

THE USE OF DOMESTIC VARIETIES OF TRITICALE FLOUR FOR THE PRODUCTION OF FLOUR CONFECTIONERY

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Abstract

Flour confectionery products occupy the second place in the confectionery industry of Kazakhstan in terms of production volumes. In the struggle for the sales market with imported suppliers, Kazakhstani manufacturers need to expand the range of flour confectionery products by developing new original recipes for products of increased nutritional value, functional products using highly efficient technologies to increase consumer demand. In this regard, an urgent problem is the development of technologies for the production of flour confectionery products with increased nutritional and biological value, which was the aim of this research.

The objects of the study were sugar cookies with various domestic varieties of triticale flour, as: "Taza", "Asiada", "Kozha" and "Baru". Raw materials were analyzed by: GOST 10444.12-88 and GOST 27558-87. Method used for color, smell, taste and crunch were determined by GOST 27495-87, while the method used for determining the acidity of the chatterbox was GOST 9404-88 Flour and bran. Humidity was determined by GOST 27839-2013, while method used for determining the quantity and quality of gluten was GOST 27494-87. Ash content was determined by: GOST 27676-88, and rheological parameters were examined on a pharynograph.

According to the results of laboratory baking, it was revealed that cookies using triticale flour of the "Leather" and "Baru" varieties have the best advantages compared to other samples. According to the rheological properties, it is noted that when using triticale flour, there is no need to increase the kneading time, the dough from triticale flour of the "Baru" variety has an imperceptible effect on the change in the physical properties of flour. The best option is a dough made of triticale flour of the "Baru" variety.

It has been established that triticale flour improves the organoleptic and physico-chemical indicators of cookie quality, increases its nutritional value. The replacement of wheat flour with triticale in the production of flour confectionery, in particular, sugar cookies, will compensate for the inferiority of wheat flour proteins.

Key words: *Triticale, Flour confectionery, Dough, Rheological properties of dough.*

1. Introduction

Flour confectionery products included in the category of the most popular are bought by almost all residents of Kazakhstan. Thus, due to the fact that flour confectionery products are in the greatest demand among the population, they are promising objects for enrichment and functional ingredients. As noted, the deficiency of full-fledged proteins in the diet reaches 25%, dietary fiber and vitamin C - up to 50%, B group vitamins and vitamin A - up to 20 - 30%, while many foods are characterized by an imbalance of the main structural elements of food - proteins, fats, carbohydrates. In solving this problem, instead of wheat flour, it is of interest to use first grade triticale flour of domestic production, which is a source of high-quality protein, dietary fiber, C, A, E, and group B vitamins, macro- and microelements, in the technology of flour confectionery.

The authors Magomedov *at al.*, [1], examined two samples of shortbread dough based on wheat flour and whole grain flour instead of wheat of the highest grade. The control sample was a shortbread dough "Zvezdochka". The developed confectionery products made of tritical flour have high consumer properties and functional orientation.

Fadeeva *et al.*, [2], considered the actual problems of expanding the assortment, increasing the nutritional value and improving the quality of flour confectionery products. They developed technologies for the production of flour confectionery products with the addition of various additives from non-traditional raw materials used in the production of flour confectionery products.

Leon *et al.*, [3], considered an approach to aspects related to the use of triticale flour for human consumption.

In the article of Leonova *et al.*, [4], the properties of two triticale varieties and three breeding lines bred in Bashkortostan are investigated. Organoleptic parameters are typical for standard grain; all samples had a high level of protein content. The mass fraction of gluten corresponded to the grain genotype. The number of drops of the studied samples was low. The modes of hydrothermal processing of triticale grain before grinding are optimized. It was found that the flour yield of the studied varieties and lines is 65.15 - 70.18%. The conducted polynomial two-factor regression analysis showed that the flour yield coefficient is the grain softening period of 6 hours. The deformation energy of the dough of the obtained flour samples was 67 - 129 units, the number of drops was 104 - 155 s that indicates low baking properties of flour, thereby it was proposed to produce brittle and crumbly bakery products in the form of crispy bread and bread sticks. A recipe for breadsticks has been developed with the replacement of 60% wheat flour with triticale flour. The number of rope (*Bacillus subtilis*, which is usually found on the outside of the wheat grain) spore bacteria increased slightly during the shelf life, but did not exceed the permissible values. Recipes and methods of making loaves for the production of crackers with a triticale bran content of 40% have been developed.

