O. Changes in the microbiological quality and content of biogenic amines in chicken fillets packed using various techniques and stored under different conditions. *Food Microbiology*, 2022, 102, 103920. https://doi.org/10.1016/j.fm.2021.103920

2. Alayande, K. A., Aiyegoro O. A., Ateba C. N. Probiotics in animal husbandry: Applicability and associated risk factors. *Sustainability*, 2020, 12 (3), 1087. https://doi.org/10.3390/su12031087

3. Rolhion, N., Chassaing B. When pathogenic bacteria meet the intestinal microbiota. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2016, 371(1707), 15-20. https://doi.org/10.1098/rstb.2015.0504

4. Bhogoju, S., Nahashon S. Recent advances in probiotic application in animal health and nutrition: A review. *Agriculture*, 2022, 12 (2), 304. https://doi.org/10.3390/agriculture12020304

5. Chen, H., Liu, S., Chen, Y., Chen, C., Yang, H., & Chen, Y. Food safety management systems based on ISO 22000: 2018 methodology of hazard analysis compared to ISO 22000: 2005. *Accreditation and Quality Assurance*, 2020, 25, 23-37. https://doi.org/10.1007/s00769-019-01409-4

6. Maunsell B., Bolton D. J. Guidelines for food safety management on farms. *Food Safety Department*, Teagasc -The National Food Centre, 2004.

7. Arendt, M., Elissa, J., Schmidt, N., Michael, E., Potter, N., Cook, M., & Knoll, L. J. Investigating the role of interleukin 10 on Eimeria intestinal pathogenesis in broiler chickens. *Veterinary immunology and immunopathology*, 2019, 218, 32-34. https://doi.org/10.1016.2019.109934

8. Shields, S. J., Garner J. P., Mench J. A. Effect of sand and wood-shavings bedding on the behavior of broiler chickens. *Poultry science*. 2005, 84 (12), 1816-1824. https://doi.org/10.1093/ps/84.12.1816

9. Abadi, M. H. M. G., Moravej, H., Shivazad, M., Torshizi, M. A. K., & Kim, W. K. (2019). Effect of different types and levels of fat addition and pellet binders on physical pellet quality of broiler feeds. *Poultry science*, 98(10), 4745-4754. https://doi.org/10.3382/ps/pez190

10. Yeleusizova, A., Aisin, M., & Dyusembekov, S. (2023). Evaluation of the sanitary and hygienic characteristics of chicken meat and semi-finished products. *Ġylym ža″ ne bìlìm*, 1 (70), 27-34. https://doi.org/10.52578/2305-9397-2023-1-1-27-34

11. Guergueb, N., Alloui, N., Ayachi, A., & Bennoune, O. (2014). Effect of slaughterhouse hygienic practices on the bacterial contamination of chicken meat. *Scientific Journal of Veterinary Advances*, 3(5), 71-76. doi:10.14196/sjvs.v3i5.1405

12. Faridi, A., Gitoee, A., Donato, D. C. Z., France, J., & Sakomura, N. K. (2016). Broiler responses to digestible threonine at different ages: a neural networks approach. *Journal of Animal Physiology and Animal Nutrition*, 100(4), 738-747. https://doi.org/10.1111/jpn.12373

13. Ismail, I., & Joo, S. T. (2017). Poultry meat quality in relation to muscle growth and muscle fiber characteristics. *Korean journal for food science of animal resources*. 37(6), 873. https://doi.org/10.5851%2Fkosfa.2017.37.6.87

14. Nam, I. S. (2017). The implementation and effects of HACCP system on broiler farms in Korea. *JAPS: Journal of Animal & Plant Sciences*. 27(6). https://doi.org/10.1016/j.jclepro.2020.124231

15. Leonov, O. A., Shkaruba, N. Z., Cherkasova, E. I., & Odintsova, A. A. (2020, April). Quality assessment of temperature measurements in incoming inspection of raw meat. *In Journal of Physics: Conference Series*. Vol. 1515, No. 3, p. 032030. DOI 10.1088/1742-6596/1515/3/032030

