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ВЕСТНИК

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

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NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабаршысы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабаршысының Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді мультидисциплинарлы контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

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INCREASE IN NUTRITION AND BIOLOGICAL VALUE OF WHITE BREAD WITH USE OF THE GRAIN MIX «OMEGA-6»

Abstract. In the course of research work, scientists of the Almaty Technological University have developed a technology for the production of bread on the basis of the Omega-6 grain mixture. The composition of the grain mixture includes grains and oilseeds: germinated corn, amaranth, flax seeds, sunflower seeds, pumpkins, sesame, wheat bran. This article presents the results of studies of the nutritional and biological value of wheat bread made from flour of the 1st grade and wheat bread with the addition of the "Omega-6" grain mixture.

When developing the formulation of grain mixtures based on grains and oilseeds, special attention was paid to the selection of enriching components of plant origin, depending on their functional orientation. In order to determine the optimal composition of the grain mixture, various versions of the ratios of the components were made and pastries were made using them. First of all, we focused on organoleptic characteristics, such as appearance, taste, aroma, color and porosity. According to the results of the analysis of the organoleptic indicators of variants of grain bread, using different dosages of the components of the Omega-6 grain mixture, clearly demonstrated using a profilogram, their optimal ratio was revealed. The optimum ratio: corn - 63%, amaranth - 1%, sunflower seeds - 2%, pumpkin seeds - 2%, flax seeds - 15%, sesame seeds - 2%, wheat bran - 15%.

Additionally, baking was carried out to determine the optimal dose of introducing the "Omega-6" grain mixture into the recipe from 5 to 30%. The best result in organoleptic and physico-chemical properties, the sample was obtained by adding 20% grain mixture. The finished products were sent to determine the nutritional and biological value of bread on the basis of the grain mixture "Omega-6" to the accredited testing laboratory "Food Safety". The following indicators of the control and experimental samples were determined: mass fraction of protein, fat, carbohydrates, vitamins of group B and vitamin E, magnesium, amino acid composition and antioxidant activity, microbiological indicators using modern standard research methods.

According to the results of the analysis, it was found that the content of essential amino acids increased by about 56.6%. The magnesium content increased by 33.8%. Sodium content increased by 7.3%. Potassium levels increased by 10.2%. Antioxidant activity in grain bread increased by 1.89 times compared with the control. The use of the "Omega-6" grain mixture in bread products allowed to increase the content of group B vitamins, vitamin E. The amount of mesophilic aerobic and optional anaerobic microorganisms decreased by 50% in experimental bread. Shelf life 72 hours. Thus, the use of the "Omega-6" grain mixture in the bakery industry will expand the range of grain types of bread with increased nutritional and biological value.

Keywords: bread, grain mix "Omega-6", germinated grain and olive grains, antioxidatic activity, amino acids, nutrition value.

Introduction. Modern bread baking is a highly developed branch of food production. However, in the field of bread baking, the problem of nutrient deficiency is still very acute, since the processing of grain into flour is accompanied by substantial losses of useful substances, such as vitamins, minerals, which are removed along with the embryo and the shell of the grain. From the point of view of food hygiene, varietal milling of wheat (flour of the highest and first grade) is depleted in useful nutrients that are of great importance for the metabolism in the human body [1-6].

One of the most urgent and sought-after ways to replenish biologically active substances is the creation of grain mixtures for their further enrichment of bread products [7-11]. Properly selected recipes and specially prepared cereal mixtures are a source of nutrient deficiencies in bread. This bread belongs to an exceptional place in human nutrition, due to the content in it of components with nutritional and biological value [12-16].

To improve the nutritional status of the population of the Republic of Kazakhstan in the field of healthy nutrition, it becomes necessary to expand the range and increase the production of functional bread products. One of the possible solutions is to attract new sources of plant origin (grain mixtures based on grains, oilseeds, wheat bran, rye) [17-21].

