

ISSN 2181-8622

Manufacturing technology problems



Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX  COPERNICUS
INTERNATIONAL

**Volume 10
Issue 3
2025**



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

KURAYAZOV ZARIPBAY

PhD, Urgench State University named after Abu Raykhan Beruni, Urgench, Uzbekistan
Phone.: (0894) 230-5528, E-mail.: kurayazovzarifboy@gmail.com

RAVSHANOV SUVANKUL

Professor, Tashkent Chemical Technological Institute, Tashkent, Uzbekistan
Phone.: (0897) 156-4926, E-mail.: suvankulravshanov@gmail.com

KANOATOV XAYRULLO

Professor, Namangan State Technical University, Namangan, Uzbekistan
Phone.: (0897) 335-8086, E-mail.: kanoatov8086@mail.ru
**Corresponding author*

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	70
Bread moisture , %	43,7	44,2	44,2
Bread size, cm ³	520	580	650
Bread ΔH indicator	0.42	0.47	0.53
Specific gravity of bread , g/cm ³	2,5	2.73	3.16
Acidity of the core, °H	5,4	5,4	5,4
Bread quality rating, points	68	70	72

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]:

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

where: B - bread quality assessment, points; Q_n - 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
		Q _n	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	10	11	12
Fragrance	1-5	3	3-15	11	12	12
Taste	1-5	3	3-15	11	12	12
Evaluation of bread quality, points			20-100	71	76	80

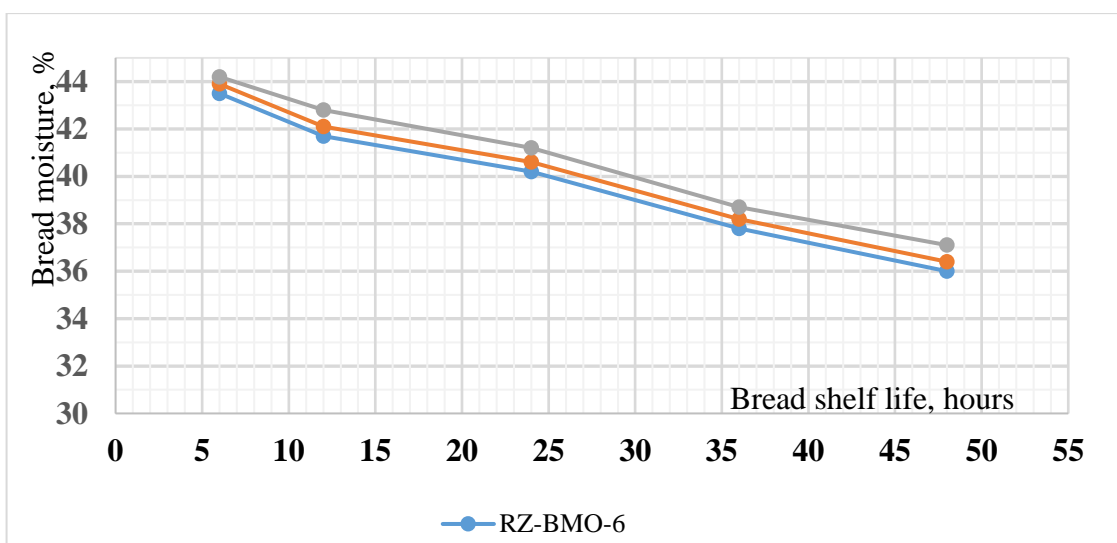


Figure 1. They are essential for storing bread samples humidity changes (%)

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 $75 \pm 2\%$.

