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ANALYSIS OF THE INFLUENCE OF THE WHITENING PROCESS DURING PREPARATION FOR FLOURING ON THE QUALITY OF BAKERY FLOUR MADE FROM A MIXTURE OF WHEAT AND RYE GRAINS

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Abstract: The article experimentally studies the effect of different methods of dry processing of the surface of local wheat and rye grains when preparing them for grinding into fine flour and their aging process during storage. The purpose of the study is to experimentally study the effect of different methods of dry processing of the surface of wheat and rye grains when preparing them for grinding into fine flour on the quality of bread products and their aging process. Materials and methods of research, sample bread was prepared from flours milled from a mixture of wheat and rye grains selected for the study in accordance with GOST 27669-88, their technological quality indicators were analyzed , and the results were processed using the full-factorial experimental method. The quality indicators of the bread sample prepared from the flour sample ground by dry processing on the proposed equipment showed the superiority of the specific volume of the bread, kernel porosity, ΔH index, bread volume and organoleptic assessment of bread quality over the samples ground on the current equipment used in production enterprises. It was proved that dry processing of the surface of this grain in preparing it for grinding into fine flour is of great technological importance in increasing the technological quality indicators of bakery products.

Keywords: bread, wheat and rye , specific volume, kernel porosity, ΔH index, loaf size and organoleptic assessment of bread quality.

Introduction. Considering that 60% of human bioavailability comes from cereals, there is a growing interest in leading wheat-producing countries to avoid the use of synthetic additives that pose health risks. At the same time, special attention is paid to energy and resource efficiency in the production of widely consumed bakery products, flours obtained from the processing of various cereal raw materials, such as rye and wheat, and the rational use of the technological potential of cereals.

In wheat processing, when producing bakery and pasta flour from low-functional categories of grain, technological defects in the quality of finished products are partially eliminated by using synthetic additives of a chemical nature [1]. This is due to the fact that the population of countries with insufficient grain raw materials does not consume grain products with a variety of compositions in the prescribed amount, which causes health problems , which is why there is an increasing interest in the use of plant -based additives as food additives.

To expand the cultivation of rye and triticale grains, to create varieties that are suitable for climatic conditions and resistant to diseases, and to develop agricultural techniques [2]. Experimental studies of the baking properties of wheat and rye grains created as a result of these studies are of great importance.

It is known that bakery products are unstable, losing their quality during storage, and the dependence of their quality on aging has been poorly studied. Also, the aging of bakery products occurs as a result of complex physicochemical, colloidal and biochemical processes. The results of the research obtained during this study are aimed at studying the effect of aging of bakery products during storage.

In countries with a high level of consumption of bakery products, bread storage is one of the urgent tasks. In particular, the hot climate in the summer months, as well as high humidity in the autumn and spring months, require the development of rational technological regimes for the storage of bakery products. In this case, it is advisable to use effective technologies and methods of production and storage to extend the shelf life of bakery products. This, in turn, also depends on the quality of the main raw materials, which is beyond doubt.

Modern research methods provide ample opportunities to gain a complete picture of the changes that occur in bread during its storage as it ages and to identify ways to slow down this process [3].

Today, objective methods for determining the degree of freshness of bread have been developed and are being improved, which are based on changes in the properties of the bread kernel during storage [4].

It has been studied that stale bread has a dull crust and a soft, inelastic texture and a very easily crumbly core, while fresh bread has a brittle, smooth, elastic core and a shiny crust. It has been studied that bread with thin pore walls and well-developed core porosity has a large specific volume, which prolongs the time it can be stored “fresh”, that is, slows down the “staleness” process [5].

During storage, the aroma and taste of bread change along with the physical properties of the dough . The loss of some odorants is associated with the breakdown of these substances in the flour, and studies have shown that stale bread acquires a characteristic taste and smell. [6].

It has been found that the shelf life of bread is primarily affected by changes in the moisture binding properties of the product. Analysis of scientific studies shows that the amount of bound osmotic and adsorbed moisture in samples using activated water increases during the initial storage period. [7-11].