The aim of the work is to increase the nutritional and biological value of wheat bread using the "Omega-6" grain mixture, which consists of germinated grains and oilseeds rich in essential Omega 6 and Omega 3 essential fatty acids

Objects and research methods. Objects of study: grain mixture "Omega-6", wheat bread, grain bread based on the grain mixture "Omega-6".

Determination of the mass fraction of protein, fat, carbohydrates was performed by standard methods. The mass fraction of mineral substances was determined by atomic absorption spectroscopy (ACC) on a spectrometer with an electric atomization "QUANT-Z.ETA-T" with software according to GOST R 53152-2008. Water-soluble vitamins and the content of amino acids were determined using the "Kapel'-105" capillary electrophoresis system. Vitamin E was determined using high performance liquid chromatography on an Agilent Technologies 1200 Series high performance liquid chromatograph. The total determination of antioxidant activity was carried out on a "Tsvet Yauza 01-AA" instrument with an amperometric detector.

Results and its discussion. In the course of performing experimental studies, an optimal recipe for grain bread was developed based on the "Omega-6" grain mixture. To determine the optimal composition of the grain mixture, bread baking tests were carried out using different ratios of the ingredients of the "Omega-6" grain mixture. Additionally, bread baking was carried out to determine the optimal dose of the Omega-6 grain mixture in the recipe from 5 to 30%.

Table 1 shows the options for the percentage of ingredients of the grain mixture "Omega-6".

Table 1 – Percentage ratio of ingredients of the "Omega-6" grain mixture used for baking grain bread

Name	The percentage of ingredients, %			
Culture	Option 1	Option 2	Option 3	Option 4
Germinated, chopped corn grain	60	50	45	40
Germinated Amaranth	10	15	20	25
Sunflower	5	5	5	5
Pumpkin seeds	5	5	5	5
Flax seeds	5	7	10	15
Sesame seeds	5	4	3	2
Wheat bran	10	14	12	8

An organoleptic evaluation of grain bread baked with the addition of various variants of the "Omega-6" grain mixture was carried out. Figure 1 shows the profilogram of organoleptic indicators of variants of grain bread based on different dosages of the components of the Omega-6 grain mixture.

Option 1 - the crumb is poorly loosened, has a dense structure. It feels a well-pronounced taste of corn, bitterness appears when chewing.

Option 2 - the structure of bread is not developed, the crumb is characterized by low porosity. There is a strong flax flavor on the palate.

Option 3 - the taste is pleasant, there is a taste of wheat bran. Crumb has a uniform structure. Large pumpkin and sunflower seeds are often found in the crumb and evenly distributed.

Option 4 - the taste is pleasant and harmonious, all components are well-mixed and evenly distributed. The pulp has a well-developed porosity and texture.

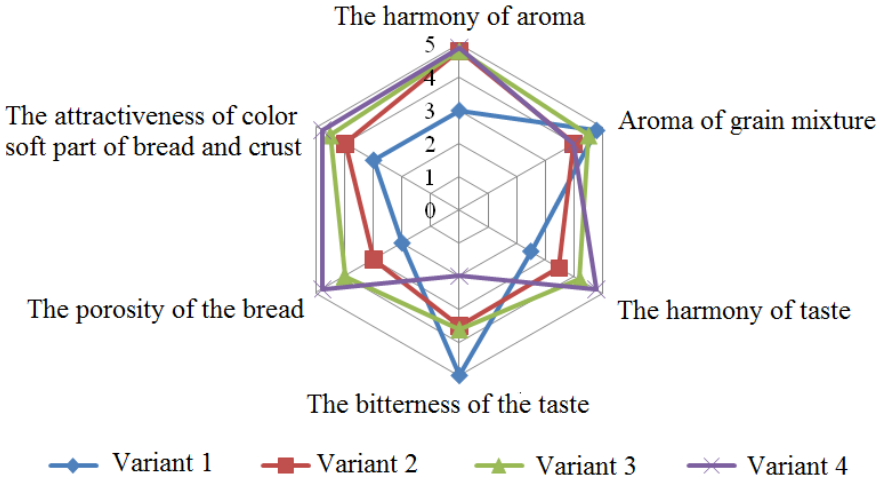

Figure 1 – Profilogram of organoleptic indicators of variants of grain bread based on different dosages of the components of the "Omega-6" grain mixture

