TECHNICAL SCIENCES

EFFECTS OF MULTICOMPONENT MIXTURE "SOLODOK SUPER" ON THE QUALITY OF WHEAT BREAD ENRICHED WITH A SPROUTED GRAIN MIXTURE

Bilyk O.,
Ph.D., Assoc. Prof.
Burchenko L.,
Assistant Prof.
Bondarenko Yu.,
Ph.D., Assoc. Prof.
National University of Food Technologies
Piddubnyi V.
D.Sc., Assoc. Prof.
Kyiv National University of Trade and Economics

Abstract

This paper is dedicated to improving the technology of bakery products made from wheat flour with added mixture of sprouted grains. The sprouted grain mixture (SGM) contains wheat, barley, corn, and oat grains, produced by “Choice” LLC (Kyiv, Ukraine). It has been proven that increasing the amount of grain mixture to 15% to weight of flour has a negative impact on sensory, physical, and chemical qualities of bread products. This amount of sprouted grain mixture reduces viscosity and increases spreading of dough, which leads to the smaller volume of the finished products. Thus when adding 15% of the mixture, it is recommended to use multicomponent mixtures. Multicomponent mixture "Solodok SUPER" has been developed and its optimal dosage has been established. Using it increases specific volume of bread products and improves their porosity and shape stability.

Keywords: sprouted grain mixture, baking properties, consumer properties, wheat bread, bread freshness, bread enrichment, bread staling.

Introduction. Nutrition problems have always been given a lot of attention around the world. Nutrition is one of the main factors that has large impact on health, performance, and life expectancy. Balanced nutrition involves a balanced and varied diet, because no product is able to provide all the necessary nutrients. Malnutrition has long been considered a risk factor for the development of nutritional diseases among the population due to nutrient imbalances in the diet [1]. The main direction of solving this problem is to meet the physiological needs of the population in basic nutrients and energy.

Bread is a staple food and is part of the daily diet. Increasing its nutritional value makes it possible to improve the quality of bakery products.

In order to enrich the chemical composition of bread products and increase their nutritional value, it is advisable to use a sprouted grain mixture (SGM) that consists of wheat, barley, oats, and corn. Sprouted grains include the full range of ingredients needed for a balanced diet: proteins, easily digestible carbohydrates, fiber, fatty acids, minerals, vitamins, and enzymes [2]. Also, the mixture retains almost all the substances contained in the whole grain, which is rather important, considering the losses in the chemical composition of grain induced by flour production [3].

Thus, there is a need to expand the range and increase the nutritional value of bread products.

Analysis of modern research on this subject. It should be noted that among the great variety of food products, bread is characterized by the complete absence or minimal (compared to other products) content of flavorings, dyes, preservatives, etc. Its safety for the human body and naturalness is what allows bread to be the basis for creating functional products with predetermined chemical composition and physiological properties. Along with these advantages, bakery products are characterized by an imbalance in the main food nutrients: high carbohydrate content and low protein content with incomplete amino acid composition. In order to increase the biological value of bread products, it is advisable to use sprouted grains of wheat, barley, oats, and corn. After all, a large amount of micro- and macronutrients is accumulated due to the germination process. Despite the fact that sprouted grains significantly enrich the product with nutrients, their use in bread products has been limited until recently. The reason for this is the complex uncontrolled processes of wheat grain germination, which cause high accumulation of enzymatic activity that negatively affects dough structure.

Due to the rich chemical composition of SGM, it can be argued that it is an effective source of soluble dietary fiber, protein, vitamins, and minerals. However, a possible disadvantage of its use in bread technology is high autolytic activity and acidity, as well as low whiteness and grey color. This must be taken into account when improving the technological process. It is recommended to add multicomponent mixtures to bakery products with SGM.

The effect of lactic acid on the dough has been studied [4, 5]. It has been discovered that increasing dough acidity inhibits α-amylase activity, accelerates dough maturation, improves the taste of bakery products, prevents rope spoilage. A positive effect of phosphatide concentrates on the quality of bread products has been discovered [7, 8, 9]: the volume and porosity increased and the crumb lost its "softness" more slowly during storage, which is a sign of slower staling. It has been also noted that bakery products with phosphatide concentrates retain a crispy, shiny crust longer. Moisture-retaining food additives have been studied [10, 11] and it has been determined that carboxymethylcellulose and apple pectin bind free water in the dough, thereby extending the shelf life and freshness of bread products as evidenced by studying the structural and mechanical properties of the crumb on the penetrometer and its sensory qualities. It has been found [12, 13, 14] that inulin strengthens the gluten structure of the dough and improves the fermentation activity of the dough microflora. It has been determined that adding 3% of inulin to the weight of flour improves sensory, physical, and chemical properties of the finished products. Additionally, introducing inulin improves economic performance of wheat bread production due to reduced losses and increased yield of finished products. It is also recommended to add dry wheat gluten. According to the studies [15, 16, 17], it is recommended to use dry whey enriched with Mg and Mn to increase dough acidity. Adding 5% of dry whey to the weight of flour improves the quality of wheat dough and bread: increases the specific volume, prolongs the shelf life, increases the content of calcium, phosphorus, potassium, magnesium, and iron.