LI Puchkova and LL Sugrobova determined the amount of moisture in macrocapillaries, known as osmotically bound “free water”, using low-temperature differential scanning microcolorimetry on a DCM-2 device. The method is based on determining the thermal effect of the phase transition of ice to water when heating a core sample frozen to -60 °C in a special cryostat [12].

NV Naumenko in his scientific research studied the effect of activated water on the quality of wheat bread and its microbiological spoilage during storage. According to him,

the combined use of cathodic water (for kneading dough) and anodic water (for surface treatment of baked goods) was found to be effective in slowing down the development of potato disease and the formation of mold mycelium. as well as increasing the microbiological safety of bread. [13].

Studies have shown that the higher the protein content of wheat flour and the stronger the gluten, the slower the bread rises. [14-15].

The most common methods for determining the degree of bread hardening are based on determining the physico-mechanical properties of bread. To determine the physico-mechanical properties of bread, automated penetrometers AP-4/1 and AP-4/2 manufactured by Finemass (Germany) are used. Bread crispness can be used to determine whether bread is fresh or stale.

There are different opinions about how stale bread is. However, the results of many studies have confirmed that it is due to retrogradation (returning to its original state) of the starch in the bread kernel.

Various factors affect bread spoilage, and it has been found that bread does not spoil at all at temperatures of 60 ˚C and above, that lowering the storage temperature from 60 ˚C to minus 2 ˚C accelerates spoilage, and that further lowering the temperature to minus 20 - minus 30 ˚C prevents bread spoilage [16].

Deep freezing of bread has been shown to be an effective method of preventing spoilage, reducing dryness and preserving the bread's characteristic aroma and flavor [17].

Bread made from rye flour has been shown to keep longer than bread made from wheat flour of the same yield [18]. Also, the higher the protein content and stronger the gluten in wheat flour, the slower the bread will go stale. Sugar and fat have also been shown to slow down the process of bread going stale [19].

Based on the analysis of studies on factors affecting the aging process of bread products, an experimental study was conducted to study the effects of dry surface treatment of wheat and rye grains in various equipment during the preparation of a mixture of wheat and rye grains for grinding into varietal flour, along with the evaluation of organoleptic indicators, changes in the moisture content, water absorption, and degree of crumbing of bread products.

Purpose of the study The aim of the study is to experimentally study the effect of various methods of dry surface treatment of wheat and rye grains on the quality of bread products and their aging process when preparing them for milling.

Materials and methods of research. Sample bread was prepared from flours selected for the study from a mixture of wheat and rye grains according to GOST 27669-88 [20] , and their technological quality indicators were analyzed using the resource bases of the laboratories of the Tashkent Chemical Technology and the “Khorezm Innovative Technopark” unitary enterprise. The results were processed using the full-factorial experimental method to develop regression equations and check their adequacy, and the results were analyzed using graph-analytical methods.

Results and discussion. In the laboratories of mills and bakeries, a bread sample is usually prepared from a small amount of the flour being tested, after performing a sample test baking. A conclusion about the baking properties of flour is drawn based on the quality of the bread sample - its size, shape, color of the crust, color of the core, porosity, elasticity, taste and smell. The more pronounced these indicators are, the better the flour has baking properties. This part of the study aimed to study the effect of flour samples made from a mixture of local wheat and rye grains on the quality of bakery products.

As an object of research, sample bread was prepared according to GOST 27669-88 from flour samples processed in various polishing equipment and weighed from a mixture of wheat and rye grains in a ratio of 4:1, and their technological quality indicators were analyzed using the resource bases of the laboratories of the Tashkent Chemical Technology and the "Khorezm Innovative Technopark" Unitary Enterprise. The results of the research experiments are presented in Table 1.