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DEVELOPMENT OF BREAD TECHNOLOGY WITH THE USE OF GRAIN RAW MATERIALS

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Bread made with sourdough is the leader among other baked goods in nutritionist ratings. It is a wonderful source of energy and has a low glycemic index. Making bread using sourdough meets environmental requirements. The use of grain mixtures and their individual components helps to increase the nutritional value of bread and the quality of bread. This paper presents the possibilities of developing bread of nutritional value using sprouted components. The article presents the results of the study. Quality and nutritional value of bread with grain mixtures and components. Organoleptic, physical and chemical, microbiological and rheological studies of semi-finished products and bread of high nutritional value using grain components were carried out. It is proven that the

introduction of 28% of sourdough starter with components from grains, whish were prepared and sprouted in advance, to the mass of flour has a positive effect on the nutritional value of bread.

Keywords: bread, nutritional value, sourdough starter, components, grain.

РАЗРАБОТКА ТЕХНОЛОГИИ ХЛЕБА С ИСПОЛЬЗОВАНИЕМ ЗЕРНОВОГО СЫРЬЯ

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Хлеб, приготовленный на закваске, занимает лидирующие позиции среди другой выпечки в рейтингах диетологов. Это прекрасный источник энергии и имеет низкий гликемический индекс. Изготовление хлеба на закваске соответствует экологическим требованиям. Использование зерновых компонентов обеспечивает высокую пищевую ценность хлеба и более привлекательные хлебопекарные свойства, как доказывают данные исследования. Целью работы была разработка зернового хлеба повышенной пищевой ценности с использованием зерновых компонентов. В данной работе исследованы возможности разработки хлеба повышенной пищевой ценности с использованием пророщенных зерновых компонентов. В статье показаны результаты исследования качества, пищевой ценности хлеба с зерновыми смесями. Были проведены органолептические, физико-химические, микробиологические и реологические исследования полуфабрикатов и хлеба повышенной пищевой ценности с использованием зерновых компонентов. Доказано, что внесение к массе муки 28% закваски с компонентами из зерна, которые заранее были подготовлены и пророщены, положительно влияет на пищевую ценность.

Ключевые слова: хлеб, пищевая ценность, закваска, компоненты, зерно.

АСТЫҚ ШИКІЗАТЫН ПАЙДАЛАНЫП НАН ТЕХНОЛОГИЯСЫН ӘЗІРЛЕУ

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Ашытпадан жасалған нан диетологтардың рейтингінде басқа пісірілген өнімдердің арасында жетекші орын алады. Ашытпа пайдаланып нан жасау экологиялық талаптарға сай келеді. Астық компоненттерін пайдалану нанның жоғары тағамдық құндылығын және одан да тартымды нан пісіру қасиеттерін қамтамасыз етеді, зерттеулер дәлелдейді. Жұмыстың мақсаты астық компоненттерін пайдалана отырып, тағамдық құндылығы жоғары дәнді нан өндіру. Бұл жұмыста көкөніс және астық компоненттерін пайдалана отырып, тағамдық құндылығы жоғары нан өндіру мүмкіндіктері зерттелді. Жұмыста астық қоспалары бар тағамдық құндылығы бар нанның сапасын зерттеу нәтижелері көрсетілген. Көкөніс және астық компоненттерін қолдану арқылы тағамдық құндылығы жоғары жартылай фабрикаттар мен нанға органолептикалық, физика-химиялық, микробиологиялық және реологиялық зерттеулер жүргізілді. Ұн массасына алдын ала дайындалған және астық компоненттеріне негізделген ашытпаны 28% қосу нанның тағамдық құндылығына ең оң әсер ететіні дәлелденді.

Негізгі сөздер: нан, тағамдық құндылығы, ашытқы стартер, компоненттер, дән.