Two Russian triticale grain varieties Ramses and Saur were studied by Kandrov *et al.*, [5]. Two schemes of processing of these grain varieties into high-quality bakery flour have been investigated. The first scheme was abbreviated and included only crushing and grinding processes, while the second scheme was more advanced and included crushing, sieving, calibration and grinding processes. The article describes in detail the processing schemes, their parameters and milling modes. A detailed analysis showed the high efficiency of the improved scheme, which involved the use of lattice cleaners. Their expediency was determined by the specifics of the fault products at breaks I, II and III. Triticale flour varieties were obtained by mixing different streams of the central, intermediate and peripheral parts of the endosperm of triticale grain. According to the reduced scheme, the yield of

the Ramses variety was 40% (ash content = 0.70%, according to GOST 34142-2017), and according to the improved technological scheme - 63%. As for the Saur variety, according to the improved scheme, a total yield of 78% was obtained, which is 0.6% higher than according to the reduced scheme. According to the improved scheme, 46% of flour of the T-60 variety was obtained, which has the lowest ash content among all triticale flour varieties, whereas according to the simplified scheme, flour of this variety was not obtained. As part of the experiment, the first-ever study of the rheological properties of triticale flour was also conducted using Mixolab (Chopin Technologies, France). The study revealed significant differences in baking absorption, kneading time, kneading, gluten, viscosity, amylase and retrogradation. The best baking properties were shown by triticale T-70 and T-80 flour obtained from the central part of the endosperm, both according to simplified and enhanced processing schemes. However, the improved scheme turned out to be the most effective way of processing triticale grain into bakery grade flour.

The enrichment of food products with new raw materials, as a rule, faces the problem of changing their traditional characteristics. Accordingly, it is difficult to assume the attitude of consumers to these foods and predict the success of their introduction to the consumer market. For an earlier assessment of new developments in the field of enriched (functional, specialized) bakery products, it is proposed to use classification methods. At the first stage, in relation to a specific commodity group - bread made from a mixture of rye and wheat flour, an organoleptic evaluation scale was developed with characteristics of each quality level. The production of bread from a mixture of rye and wheat flour was carried out by the method of expert evaluation in the regional consumer market. Discriminant analysis was carried out for objective classification of samples by quality levels and linear discrimination functions were obtained for subsequent classification of new samples. Samples of grain bread from triticale were subjected to expert evaluation. It was found that, despite the worse characteristics compared to darnitsky bread, grain triticale produced according to the developed technology belongs to the "good" class, which indicates its positive entry into the consumer market [6].

The cultivation of soft wheat in Argentina is prohibited. Consequently, cookies are made from flour of poor baking quality from *Triticum aureus*, unsuitable for bread production. Using triticale in the production of these products seems to be an interesting alternative. The purpose of this study was to determine the quality of flour obtained from 10 advanced experimental lines and triticale varieties, as well as to analyze their

usefulness in the production of cookies and factors that are likely to affect the quality of the cookies produced [7].

The analysis of scientific and technical literature in order to determine the priority directions for the development of food production technologies has shown the prospects of new approaches to the processing of raw materials and its use in food production.

In this regard, flour confectionery products, which are a group of various high-calorie products with low humidity and a significant sugar and fat content, can be considered as new promising bases for food enrichment. The most popular types of flour confectionery products among the population are sugar cookies. The use of these products as an object of enrichment creates real conditions that ensure regular consumption of sources of scarce micronutrients by all categories of the population. Enrichment of this group of products with dietary fibers, minerals and other functional ingredients makes it possible to increase their nutritional value and health benefits. At the same time, one of the significant technological risks in food fortification, which is accompanied by a modification of the prescription composition, is a change in organoleptic properties, which becomes a critical control point in the development of food products.

Use of triticale, pumpkin and wheat germ in the production of flour confectionery is currently relevant, since there is no production in Kazakhstan for the use of wheat germ and pumpkin in sugar cookies. Therefore, the creation of new formulations for flour confectionery products with the addition of flour from a new domestic triticale variety, wheat germ and pumpkin with increased biological and nutritional value and the development of sugar cookie technology are relevant areas in the field of improving food technology. In this regard, the development of scientifically sound rational technologies for processing new high-yielding domestic triticale varieties and new types of semi-finished products based on triticale flour and fillers with improved organoleptic properties, increased nutritional and biological value is relevant and timely.