Table 1. The effect of dry surface treatment of 4:1 mixtures of local wheat and rye grains on bread quality parameters

Indicators	Dry grain surface treatment equipment		
	RZ-BMO-6	RZ-BGO-6	Suggested equipment
Core porosity , %	66	67	7 0
Bread moisture , %	43, 7	44, 2	44, 2
Bread size, cm^3	5 2 0	5 8 0	6 5 0
Bread ΔH indicator	0.4 2	0.4 7	0.5 3
Specific gravity of bread , g/cm^3	2, 5	2.7 3	3.1 6
Acidity of the core, ^0H	5, 4	5, 4	5, 4
Bread quality rating, points	6 8	70	7 2

Of the study presented in Table 1 show that the quality indicators of bread samples prepared from flour samples ground by dry processing on the proposed equipment showed an increase in the bread crumb content by up to 0.7 g/ cm3 , kernel porosity by up to 5%, ΔH by 0.09 units, bread volume by up to 70 cm3, and organoleptic assessment of bread quality by 2-4 points compared to samples ground by current equipment used in *production* enterprises. It was proved that dry processing of the surface of this grain in preparation for grinding ^{of} graded flour is of great technological importance in increasing the technological quality indicators of bakery products.

In preparation for grinding a mixture of wheat and rye grains into fine flour, sample mold loaves were prepared from flours that were subjected to dry surface treatment using various equipment and then ground in a mill, and their quality indicators were determined. These loaves were baked for 24 and 48 hours . The results of organoleptic evaluation after 10 hours of storage are presented in Table 2.

When evaluating organoleptic quality indicators, a 100-point system was used to assess the quality of bakery products made from wheat and rye flour [2 1]:

$$C = B \times Qn = min+max \quad (1)$$

where: B - bread quality assessment, points; Qn - weighting coefficient of each indicator; m - number of indicators, the assessment of each indicator on a 5-point scale.

Table 2. The effect of dry surface treatment of 4:1 mixtures of local wheat and rye grains on the organoleptic quality parameters of bread

quality of bread show	Rating, score	For moldy bread		RZ-BMO-6	RZ-BGO-6	Suggested equipment
		Qn	Min-max			
Shapely	1-5	2	2-10	7	7	8
The color of the shell	1-5	2	2-10	8	8	8
Condition of the shell surface	1-5	2	2-10	7	8	8
The state of the brain	1-5	5	5-25	17	18	20
The hollowness of the bread kernel	1-5	3	3-15	1 0	1 1	12
Fragrance	1-5	3	3-15	1 1	12	12
Taste	1-5	3	3-15	1 1	12	12
Evaluation of bread quality, points			20-100	71	76	8 0

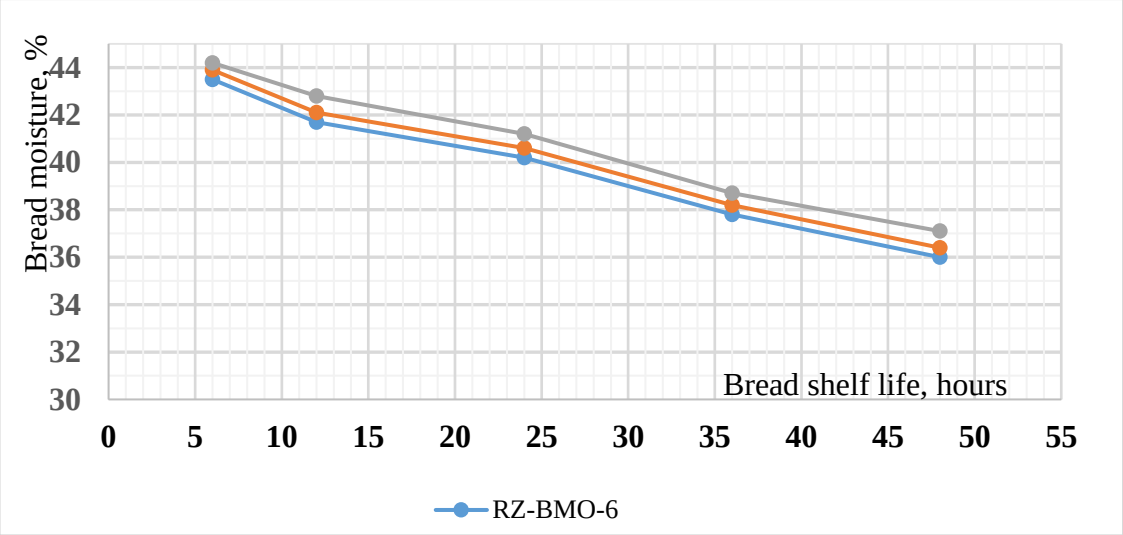


Figure 1. They are essential for storing bread samples humidity changes (%)

