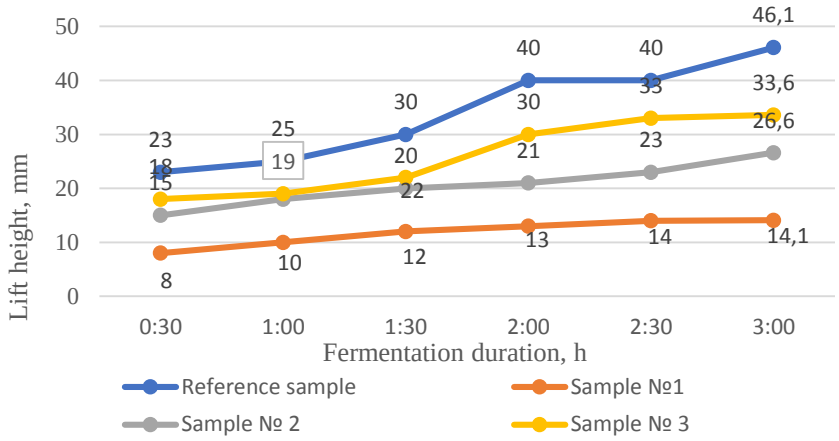

Fig. 1. Graphs of gas kinetics in semi-finished bakery products from wheat flour and a wheat flour and bulgur flour mixture in different percentage ratios

Furthermore, the addition of bulgur flour has a positive effect on the quality of semi-finished products. Bulgur, as it is known, is steamed, partially peeled from the shell and finely crushed groats, its content of gluten, "wheat protein", is almost as high, which favorably affects the structural and mechanical properties of dough by giving it elastic and elastic properties, due to the course of oxidation-reduction reactions of mutual transformations of -SH- and -SS- bonds. When bulgur flour containing a large amount of sulfur-containing amino acids is added, the flow of the reaction towards the accumulation of SS-groups is observed. Additional strong covalent bonds in the wheat gluten protein. However, the increased addition of a non-traditional raw material source, leads to weakening of the dough blank. Figure 3 shows the kinetics of gas formation. The presence of husks in the raw material source - bulgur flour provides a high content of fiber coarse fiber, which absorbs a significant amount of water.

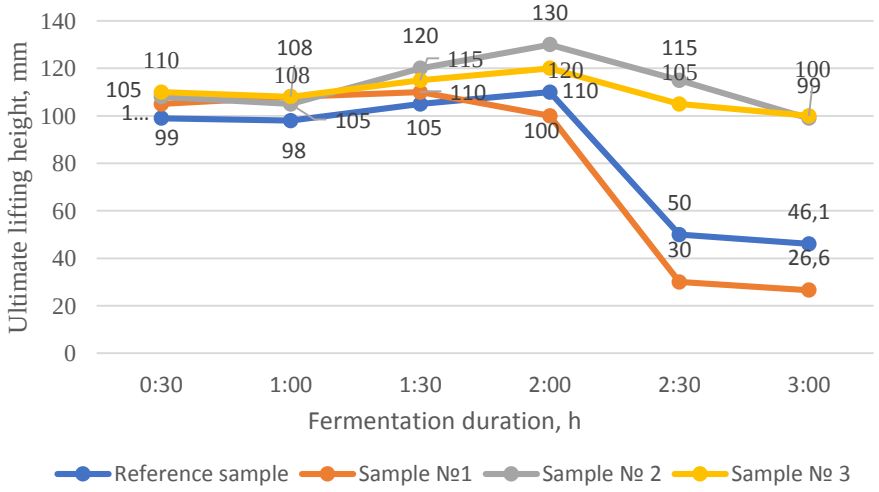

Fig. 2. Graphs of gas kinetics in semi-finished bakery products from wheat flour as well as a wheat flour and bulgur flour mixture in different percentage ratios

Based on the data of diagrams shown in Figures 1, 2 we can conclude that the introduction of bulgur flour increases the gas-holding capacity. Gas retention ability of sample No.1 increased by 14.39 % in comparison with the control, in samples No.2,3 – 29.51%, 33.49% respectively. The results of research of influence of added bulgur flour on gas-holding ability showed that its introduction leads to significant increase of carbon dioxide amount released for 3 hours of dough fermentation in comparison with the control. This is due to the presence of its own sugars in bulgur flour, which contribute to yeast activation. The total volume of carbon dioxide emitted increased when the proportion of bulgur flour in the mixture increased: 14.45%, 29.39%, 33.41%, respectively.