Introduction

Bakery products are one of the most widely consumed products all over the world. Bread made with sourdough is the leader among other baked goods in nutritionist ratings. It is a wonderful source of energy and has a low glycemic index. Making bread using sourdough meets environmental requirements [1]. During the work of lactic acid bacteria in the starter, vitamins are formed: B1, B2, PP, B4, B5, B6, B9, B12. Recently, there has been a noticeable trend among consumers towards grain breads known for their enhanced nutritional value. The use of basic and additional components ensures the high nutritional value of bread. [2-4].

The chemical composition of grain bread contains a large number of important substances.

These are proteins, fats, carbohydrates, vitamins (B1, B2, B6, PP), minerals. The first component contained in grain bread is nutritional components that help the gastrointestinal tract, helping to remove and heal stomach diseases. The body's daily fiber intake is about 30 grams. The proven norm for an adult engaged in various types of work is 250–300 g of bread per day. The need for a certain amount of bakery products may vary. It depends on age, how a person does work, what he prefers in the composition of foods included in the diet [5-7].

The first methods of preparing sourdoughs use traditional types of flour (wheat and rye) for everything else, without the use of main and additional raw materials that increase nutritional value. The missing factors of most existing bread production approaches are the low relationship between the starter and the dough, due to the low content of dietary fiber and other types of raw materials [8-11]. Bread, as known by type, how processed or how obtained, is usually made from pure soft medium wheat *(Triticum aestivum)*. However, as is often the case, refined wheat quads or without genetically modified approaches are whole grains or gluten-free grains (rice, corn, sorghum, millet), and other grains (amaranth, buckwheat, quinoa) and little-known grains. This has been the target of a variety of reasons, from health and environmental concerns to economic development. [12-15].

Materials and research methods

To conduct the study are: rye flour, variously ground grain mixture, consisting of pre-treated crushed wheat, corn with a particle size of no more than 3.5 mm. and flax seeds in a ratio of 1: 0.5: 0.2: 0.19 were used.

Experimental work took place in a research laboratory to determine quality and as a food safety necessity of Almaty Technological University JSC.

Physical and chemical (humidity, acidity, mass fraction of protein, vitamin composition, content of micro- and macroelements, amino acid composition contained in the finished bread) were studied.

All studies were conducted in accordance with existing GOST methods. Determination of protein, if necessary, was determined by GOST ISO 5983-2-2016. The vitamin composition was determined in accordance with GOST EN 14152-2013 - vitamin PP, GOST 32042-2012 - vitamin B1, GOST 32042-2012 - vitamin B2.

Determination of the amino acid composition was tested according to the M-04-38-2009 method. The determination of the content of mineral elements in the composition of the selected raw materials was carried out in accordance with: GOST P 51429-99-calcium, GOST 30615-99-phosphorus, GOST P 51429-99-sodium, GOST P 51429-99-potassium, GOST P 51429-9-magnesium, GOST ISO 9526-2017-iron.

As a starter, a thick starter is used, prepared from peeled rye flour, water and grain components if necessary, the leaven is brought to condition for 180-210 minutes at a temperature of 26-280C to an acidity of 12-14 degrees, after which the finished semi-finished product is used when kneading the dough. The dough can be kneaded from rye flour, wheat flour or their alternatives, other additional raw materials and ingredients such as yeast, salt, sugar, leaven is added when kneading the dough in an amount of 24-40% of the weight of flour in the dough, the dough is fermented for 50-60 minutes until the final acidity is 7-10 degrees. A mixture consisting of crushed sprouted wheat, crushed sprouted corn with a particle size of no more than 3.0 mm and flax seeds is used as grain components.

In a dough mixing machine, dough is kneaded from peeled rye flour, wheat flour, baker's yeast, salt, sugar and ready-made thick starter in an amount of 24-40% by weight of flour in the dough, the dough is fermented for 50-60 minutes until the final acidity is 7-10 degrees. The dough is left to ferment for 50-60 minutes until the final acidity is 7-10 degrees, then the dough is cut into dough pieces weighing 0.9 g. Dough pieces or semi finished products are given a round shape and covered in molds. Dough pieces are immediately proofed; After proofing, the dough pieces are laid out in any type of oven. The bread is brought to readiness for 50-55 minutes at a temperature of

200-2200C.