The results presented in Table 2 show that the bread obtained from the sample, which was dry-processed on the surface of a mixture of wheat and rye grains in a ratio of 4 : 1 , in the proposed equipment, showed superiority in organoleptic quality indicators over the other two samples, that is, it was 4 points higher of dry processing of the surface of a 4:1 mixture of wheat and rye grains on the moisture content of the bread kernel, the level of freshness , the degree of friability, water retention and changes in penetrometric

indicators of bread products was experimentally analyzed (Figures 1-4). The storage conditions of the bread samples during the experiment were the same , the storage temperature was 20±2 °C, and the relative humidity was 75±2%.

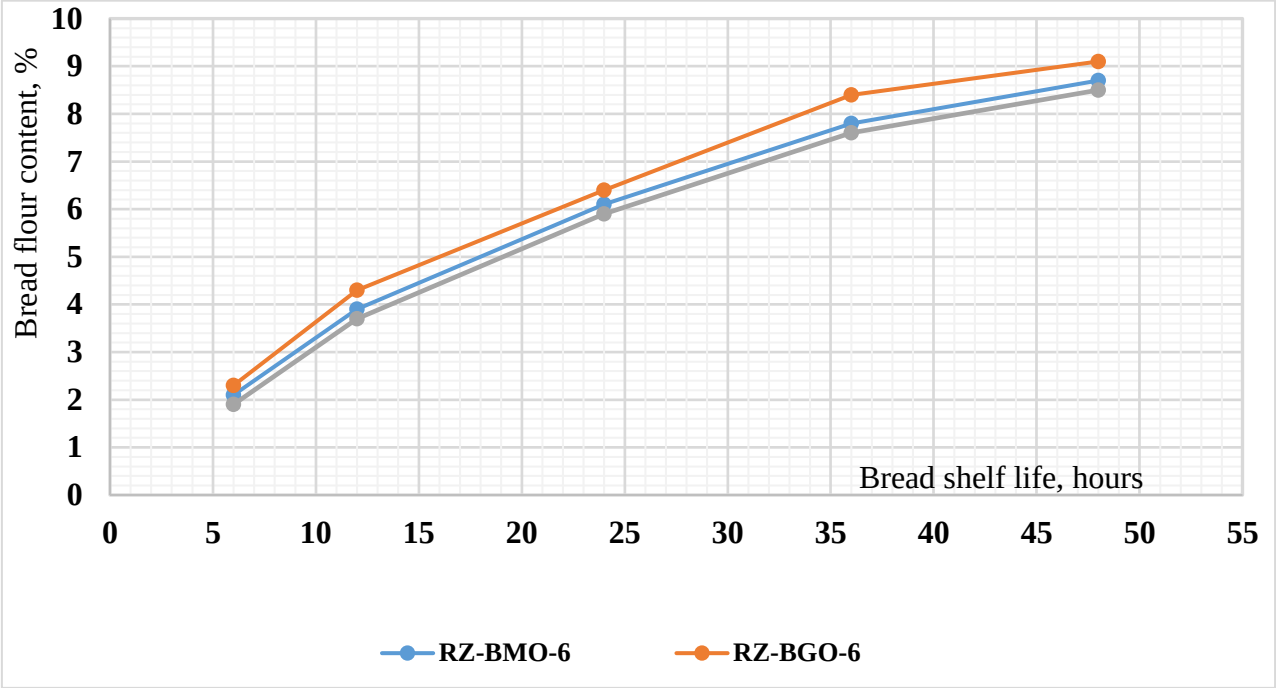
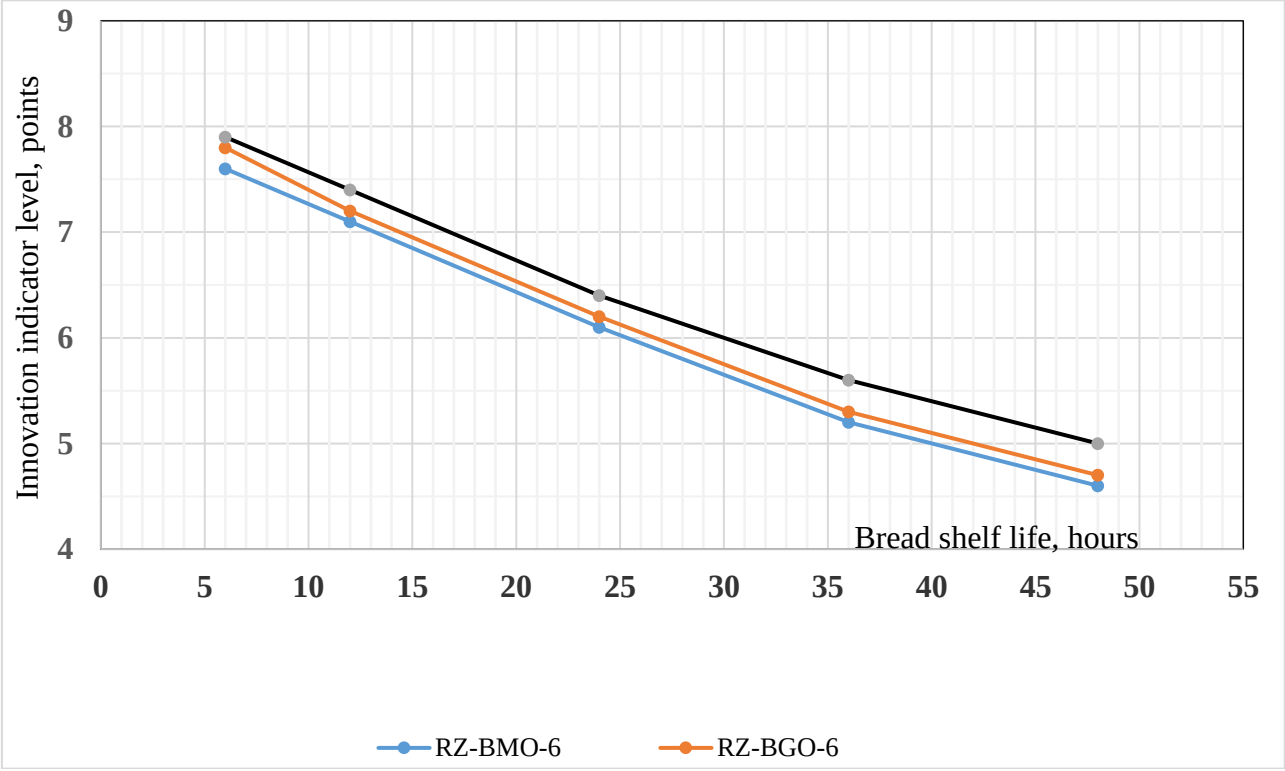