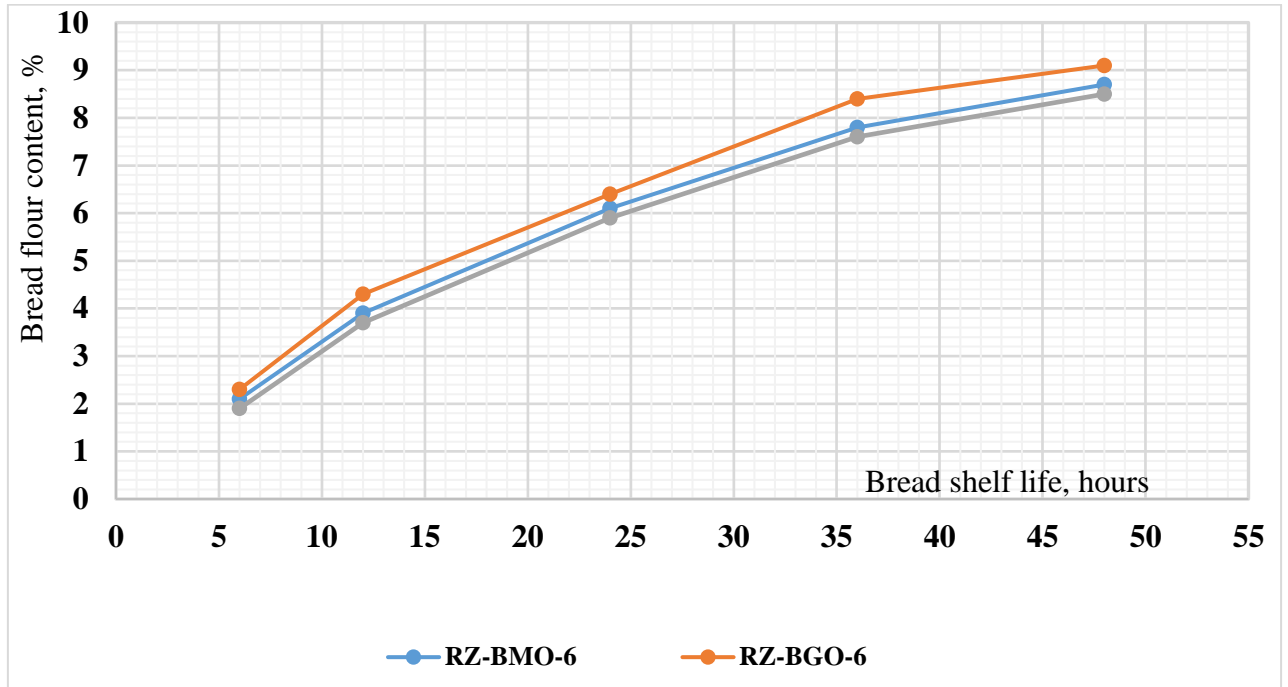
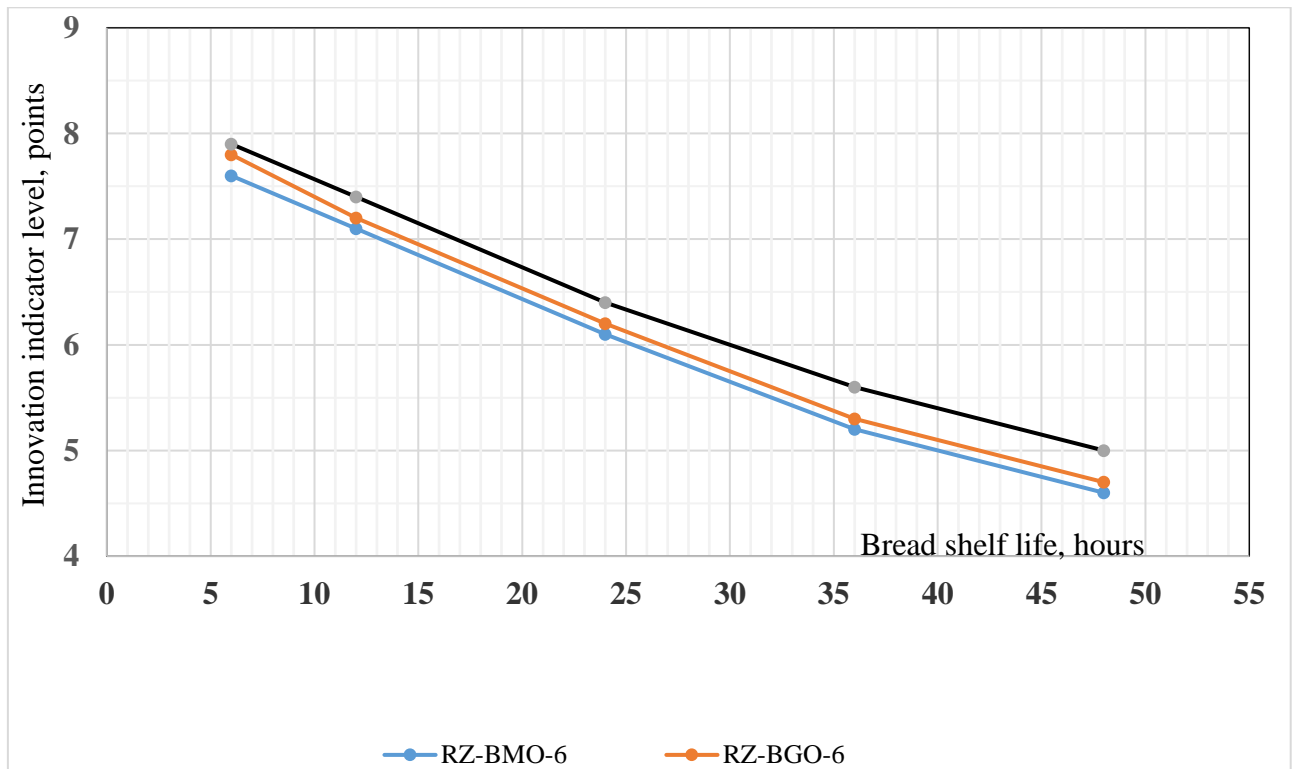
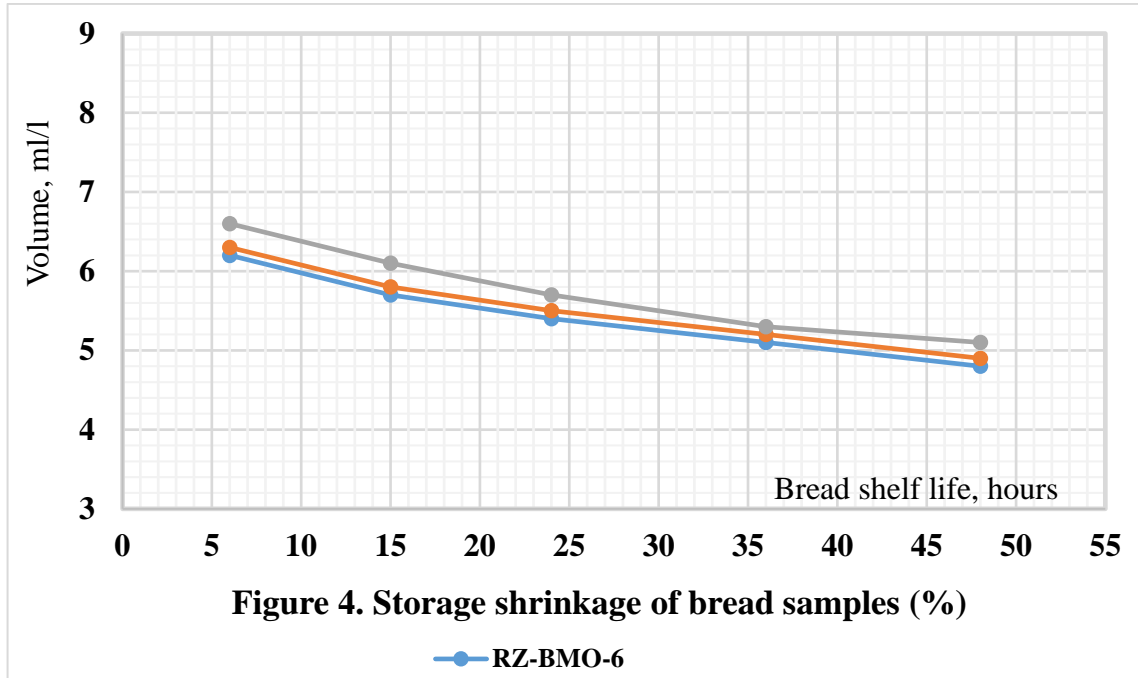