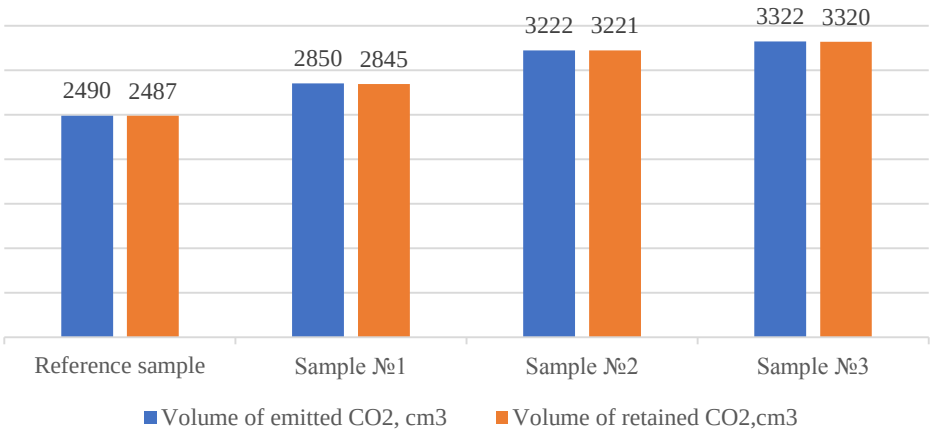

Fig. 3. Kinetics of gas formation

Conclusion. Consequently, based on the results obtained in the study, it can be argued that the addition of bulgur in the recipe of bread and bakery products significantly increases gas formation in the dough, due to the process of starch pasteurization, embedded in the technology of cooking groats. Especially relevant is the introduction, when processing flour with low gas-forming ability. The optimum dosage can be considered sample No. 2 with 15% of bulgur flour in the bread recipe. This research helped to optimize the evaluation and prediction of the quality of dough semi-finished products, to provide the intensity of fermentation of dough from a mixture of wheat flour and bulgur flour, determining the course of final proofing and quality of bread.

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Material received on 09.06.23.

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БУЛГУР ҰНЫНЫҢ БИДАЙ ҚАМЫРЫНЫҢ САПАСЫНА ӘСЕРІ

Аңдатпа. Жұмыс – нан пісіру үшін перспективалы шикізат болып табылатын, құнды химиялық құрамы, жоғары тағамдық және биологиялық құндылығымен ерекшеленетін булгур ұнын пайдалануды зерттеуге арналған. Эксперименттік зерттеулер барысында булгур ұнын енгізу нан пісіретін ұн мен жартылай фабрикаттардың сапасын жақсартуға ықпал ететіндігі анықталды. Зерттеу барысында булгур ұнының бидай ұнынан жасалған қамырдың газ түзу және газ ұстау қабілетіне әсерін ашу кезінде түзілетін көмірсу диоксиді қысымының өзгеру жылдамдығын бақылауға мүмкіндік беретін Реоферментометр F3 құрылғысы көмегімен анықталды.

Тірек сөздер: булгур ұны, нан-тоқаш өнімдері, тағамдық және биологиялық құндылығы, газ түзетін және газ ұстайтын қабілеті.

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ВЛИЯНИЕ МУКИ ИЗ БУЛГУРА НА КАЧЕСТВО ПШЕНИЧНОГО ТЕСТА

Аннотация. Работа посвящена исследованию возможности использования перспективного для хлебопечения сырья – муки из булгура, обладающей ценным химическим составом, высокой пищевой и биологической ценностью. В ходе экспериментальных исследований установлено, что внесение муки из булгура способствует повышению качества хлебопекарной муки и полуфабрикатов. Проведены исследования влияния муки из булгура на показатели газообразующей и газоудерживающей способности пшеничного теста с использованием прибора Реоферментометр F3, позволяющего контролировать скорость изменения давления образующего диоксида углевода при брожении.

Ключевые слова: мука из булгура, хлебобулочные изделия, пищевая и биологическая ценность, газообразующая и газоудерживающая способность.