The purpose of this work is to develop the technology of sugar cookies with the use of grain processing products of "Baru" triticale flour. The goal is to expand the range of production of flour confectionery products using triticale flour from new domestic triticale varieties. The novelty of this research is development of flour confectionery products using triticale flour from domestic new varieties in accordance with scientifically based rheological and physico-chemical, biological and energy values.

2. Materials and Methods

Experimental studies were carried out using the following modern methods, allowing on the basis of a set of indicators to obtain a characteristic of raw materials:

- GOST 10444.12-88 Food products. Method for the determination of yeast and mold fungi;
- GOST 27558-87 Flour and bran.

Method used for determining color, smell, taste and crunch was GOST 27495-87 - Flour and bran, while the method used for determining the acidity of the chatterbox was GOST 9404-88 Flour and bran.

Humidity was determined by GOST 27839-2013 - Wheat flour, while method used for determining the quantity and quality of gluten was GOST 27494-87 - Flour and bran.

Ash content was determined by: GOST 27676-88 - Grain and its processed products, and rheological parameters were examined on a pharynograph.

As a result of scientific research, the technology of flour confectionery products with the use of triticale flour of various varieties of domestic production has been developed.

3. Results and Discussion

To develop the technology of flour confectionery products, flour from various triticale varieties suitable for all indicators was selected. For the selection of flour from various domestic varieties of triticale grain in the technology of sugar cookies, the traditional recipe was taken as a basis. In order to determine the technological evaluation of flour varieties from triticale grain, sugar cookies were baked with wheat flour of grade 1 and flour from different domestic triticale grain varieties.

Flour from following different triticale varieties was used as research objects: "Taza", "Asiada", "Kozha" and "Baru".

Experimental options were:

- Sample 1 - Control - wheat flour of the first grade;
- Sample 2 - Cookies using triticale "Taza" grain flour;
- Sample 3 - Cookies with the use of triticale grain flour "Asiada";
- Sample 4 - Cookies using triticale grain flour "Kozha";
- Sample 5 - Cookies using triticale "Baru" grain flour.

Cookies made from triticale flour had a darker color compared to the control, due to the presence of characteristic features of triticale flour as a rye-wheat hybrid. The obtained physico-chemical and organoleptic quality indicators of baked products from samples of wheat and from different varieties of triticale flour are presented in Tables 1 and 2.

Table 1. Organoleptic characteristics of cookies from different varieties of triticale flour

Indicator	Organoleptic characteristics of cookies with various grades of flour				
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Taste and smell	Taste is sweet, the smell is pleasant with a well-defined aroma	Taste is characteristic of triticale flour, sweet, the smell is characteristic of a weakly expressed aroma, when chewing, a pleasant crunch is felt			
Shape	Round, without dents, blisters and edge damage	Round, slightly blurry, without dents and damage to the edge	Round, without dents, blisters and edge damage		
Surface	Smooth, with a clear, not blurred impression of the pattern on the upper surface. Not burnt, no bloating. The lower surface is smooth.				
Colour	Uniform, light straw	Uniform, dark brown			
View in the break	Brittle, crumbly, uneven porosity, well baked, without voids and traces of lumps	Brittle, uneven porosity, with the presence of small voids, well baked	Brittle, uneven porosity, well baked, with the presence of small voids	Brittle, crumbly, uneven porosity, well baked, without voids and traces of lumps	Brittle, crumbly, uneven porosity, well baked, without voids and traces of lumps

From the data in Table 1, it can be seen that all the cookie samples differed in a fairly high assessment of appearance and characteristic taste for triticale flour compared to the control. The surface of the cookies in all samples was uniform. The color of the control sample of cookies was light straw, and the other types were dark brown. The view in the fracture of the control samples, cookies with flour "Kozha" and "Baru" were fragile, crumbly, uneven porosity and without voids. The cookie samples with the use of "Taza", "Asiada" had brittle, uneven porosity, with the presence of small voids and medium hardness. The taste and smell of all prototypes were specific to triticale flour. Cookies with the use of triticale flour received a favorable assessment "Leather" and "Baru", which were attractive to consumers in terms of fragility and porosity.