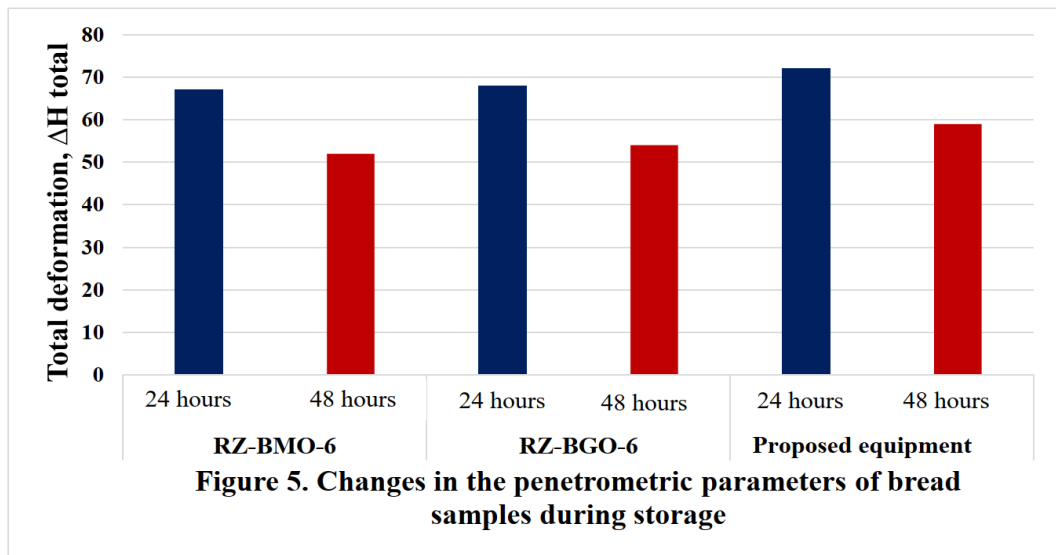
Figure 2. During storage of bread samples, their kernels compatibility (%)