The goal of the work was to develop grain bread with increased nutritional value using grain components. A feature planned research is to search for new technology for rye-wheat bread with sprouted grain components to obtain bakery products of increased nutritional value.

The goal is to develop a method of producing rye-wheat bread using grain components for preparing dough, conditioning, shaping the dough, proofing dough pieces, and processing rye-wheat bread in the oven.

Results and discussion

To begin with, 2 types of thick rye sourdough were prepared: with the addition of grain components and a control sample without their addition. Sourdough made from peeled rye flour without the addition of a grain mixture has a more viscous, slimy consistency with porosity, a sour odor, and a

pronounced sourness. The color has a grayish tint. Sourdough with the addition of grain mixtures ferments faster, has uniform bubbles in its structure, and also has a more porous consistency with a sour-milk sweetish smell and a bready taste with sourness. Thus, with the same amount of fermentation time, the starter with the addition of a grain mixture has a more pleasant smell and taste and has a better consistency. Sourdough with the addition of grain mixtures has a more active fermentation, but in the sense of a process of assimilation of nutrients occurs more slowly, this starter does not peroxidize, does not liquefy, and its porosity is higher than in the control sample. Thus, sourdough with a grain mixture is more attractive at the initial stage of quality research.

The final acidity of the starter with the addition of a grain mixture was 10.4 degrees and 8.0 for the control sample. The lifting force was 15 minutes for bread with the addition of a grain mixture and 20 minutes for the control sample. The moisture content of the thick starter was 55%.

Microbiological indicators were also examined: the presence of mold fungi, *Escherichia coli* bacteria, and pathogenic microorganisms like *Salmonella*. In all studied samples, no pathogenic microflora exceeding GOST standards was found.

Next, the prepared starter with grain components is added to the dough in different percentages (24-40%). Some organoleptic, physical and chemical, and rheological properties were studied for all products (Table 1). From Table 1 in all samples the acidity did not exceed the permissible GOST values.

Table 1 – The influence different amounts of planned leaven affect the quality of bread with grain components

Name indicators	Bread quality indicators					
	from rye-wheat flour (control)	with percentage addition of sourdough based on grain components				
		24%	28%	32%	36%	40%
	№0	№1	№2	№3	№4	№5
Color	Gray with light brown tint	Gray with light brown tint	Gray with a light brown tint and subtle inclusions of grain	Brown with grain flecks	Dark brown with lots of grain flecks	
Taste	Sweetish, characteristic of this type of product	Sweetish, characteristic of this type of product and type of grain mixture, a pleasant aftertaste of grain components is felt. As the dosage increases, the taste increases, in sample No. 4 the taste becomes unpleasant				
Aroma	Pleasant aroma without foreign inclusions	Pleasant aroma with notes of rye bread and a grainy feel depending on the grain dosage. In sample number 4, this aroma intensifies and dominates the smell of bread				
Crumb moisture, %	43,0	43,5	44,0	44,5	44,7	45,2
Crumb acidity, degrees	6,0	6,0	6,2	6,4	6,6	6,8
Porosity, %	65	65	67	68	68,5	70
Specific volume of bread, cm^3/g	1,8	1,6	1,8	1,9	2,0	2,3
Form stability H:D	0,43	0,35	0,37	0,40	0,45	0,49
Total compressibility of bread crumb, units. device	110	115	120	125	130	130

An analysis of the quality of bread showed that the best in terms of physical and chemical indicators are samples with the addition of 24-40% grain components in the sourdough composition. The bread crust of numbers 2 and 3 has a more intense color, the taste and aroma of the products is also more pronounced. Structural-mechanical, rheological properties improve with increasing percentage of grains due to increased strengthening of the gluten frame test[10]. Next, the physical and chemical and biochemical parameters of bread with the addition of grain components were studied (Table 2).