Table 2 shows the physico-chemical parameters of cookies.

From the data in Table 2, it can be seen that the products had a humidity of 7 to 7.4%, the acidity of the cookie samples with the use of grain flour "Kozha" and "Baru" at the level with the control sample, while overestimated acidity was observed in the cookie samples with the use of "Taza" and "Asiada" (1.6). According to the wetness of the control sample, the cookies of the control variant (made of wheat flour)

are in the lead, followed by the cookies with the use of Baru flour variety, which had the better its digestibility. This result indicates that these cookie samples have good porosity and high hardness, which affects the consistency of the cookie (friability).

According to the results of laboratory baking, it was revealed that cookies with the use of triticale flour varieties "Kozha" and "Baru" have the best advantages compared to other samples and allows expanding the range of flour confectionery products of high nutritional and biological value.

Next, the effect of triticale flour on the rheological and physical properties of semi-finished products was investigated. We studied the effect of triticale flour produced from triticale grain of domestic different varieties (5 samples) ("Taza", "Baru", "Kozha", "Asiada") on the rheological properties of the test on the Brabender farinograph device. The studies used wheat flour bakery of the first grade (control version).

Experimental options were:

Sample 1 - Control;

Sample 2 - Dough from triticale flour of the "Taza" variety;

Sample 3 - Dough made of triticale flour of the "Kozha" variety;

Table 2. Physico-chemical parameters of cookies with various grades of flour

Indicator	Physico-chemical parameters of cookies with various grades of flour				
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Humidity, %	7.2	7.2	7.0	7.0	7.2
Acidity, degree	1.0	1.6	1.6	1.2	1.2
Wetness, %	246	201	210	219	223

Sample 4 - Dough from triticale flour of the "Asiada" variety;

Sample 5 - Dough made of triticale flour of the Baru variety.

The experimental data obtained are shown in Figures 1 and 2.

The peculiarities of the biochemical composition of triticale flour produced from triticale grains of different varieties can have a noticeable effect on the physical properties of the dough.

The water absorption capacity varied from 71.9% to 56.6%, i.e. all flour samples have an average water absorption value. The dependence of the water capacity demonstrates the volume of water injected to reach a consistency of 500 FE, which is expressed in milliliters: per 100 g of flour with a moisture content of 14% and further absorption of water with more than 56% - we are talking about good quality gluten, which allows good baking volumes. With water absorption of less than 52%, reduced volumes of the final product should be expected. According to the research results, it can be seen that in all experimental variants the water absorption was higher than 56%, which indicates a good quality of gluten.

According to the results of the Figure 2, it can be seen that the value of the water absorption capacity increases in the experimental variants 3.4, respectively, by: 19; 16.8%. The water absorption capacity in the experimental sample 2.3 decreases by 8.2; 0.5% compared with the control variant.

The time of dough formation (development) is the time from the beginning of adding water to the point on the curve immediately before the first signs of a decrease in the consistency of the dough appear. When using triticale flour, this value decreased by: 1, 1.3, 0.7, and 0.3 minutes, respectively.

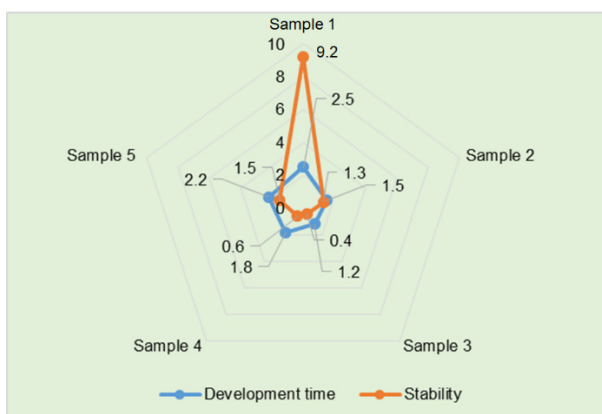


Figure 1. The effect of triticale flour produced from triticale grains of different varieties on the rheological properties of the dough (development time, stability)