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



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.



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).

References

1. Ториков В.Е., Долгополова Н.В. "Сравнительная характеристика сортов яровой твердой пшеницы для выявления лучших показателей зерна в технологии макаронных изделий" Вестник Брянской государственной сельскохозяйственной академии, 2, 2014, 6-11.с.
2. Горбунов В.Н., Шевченко В.Е. "Селекционные достижения по тритикале в научных центрах России и ближайшего зарубежья" Достижения науки и техники АПК, 29, 4, 2015, pp. 24-27.
3. Федотов В.А.. "Современные методы исследования и оптимизации хлебопекарного производства" Международный научно-исследовательский журнал, no. 8-1 (98), 2020, pp. 144-147.
4. Науменко Наталья Владимировна. "Метод микроскопии в исследовании процессов черствения хлеба" Вестник Южно-Уральского государственного университета. Серия: Пищевые и биотехнологии, vol. 2, no. 1, 2014, pp. 80-83.
5. Ayala-Soto, Fabiola & Serna-Saldivar, Sergio & Welti-Chanes, Jorge. (2016). Effect of arabinoxylans and laccase on batter rheology and quality of yeast-leavened gluten-free breads. *Journal of Cereal Science*. 73. 10.1016/j.jcs.2016.11.003.
6. Cho, In & Peterson, Devin. (2013). Chemistry of Bread Aroma: A Review. *Food science and biotechnology*. 19. 575-582. 10.1007/s10068-010-0081-191.<http://hleb-produkt.ru/sohranenie-svezhesti-hleba/12-metody-kontrolya-svezhesti-hleba.html>.
7. Лазарев, Е.Н. Исследование возможности применения активированных водных растворов для сохранения пищевых продуктов / Е.Н. Лазарев, А.А. Вытовтов // Сборник научных трудов СПбТЭИ «Современные проблемы оценки качества потребительских товаров и пути совершенствования технологии кулинарной обработки пищевой продукции», 1999. - С. 5 - 8.
8. Aydar, A. Y. (2020). Investigation of ultrasound pretreatment time and microwave power level on drying and rehydration kinetics of green olives. *Food Science and Technology*, (AHEAD). DOI: <https://doi.org/10.1590/fst.15720>.
9. Aldoradin-Puza, E., Salazar-Fuentes, A. G., Rodríguez-Olibarría, G., Rodríguez-Felix, F., Barreras-Urbina, C. G., Marquez-Rios, E. (2020). Effect of the application of ultrasound on sarcoplasmic proteins from giant squid (*Dosidicus gigas*) mantle. *Food Science and Technology*, (AHEAD). DOI: <https://doi.org/10.1590/fst.26919>.
10. Yikmiş, S. (2020). Effect of ultrasound on different quality parameters of