Figure 2. During storage of bread samples, their kernels compatibility (%)



3 - Fig. Changes in the freshness index during storage of bread samples (in points)

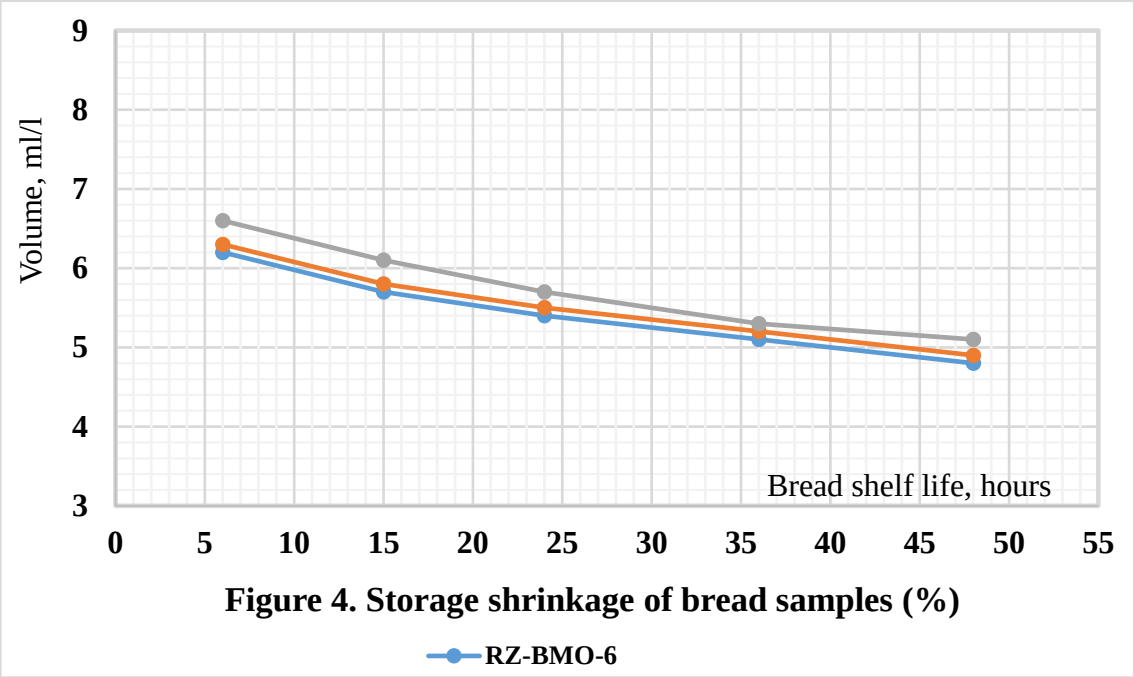


Figure 4. Storage shrinkage of bread samples (%)

As shown in the graphs above, the samples treated with a 4:1 mixture of wheat and rye grains on the surface of the proposed whitening equipment showed superior crumb moisture , freshness index , crumb quality, and water retention index compared to the next two samples . The results obtained from these experiments are presented in figure 5. The results of the penetrometric studies presented in the figure also confirm this.

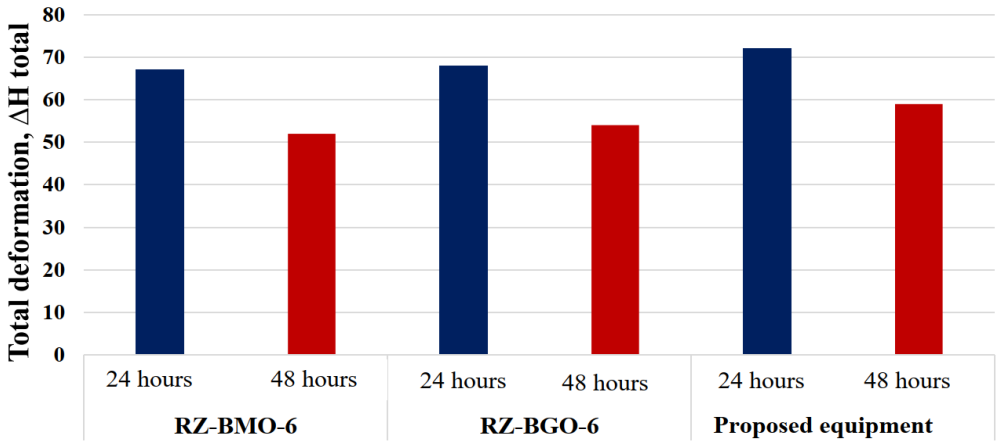


Figure 5. Changes in the penetrometric parameters of bread samples during storage

Flour was ground from samples of dry-processed mixtures of wheat and rye grains in a 4:1 ratio in a laboratory mill of the CD 1 MILL (Chopin technology, France) model in the "Storage and processing of cereals and cereal products" laboratory of the "Food Technology" department of the Tashkent Institute of Chemical Technology. Production test experiments conducted at the "Khorezm Innovative Technopark" unitary enterprise

under Urgench State University to analyze changes in the preparation and storage of bakery products from these flour samples confirmed the effectiveness of the proposed method.

Conclusion. The results of experimental studies have shown that the proposed equipment for dry processing of the surface of the grain mixture in the preparation of a mixture of wheat and rye grains for grinding high-quality flour increases the yield and quality of flour and improves the preservation of the freshness of bakery products during storage (does not spoil quickly).

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