As a result of the research, based on the analysis of the organoleptic indicators of grain bread options, using different dosages of the components of the Omega-6 grain mixture, clearly demonstrated using a profilogram, the optimum ratio of grain additives in the grain mixture was determined: sprouting crushed corn grain - 63%, germinated amaranth 1%, seeds of sunflower, pumpkin, flax, sesame - 2%, 2%, 15%, 2%, respectively, wheat bran - 15% (table 1).

Table 2 shows the organoleptic data on test baking, depending on the number of dosages applied to the grain mixture.

Table 2 – Comparative characteristics of grain bread with different content of the grain mix "Omega-6"

The name of indicators	Control (wheat bread)	The content of grain mixture in grain bread,%					
		5	10	15	20	25	30
Taste and aroma	Peculiar to wheat bread, pleasant	Peculiar to bread, pleasant	Peculiar to bread, pleasant	Peculiar to bread, pleasant	Peculiar to bread, pleasant	Peculiar to bread, pleasant	Peculiar to bread, pleasant
Appearance	Crust golden yellow	The crust of light brown color, traces and taste of the grain mixture is not observed	Crust of a pleasant brown color, the presence of a grain mixture is not pronounced	Crust of a pleasant brown color, the presence of a grain mixture is not very pronounced	Crust of a pleasant brown color, the presence of a grain mixture is poorly pronounced	Crust of a pleasant brown shade, with frequent appearances of grain mixture and gaps on the surface	Crust is light brown in color, with frequent appearances of grain mixture and large gaps
Acidity, 0T	3,3	2,9	2,9	3,0	3,0	3,2	3,2
Porosity, %	63	52	48	45	43	40	38

The data of table 2 show that the best result on organoleptic and physico-chemical parameters is characterized by a prototype with the addition of 20% of the "Omega-6" grain mixture. Indicators of acidity and porosity correspond to the regulatory limits that determine the quality indicators of bakery products.

Figure 2 shows a photograph of grain bread based on wheat flour of the first grade with an Omega-6 grain mixture containing 20%.

Figure 2 – Grain bread on the basis of wheat flour of the first grade with the addition of the grain mixture "Omega-6" 20%

Indicators of the nutritional and biological value of wheat bread (control) and grain bread with the content of the Omega-6 grain mixture of 20% were determined in the accredited testing laboratory "Food Safety" of the Almaty Technological University. The results are presented in table 3.

Table 3 – Chemical composition and nutritional value of wheat bread (control) and grain bread on the basis of the Omega-6 grain mixture

Indicators	Amount	
	Control	Grain bread on the basis of Omega-6 grain mix
The nutritional value		
Proteins, g / 100 g	7.6	8.6
Fat, g / 100 g	0.9	1.4
Carbohydrates, g / 100 g	72.0	65.6
Antioxidant activity, %	215	406.25
Vitamins		
E, mg / 100 g	0.50	1.30
B_1, mg / 100 g	0.02	0.07
B_2, mg / 100 g	0.05	0.08
B_3, mg / 100 g	0.02	2.0
B_5, mg / 100 g	0.20	0.80
B_6, mg / 100 g	0.13	0.20
B_9, mg / 100 g	–	0.03
C, mg / 100 g	–	1.30
Minerals		
Magnesium, mg / 100 g	58.12	88.05
Sodium, mg / 100 g	380	410
Potassium, mg / 100 g	220	245
Amino acids		
Arginine, g / 100 g	0.28	0.59
Lysine, g / 100 g	–	0.26
Tyrosine, g / 100 g	–	0.22
Phenylalanine, g / 100 g	0.22	0.58
Leucine + isoleucine, g / 100 g	1.22	1.53
Methionine, g / 100 g	–	0.20
Valine, g / 100 g	0.10	0.35
Proline, g / 100 g	0.61	0.70
Threonine, g / 100 g	–	0.32
Serine, g / 100 g	–	0.30
Alanin, g / 100 g	–	0.27
Glycine, g / 100 g	–	0.29
The total number of amino acids, g / 100 g	2.43	5.61