functional sirkencubin syrup. *Food Science and Technology*, 40(1), 258-265. DOI: <https://doi.org/10.1590/fst.40218>.

11. Starodubtseva, G. P., Lyubaya, S. I., Gabrielyan, S. Z., Rubtsova, E. I., & Kopylova, O. S. (2020). Machine for magnetic treatment of water used in baking. Paper presented at the *IOP Conference Series: Earth and Environmental Science*, 488(1).pp.66-69.

12. Luscher, C. & Balasa, A. & Fröhling, Antje & Ananta, E. & Knorr, Dietrich. (2004). Effect of High-Pressure-Induced Ice I-to-Ice III Phase Transitions on Inactivation of *Listeria innocua* in Frozen Suspension. *Applied and environmental microbiology*. 70. 4021-9. 10.1128/AEM.70.7.4021-4029. 2004.

13. Васильева Н.В. Изменение химического состава воды при электрохимической обработке и ее влияние на сохраняемость хлеба и хлебобулочных изделий / П В Васильева // Экономика и социум на рубеже веков материалы межвузовской V научно-практической конференции - Челябинск - 2005. 18-20 с.

14. Goel, Sonia & Singh, Mohinder & Grewal, Sapna & Razzaq, Ali & Wani, Shabir. (2021). Wheat Proteins: A Valuable Resources to Improve Nutritional Value of Bread. *Frontiers in Sustainable Food Systems*. 5. 769681. 10.3389/fsufs.2021.769681.

15. Васиев М.Г. Новости науки, техники и технологии хлебопекарного и кондитерского производства (тексты научных работ по материалам Интернета и научнотехнического и производственного журнала «Хлебопродукты» за 2006 г.). Часть 1. Бухара, 2006. - 100 с.

16. Ronda, Felicidad & Caballero, P.A. & Quilez, Joan & Roos, Yrjö. (2011). Staling of frozen partly and fully baked breads. Study of the combined effect of amylopectin recrystallization and water content on bread firmness. *Journal of Cereal Science*. 53. 97-103. 10.1016/j.jcs.2010.10.003.

17. Bárcenas, Maria-Eugenia & Rosell, Cristina. (2006). Effect of frozen storage time on the bread crumb and aging of par-baked bread. *Food Chemistry*. 95. 438-445. 10.1016/j.foodchem.2005.01.023.

18. Dulova, E. & Kiseleva, M. & Nasyrova, Yu & Kuzmina, S. & Prazdnichkova, N.. (2020). Quality and consumer properties of bread baked from mixture of rye and wheat flour using iodine-containing additives. *BIO Web of Conferences*. 17. 00045. 10.1051/bioconf/20201700045.