Table 2 – Indicators of physical and chemical, biochemical quality of rye-wheat bread using grains

Name indicators	Bread quality indicators					
	from rye-wheat flour (control)	with percentage addition of grain components				
		24%	28%	32%	36%	40%
	№0	№1	№2	№3	№4	№5
Mass fraction of protein, g/100g	6,1	6,3	6,7	6,9	7,0	7,3
Mass fraction of fat, g/100g	1,1	1,2	1,2	1,2	1,3	1,3
Mass fraction of carbohydrates, g/100g	33,4	35,3	35,5	36,1	36,8	37,3
Mass fraction of dietary fiber, g/100g	3,4	4,0	4,4	4,6	4,8	5,0
Caloric content/energy value, kcal/kJ	174/729	180/754	197/825	198/830	201/840	203/851
Magnesium, mg	73,0	83,3	85,6	87,0	89,3	90,0
Calcium, mg	25,0	34,0	38,0	43,6	47,4	50,2
Thiamine, mg	0,31	1,37	1,49	1,53	1,60	1,.87
Riboflavin, mg	0,11	0,25	0,30	0,38	0,42	0,61

According to organoleptic studies, bread No. 3 is optimal. Since samples No. 4 and 5 are not acceptable for some organoleptic indicators (taste, aroma, color of crumb, crust), and sample No. 1 insufficiently has the aroma and taste of spices due to the insufficient proportion of grain mixtures and spices.

Test samples with the addition of 28-32% grain (samples number 2 and 3) with the addition of a grain mixture were the the best: porosity was better than the control sample by 7.4 and 11.2%, respectively, specific volume by 6.9 and 9.3%, dimensional stability by 4.4 and 8.0%, structural and mechanical properties by 21.7 and 29.7 total. unit device. In samples with the addition of up to 10% starter, the porosity was unambiguous and desirable. Further quantitative changes in the dosage of grain components lead to undesirable changes in the main indicators of bread quality.

Thus, the analysis of the quality of bread showed that the best in terms of physical and chemical indicators is the sample with the addition of 10% sourdough, and the analysis of organoleptic quality indicators indicates that the use of grain components contributes to the formation of a more intense color of the crust and a more pronounced taste and aroma of the products.

The existing patterns of changes in dough properties are explained by the occurrence of hydrolytic processes during dough maturation, which leads to greater flexibility of the gluten framework of the dough to stretch under the influence of carbon dioxide bubbles formed during alcoholic fermentation.

The optimal amount of bread with the addition of 28% grain components was determined, which can improve the organoleptic characteristics of bread and not worsen the physical and chemical properties of rye-wheat bread.

The inclusion of a grain mixture in the recipe not only leads to an increase in the quantity and content of amino acids, but also thus contributes to the nutritional value of bread by increasing the amount of amino acids necessary components in wheat bread - methionine and lysine.

The high vitamin value of bread containing processed grain compared to first-grade wheat flour is repeated by studying the amount of vitamin value of bread. In bread using processed grains and spices in the starter culture, its vitamin value increases as a result of an increase in thiamine by times, riboflavin by 1.6 times compared to the experimental samples.

Analysis of the obtained data on physical and chemical indicators indicates that the resulting bread samples are rich in minerals and vitamins. The amount of chemicals in breads using grain mixtures increased by up to 70% compared to the control sample. Compared to the control sample, the studied samples showed an increase in the content of protein, phosphorus, dietary fiber and antioxidant activity in grain breads using various starters.

Results and dicussion

Based on the results presented above and the research, the following conclusions can be drawn:

- the obtained indicators of the studied samples of bread using sourdough and processed grain for all organoleptic, microbiological and determined physicochemical indicators were within normal limits. Also, the use of grain components makes it possible to obtain products with high biochemical, baking and consumer properties. In particular, the content of fiber, easily digestible carbohydrates, magnesium, calcium, and vitamins increases, which generally expands the possibilities of using grain crops in baking and increasing the range. Thus, sprouted grain components can significantly enrich the nutritional value of bread and bakery products created on its basis;

-the addition of 28% grain components is the most optimal for a number of quality indicators of the finished bread;

-bread using sprouted grains is a promising area of baking due to its rich composition and prospects for use in the bakery industry, which requires more careful study.