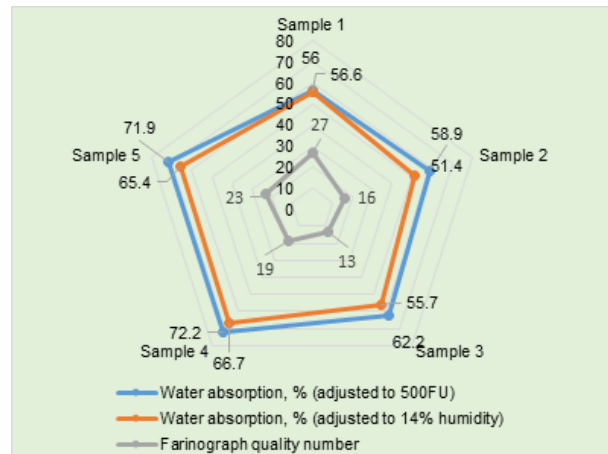


Figure 2. The effect of triticale flour produced from triticale grains of different varieties on the rheological properties of the dough (water absorption, % (adjusted to 500 FU), water absorption, % (adjusted to 14% humidity), quality number)

A lower value of the time (Sample 3) of dough formation leads to low stability of the dough, the presence of liquefaction and, as a consequence, to a decrease in the flour quality number to 13 units.

The development time in Sample 5 (dough from triticale flour of the Baru variety) was at the level of the control variant.

Stability (the stability time of the dough or the time between the first and second intersection point of the upper curve of the pharynogram with the consistency line of 500 FU) characterizes the stability of the flour to kneading. In this case, when using triticale flour, this value decreased by: 7.9, 8.8, 8.6, and 7.7 minutes, respectively. Thus, when using triticale flour, there is no need to increase the kneading time.

The flour quality indicator (quality number) can be used together or instead of stability and degree of liquefaction, there is a high correlation of the quality indicator with stability and degree of liquefaction [GOST R 51404-99], which is confirmed by the experiments.

The dough made of triticale flour of the "Taza", "Kozha", "Asiada" and "Baru" varieties decreased the quality number by: 1.7, 2.0, 1.4, and 1.2% times, respectively.

Thus, since the quality indicator is a calculated value (this is the distance in mm along the time axis between the point of adding water and the point where the value of the center of the pharynogram decreased by 30 FU compared to the value of the center of the pharynogram at the required consistency value), it does not always adequately reflect the quality of the flour under the study. The quality number of the

farinograph expresses the contour of the farinogram with one value: weak flour: softens early and quickly, the amount is low; strong flour: softens late and slowly, the amount is high. The data obtained may indicate that the dough made from triticale flour of the "Baru" variety has an imperceptible effect on the change in the physical properties of flour. As can be seen from the Figure 2, the best option is a dough made of triticale flour of the "Baru" variety.

According to the results of studies of the rheological properties of triticale flour obtained from triticale grains of different varieties, it was found that triticale dough has good gluten qualities. Studies of rheological properties have shown that the experimental variant 5 (flour from triticale "Baru") is optimal.

Thus, the data obtained indicate that the dough from triticale flour of the "Baru" variety has a noticeable effect on the change in the physical properties of flour. When using the dough from triticale flour of the "Baru" variety, the physical properties of the resulting semi-finished product are enhanced, which positively affects the quality of the characteristics of the finished product.

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4. Conclusions

- Thus, according to the results of laboratory studies, it was revealed that cookies using triticale flour varieties "Kozha" and "Baru" has the best advantages compared to other samples and allows you to expand the range of flour confectionery products of high nutritional and biological value.

- It is noted that the dough from triticale flour of the Baru variety has a noticeable effect on the change in the physical properties of flour, when using the dough from triticale flour of the Baru variety, the physical properties of the resulting semi-finished product are enhanced, which positively affects the quality characteristics of the product. the finished product. The best option is a dough made of triticale flour of the "Baru" variety.

- As a result of the conducted research, the expediency of using triticale flour in the production of sugar

cookies was proved. It has been established that triticale flour improves the organoleptic and physico-chemical indicators of cookie quality, increases its nutritional value. It should be noted that the replacement of wheat flour with triticale in the production of flour confectionery, in particular, sugar cookies, will compensate for the inferiority of wheat flour proteins.

- The development of new products using triticale flour of domestic production is a promising direction in the flour confectionery industry, which allows us to obtain qualitatively new products that are a source of vitamins, dietary fiber.

5. References

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