19. ESTELLER, MAURICIO & Amaral, Renata & Lannes, Suzana. (2004). Effect of sugar and FAT replacers on the texture of baked goods. *Journal of Texture Studies*. 35. 383 - 393. 10.1111/j.1745-4603.2004.tb00602.x.

20. .ГОСТ 27669-88 Намунавий non pishirish va uning texnologik sifat ko'rsatkichlarini aniqlash usullari.

21. Dulova, E. & Kiseleva, M. & Nasyrova, Yu & Kuzmina, S. & Prazdnichkova, N.. (2020). Quality and consumer properties of bread baked from mixture of rye and wheat flour using iodine-containing additives. *BIO Web of Conferences*. 17. 00045. 10.1051/bioconf/20201700045.

C O N T E N T S

TECHNICAL SCIENCES: COTTON, TEXTILE AND LIGHT INDUSTRY

Dustkobilov U.	
Circular economy practices in the textile industry: Current status, indicators, and development opportunities	3
Kuldashov G., Oripov J.	
Forecasting the temperature gradient of cotton revolt	10
Kuldashov G., Oripov J.	
Optoelectronic three-wave moisture meter of raw cotton	16
Umarov A.	
Research on the optimization of the saw gin's roll box	26
Tursunov A., Sharibaev N.	
Techniques and devices for mitigating environmental pollution in cotton processing industries	36
Ganikhanov Kh., Mavlyanov A., Abdusamatov A., Mirzaumidov A.	
Effect of the forces on the separation of fiber flow from the saw in an improved lower fiber removal device	43
Nurulloyeva Kh., Abdusamatov A., Mirzaumidov A.	
Experimental determination of the load on the multifaceted columns on the elastic supports of the cotton ginner	49
Muradov A.	
Study of the dynamics of the drive mechanism of moving needles	54
Ismatullayev N., Shamsiyeva M.	
Development of technology for producing leather from african catfish skins	59
Rahmatova S.	
Theoretical study of the quality indicators of newly structured knitted fabrics based on a mathematical model	65
Parpieva N., Kayumov J., Parpiyev D., Lastochkin P.	
Theory of torsional vibrations of grooved cylinders	71
Komilov Sh., Mamadaliyev N., Jurayeva G.	
Quality indicators of cotton fiber analyzed	83

TECHNICAL SCIENCES: AGRICULTURE AND FOOD TECHNOLOGIES

Sobirova M., Mohamed R., Farmonov J., Samadiy M.	
Impact of calcium chloride on the cheese yield during swiss cheese manufacturing process	91

Kurayazov Z., Ravshanov S., Kanoatov X.	
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	96
Xusanxodjayeva F., Meliboyev M., Ergashev O.	
Development of technology for complex processing of garlic onions	105
Meliboyev M.	
Development of complex processing technology for the secondary mass of watermelons and zucchini	112
Nishonov U., Mominov U.	
Evaluation of organoleptic properties of soft drinks prepared from plant materials	118
Khurmamatov A., Yusupova N., Sarsenbayev N., Mallabayev O.	
Results of determination of bitumen movement modes at different temperatures	124
Yusupova N., Sarsenbayev N., Mallabayev O.	
Results of improving the construction of the plate heat exchange	130

CHEMICAL SCIENCES

Jumayeva D., Zaripbaev K., Oxunjonov Z., Nomonova Z.	
Compositional analysis of raw materials in sorbent production	135
Abdumalikov A., Ummatov O., Mamajonov B., Esonkulova N., Ochilov G.	
Thermal treatment of various samples of low-molecular-weight polyethylene – a by-product of polyethylene production	145
Mamajonova M., Salixanova D., Abduraxmonov E., Ismailova M.	
Energetics of water molecule adsorption on modified bentonite surfaces	153
Abdurahimov A., Abdullayeva F., Usmonova Z.	
Infrared spectroscopic analysis of the purification of sunflower oil from waxy substances using perlite and vermiculite	160
Eshbaeva U., Gökhan Z., Bahri B.	
Theoretical foundations for ensuring the mechanical strength of papers containing collagen hydrolysates	167
Eshbaeva U.	
Research on the printing and technical properties of kraft paper incorporating "cotton cellulose-industrial waste-paculate"	172
Makhkamova D.	
Research on the separation of zinc from metallurgy waste with a mixture of ammonia and ammonium salts	181
Yuldasheva M., Makhkamova D., Turayev Z	188