Gratitude. The study was conducted within the framework and with the aim of initiative topic “Development of innovative technology for flour products of increased nutritional value based on processsed products of grain, legumes and oilseeds”.

REFERENCES

1. Gabitov B.H., Karimova A.Z. Discussions and disputes about the dangers of yeast bread. [Diskussii i sporyi o vrede drozhzhevogo hleba.] *Bulletin of RUK.* 2014. No. 4 (18), pp. 117-120. (in Russian).

2. Shansharova D.A., Nurgozhina Zh.K. Development of a new range of grain bread. MNPK “Modern trends in the development of chemical technology and engineering in the food and light industry”, Semey, 2023, pp. 351-354.

3. Nurgozhina Zh., Shansharova D., Umirzakova G., Maliktayeva P., Yakiyayeva M. The influence of grain mixtures on the quality and nutritional value of bread. *Slovak journal of Food Science*, 2022, pp. 320-340.

4. Parenti O., Guerrini L., Zanoni B. Techniques and technologies for the breadmaking process with unrefined wheat flours, *Trends in Food Science & Technology*, V. 99, 2020, pp.152-166.

5. Ovchinnikov A.S., Petrov N.Yu., Krayushkin A.I., Zagrebin V.L., Nikulin D.S., Salamatova A.K., Savina E.S. Nutrition optimization factor. The use of bakery products made from triticale flour with the addition of pumpkin protein. [Faktor optimizatsii pitaniya. Ispolzovanie hlebobulochnyih izdeliy iz muki tritikale s dobavleniem tyikvennogo belka.]. *Volgograd Medical Scientific Journal*. 2014. No. 4, pp. 27-30. 6. RF Patent No. 2187227, class. A 21 D 8/04, publ. 08/20/2002.

7. RF Patent No. 2616417, class. A 21 D 8/04, publ. 04/14/2017, Bulletin. No. 11.

8. Carbonetto B, Ramsayer J, Nidelet T, Legrand J, Sicard D. Bakery yeasts, a new model for studies in ecology and evolution. *Yeast*., 2018 35(11)- P. 603.

9. Dapčević-Hadnađev T., Tomić J., Škrobot D., Šarić B., Hadnađev M. Processing strategies to improve the breadmaking potential of whole-grain wheat and non-wheat fours. *Discov Food* 2, 11 (2022).

10. Wang Y, Maina NH, Coda R, Katina K. Challenges and opportunities for wheat alternative grains in breadmaking: Ex-situ-versus in-situproduced dextran. *Trends Food Sci Technol*. 2021; 113:232-44.

11. Luti S, Mazzoli L, Ramazzotti M, Galli V, Venturi M,Marino G, Lehmann M, Guerrini S, Granchi L, Paoli P,et al. Antioxidant and anti-inflammatory propertiesof sourdoughs containing selected Lactobacilli strains areretained in breads. *Food Chem.*, 2020. P.710.

12. Galli V, Venturi M, Pini N, Guerrini S, Granchi L, Vincenzini M. Liquid and firm sourdough fermen-tation: microbial robustness and interactions during con-secutive backsloppings. / *LWT –Food Sci Technol*., 2019. P. -15.

13. Rizzello CG, Portincasa P, Montemurro M, Di Palo DM, Lorusso MP, De Angelis M, Bonfrate L, Genot B, Gobbetti M. Sourdough fermented breads are moredigestible than those started with baker’s yeast alone: anin vivo challenge dissecting distinct gastrointestinal responses/*Nutrients*., 2019. pp.54.

14. Parmigiani Monteiro A. B., Moral C. R. Gil Prados M. de Lourdes Rodrigues Silva, Silva E. P., Damiani C., Francielo Vendruscolo, *International Journal of Gastronomy and Food Science*, V.24, 2021,15.

15. Suraiya Sh., Jang-Ho Kim, Jin Y. Tak. In-Soo Kong, Influences of fermentation parameters on lovastatin production by Monascus purpureus using Saccharina japonica as solid fermented substrate, LWT, V. 92, 2018, pp. 1-9.