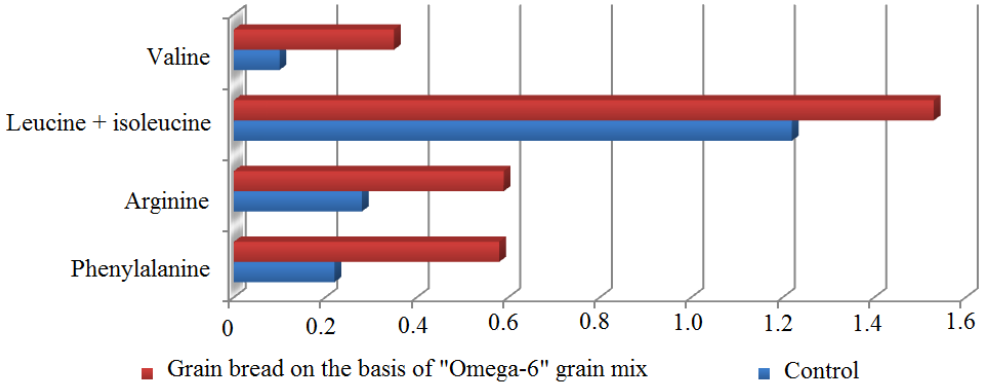

Figure 3 – Comparative chart of the content of essential amino acids in wheat bread on the basis of grain mixture "Omega-6" and control

The data in table 3 indicate that the content of essential amino acids increased by approximately 56.6%, especially among the essential amino acids essential for the organism, phenylalanine, arginine, threonine, leucine and isoleucine, and valine (figure 3). The protein content increased by 13.0%, the carbohydrate content decreased by 8.8%. In the grain bread, the content of vitamin E increased by 2.6 times, and the content of vitamin C was 1.30 mg / 100g, whereas in the control vitamin C was not found. The obtained results characterize the increase in the nutritional value of wheat bread using the Omega-6 grain mixture. The level of mineral substances also significantly increased, so the magnesium content increased by 33.8%, sodium by 7.3%, potassium by 10.2%. As compared with the control, the antioxidant activity in cereal bread increased 1.89 times.

The study found that bread based on "Omega-6" has better microbiological indicators than the control sample of bread. This is due to the addition of germinated grains to the grain mixture, which have enhanced antioxidant properties. Thus, the amount of mesophilic aerobic and optionally anaerobic micro-organisms (CMAFAnM or total microbial number, TBC) in wheat bread using the Omega grain mixture decreased by 50%. The most optimal shelf life, based on a QMAFAnM study, is 72 hours.

Fat mass fraction increased by 0.5 g / 100 g compared to the control sample, however, the obtained data indicate that the increase in the fat mass fraction did not have a significant effect on the shelf life of finished products due to an increase in antioxidant activity in the germinated grains of the grain mixture.

Table 4 – Effect of the "Omega-6" grain mixture on the period of safe storage of bread at a temperature of 20-25 °C

Storage time, hour	QMAFAnM, CFU / g	
	Control	Grain bread on the basis of Omega-6 grain mix
24	40	31
36	44	36
48	50	40
60	57	44
72	**65**	**46**
84	78	57
96	88	63

The data of table 4 indicate that the best result of the safe storage of bread, characterized by a prototype grain mixture "Omega-6", stored for 72 hours.

Conclusion. The inclusion of the "Omega-6" grain mixture in bread products has significantly increased the content of B vitamins, vitamin E, magnesium, and essential amino acids. Also as a result of germination of grains increased antioxidant activity. The use of the "Omega-6" grain mixture allowed us to increase the safe storage of bread up to 72 hours.