Study of interaction of components in the $H_3BO_3-KNO_3-H_2O$ system	
Juraev M., Siddikov D., Askarova O.	
Aboveground components of salvia sarawschanica	194
Davlatova O.	
Zeolite-based bimetallic composite catalysts for pyrolysis and gasification: chemical technologies for deep biofuel upgrading and conversion intensification	202
Davlatova O.	
Use of BaNaY faujasite zeolite-based bimetallic composite catalysts for deep biofuel purification and selective xylene separation	208
Shamuratova M., Giyasidinov A., Eshmetov I., Nurjanova G.	
On the study of physicochemical properties of soils in the regions of the republic	214
Hoshimov F., Lutpillayeva M.	
Optimized chemical synthesis of stable silver nanoparticles using various reducing and stabilizing agents	220
Sarimsakova N.	
Investigation of the adsorption properties of the sorbent obtained in the process of modification of clinoptilothite in the purification of natural gas from sulfur compounds	227
Kokharov M., Bakhronov Kh., Sultonov A., Jumaeva D., Jumaboeva Z., Gaybullayeva D., Abdumutalova G.	
Adsorption isotherm of hydrogen sulfide on an activated adsorbent derived from hybrid paulownia tomentosa wood	234
Ikramov M., Zakirov B.	
Optimization of the aqueous solubility of monoammonium phosphate, potassium nitrate, and magnesium nitrate via thermodynamic analysis and selective crystallization	243
Nazhimova N., Seitnazarova O.	
Study of the chemical and mineralogical composition of thermal power plant wastes	249

TECHNICAL SCIENCES: MECHANICS AND MECHANICAL ENGINEERING

Berdiev U., Hasanov F., Avazov B., Ostanayev., Viktor M.	
Study of the nature and prospects of practical application of the magnetocaloric effect in energy-efficient cooling systems	256

Sodikov T.	
Research of mechanical part of solar photovoltaic power station	263
Otamirzayev D.	
Calculation of absorption coefficient of organic dye N719 for dye-sensitive solar cell (DSSC)	270
Abdovakhidov M.	
Study on determining the bending and torsional stiffness of packaged working bodies	276
Abdovakhidov M.	
The study torsion fluctuations packet worker organ with provision for influences of the correlation longitudinal acerbity their element	280
Shodmonov J.	
Energy-integrated smart textiles: international trends and prospects for uzbekistan's research ecosystem	285
Djurayev Sh.	
Integrated genetic-differential evolution approach for simultaneous pressure-drop reduction and efficiency enhancement in multi-cyclone dust collectors	292
Mamaxanova Z.	
Technological principles for creating a suit that ensures high reliability and safety in aquatic environments	297
Pirnazarov U.	
Theoretic observation of the cotton movement in the operating camera of the new separator	306
Pirnazarov U.	
Investigation of the interaction between the moving separator screen surface and the cotton mass	315
Yusupov D., Abduraximov D., Muxammadjonov M.	
Determination of energy loss in the magnetic core of oil power transformers under long-term operation conditions	319

ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

Abdullayev X.	
Transition function of second-order element	326

ECONOMICAL SCIENCES

Isroilov R.	
Criteria, indicators and laws of small business development	331

Isroilov R.

Concept of assessment of the economic development potential of small business and its evaluation **340**

Bustonov M.

Econometric analysis of the activities of multi-sectoral farms **348**

Bustonov M.

Global digitalization: paths and problems **356**

Kadirova Kh.

Prospects for development and improvement of the mechanism of functioning of the stock market **366**