Thus, the use of the "Omega-6" grain mixture in the bakery industry will expand the range of grain types of bread with increased nutritional and biological value.

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"ОМЕГА-6" АСТЫҚ ҚОСПАСЫН ПАЙДАЛАНА ОТЫРЫП БИДАЙ НАННЫҢ ТАҒАМДЫҚ ЖӘНЕ БИОЛОГИЯЛЫҚ ҚҰНДЫЛЫҒЫН АРТТЫРУ

Аннотация. Ғылыми-зерттеу жұмыстарын орындау барысында «Омега-6» астық қоспасы негізінде нан өндіру технологиясы әзірленді. Астық қоспасының құрамына дәнді және майлы дақылдар кіреді: жүгері, амарант, зығыр, күнбағыс, асқабақ, күнжут, бидай кебегі. Мақалада «Омега-6» астық қоспасы қосылған бидай наны мен 1-сұрыпты ұннан жасалған бидай нанының тағамдық және биологиялық құндылығын зерттеу нәтижелері берілген.

Дәнді және майлы дақылдар негізіндегі астық қоспасы рецептурасын әзірлеу кезінде өсімдік тектес байытушы компоненттерді олардың функционалдық бағытына байланысты іріктеуге ерекше көңіл бөлінді. Астық қоспасының оңтайлы құрамын анықтау мақсатында компоненттердің әртүрлі қатынастарының нұсқалары дайындалды және оларды пайдалана отырып нандар пісірілді. Бірінші кезекте органолептикалық көрсеткіштерге назар аударды, мысалы, сыртқы түрі, дәмі, хош иісі, түсі және кеуектілігі. Астықты нан түрлерінің органолептикалық көрсеткіштерін талдаудың нәтижелері бойынша, «Омега-6» астық қоспасы компоненттерінің әртүрлі дозаларын қолдана отырып, профилограмма көмегімен көрнекі түрде көрсетілген олардың оңтайлы қатынастары анықталды. Оңтайлы арақатынас: жүгері – 63%, амарант – 1%, күнбағыс тұқымы – 2%, асқабақ тұқымы – 2%, зығыр тұқымы – 15%, күнжіт тұқымы – 2%, бидай кебегі – 15%.

Нан рецептурасына 5 тен 30% дейін «Омега-6» астық қоспасын енгізудің оңтайлы дозасын анықтау үшін қосымша нан пісіру жүргізілді. Органолептикалық және физикалық-химиялық көрсеткіштер бойынша ең жақсы нәтиже 20% астық қоспасы қосылған үлгі кезінде болды. «Омега-6» астық қоспасы негізінде дайындалған нандардың тағамдық және биологиялық құндылығын анықтау үшін дайын өнімдер «Тағам қауіпсіздігі» аккредиттелген сынақ зертханасына жіберілді. Бақылау және тәжірибелік үлгінің төмендегі көрсеткіштері анықталды: ақуыз, май, көмірсулардың массалық үлесі, В тобының витаминдері және Е витамині, магний, амин қышқылдық құрамы және антиоксиданттық белсенділігі, зерттеудің қазіргі заманғы стандартты әдістері пайдаланыла отырылып микробиологиялық көрсеткіштері.

Жүргізілген талдаулардың нәтижелері бойынша алмастырылмайтын амин қышқылдарының құрамы шамамен 56,6%-ға артқаны анықталды. Магний құрамы 33,8%-ға өсті. Натрий құрамы 7,3%-ға өсті. Калий деңгейі 10,2%-ға артты. Астықтық нанда антиоксиданттық белсенділік бақылау үлгімен салыстырғанда 1,89 есе артты. Нан өнімдерінде «Омега-6» астық қоспасын қолдану В тобының витаминдерінің, Е витаминінің құрамын арттыруға мүмкіндік берді. Тәжірибелі нанда мезофильді аэробты және факультативті анаэробты микроорганизмдердің саны 50%-ға азайды. Сақтау мерзімі 72 сағат. Осылайша, нан пісіру өндірісінде «Омега-6» астық қоспасын пайдалану жоғары тағамдық және биологиялық құндылығы бар нан түрлерінің ассортиментін кеңейтуге мүмкіндік береді.

Түйін сөздер: нан, «Омега-6» астық қоспасы, өнген астық және дәнді дақылдар, антиоксиданттық белсенділігі, аминқышқылдар, тағамдық құндылығы.

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ПОВЫШЕНИЕ ПИЩЕВОЙ И БИОЛОГИЧЕСКОЙ ЦЕННОСТИ ПШЕНИЧНОГО ХЛЕБА С ИСПОЛЬЗОВАНИЕМ ЗЕРНОСМЕСИ «ОМЕГА-6»

Аннотация. В ходе выполнения научно-исследовательских работ учеными Алматинского технологического университета разработана технология производства хлеба на основе зерносмеси «Омега-6». В состав зерносмеси входят зерновые и масличные культуры: пророщенная кукуруза, амарант, семена льна, подсолнуха, тыквы, кунжута, пшеничные отруби. В статье представлены результаты исследований пищевой и

биологической ценности пшеничного хлеба из муки 1 сорта и пшеничного хлеба с добавлением зерносмеси «Омега-6».

При разработке рецептуры зерносмеси на основе зерновых и масличных культур особое внимание уделялось подбору обогащающих компонентов растительного происхождения в зависимости от их функциональной направленности. В целях определения оптимального состава зерносмеси были изготовлены различные варианты соотношений компонентов и произведены выпечки с их использованием. В первую очередь акцентировали внимание на органолептические показатели, такие как внешний вид, вкус, аромат, цвет и пористость. По результатам анализа органолептических показателей вариантов зернового хлеба, с применением различных дозировок компонентов зерносмеси «Омега-6» наглядно продемонстрированной с помощью профилограммы было выявлено их оптимальное соотношение. Оптимальное соотношение: кукуруза – 63%, амарант – 1%, семена подсолнечника – 2%, семена тыквы – 2%, семена льна – 15%, семена кунжута – 2%, отруби пшеничные – 15%.

Дополнительно проводились выпечки для определения оптимальной дозы внесения в рецептуру хлеба зерносмеси «Омеги-6» от 5 до 30 %. Лучший результат по органолептическим и физико-химическим показателям, получился образец при добавлении 20% зерносмеси. Готовые изделия были направлены для определения пищевой и биологической ценности хлеба на основе зерносмеси «Омега-6» в аккредитованную испытательную лабораторию «Пищевая безопасность». Были определены нижеследующие показатели контрольного и опытного образца: массовая доля белка, жира, углеводов, витамины группы В и витамин Е, магния, аминокислотный состав и антиоксидантная активность, микробиологические показатели с использованием современных стандартных методов исследований.

По результатам проведенных анализов было выявлено, что содержание незаменимых аминокислот увеличилось примерно на 56,6%. Содержание магния возросло на 33,8%. Содержание натрия повысился на 7,3%. Уровень калия увеличился на 10,2%. Антиоксидантная активность в зерновом хлебе по сравнению с контролем увеличилась в 1,89 раза. Применение зерносмеси «Омега-6» в хлебных изделиях позволило повысить содержание витаминов группы В, витамина Е. В опытном хлебе уменьшилось количество мезофильных аэробных и факультативно анаэробных микроорганизмов на 50%. Срок хранения 72 часа. Таким образом, использование зерносмеси «Омега-6» в хлебопекарном производстве позволит расширить ассортимент зерновых видов хлеба с повышенной пищевой и биологической ценностью.

Ключевые слова: хлеб, зерносмесь «Омега-6», пророщенные зерновые и масличные культуры, антиоксидантная активность, аминокислоты, пищевая ценность.

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