The goal of this research is to develop and determine the optimal dosage of the multicomponent mixture "Solodok SUPER" for wheat bread enriched with 15% of SGM to the weight of flour.

Materials and methods. The object of research is wheat bread. In this study, we used premium organic wheat flour, organic SGM of wheat, barley, oats, and corn produced by “CHOICE” company (Kyiv, Ukraine). It is a certified organic raw material grown by organic farming technologies without the use of synthetic mineral fertilizers, chemical plant protection products, or GMOs. Pressed yeast produced by TM "Lviv Yeast" is not certified as an organic food product. Its content in the formula is 3%, which is a permitted amount of inorganic ingredients for organic food products.

Autolytic activity has been determined by the amount of water-soluble substances formed under the temperature conditions of baking bread.

The dough has been made by the straight method with moisture content of 43.0% according to wheat bread technology. SGM has been introduced in the amount of 15% to the weight of flour. The dough has been made in a two-speed kneader Escher. The dough has been formed manually, then proofed in a thermostat at a temperature of (38±2) °C and (78±2) % relative humidity until ready. The bread loaves weighing 0.25 kg have been formed manually. The products were baked in the Sveba-Dahlen cabinet oven at a temperature of 220… 240 °C for 25…30 minutes.

The gas-forming ability and dynamics of gas formation, which characterize the biochemical processes in the dough, have been studied using the device AG-1M according to the method [20].

The bread quality has been evaluated by physicochemical (specific volume, shape stability, structural and mechanical properties of the crumb) and sensory parameters (appearance, crust condition, porosity structure, taste, aroma) [19].

The freshness duration of the products has been determined by the changes in the structural and mechanical properties of the crumb. Its total deformation after 48 hours of storage has been studied on the penetrometer AP 4/1 [19].

The main part of the research. Amylases play a significant role in bread technology. During the processing of flour with active α-amylase, the starch is deeper hydrolyzed, which intensifies the fermentation process. During baking, low-molecular-weight dextrins accumulate in the bread crumb, which causes its stickiness. Due to the high autolytic activity of SGM, it is advisable to investigate its effect on the autolytic activity of dough, which is assessed by the amount of water-soluble substances formed under the temperature conditions of baking bread. The research results are presented in Fig. 1.

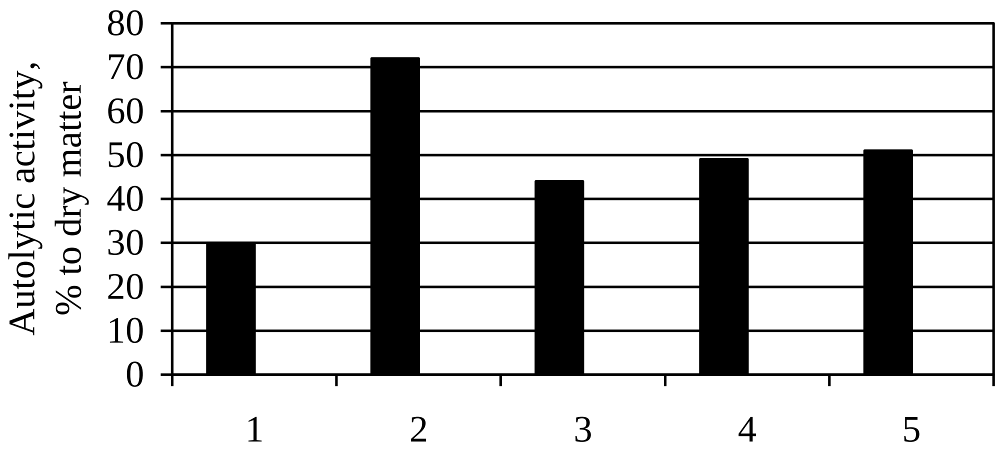

Fig. 1. Autolytic activity: 1 – premium wheat flour; 2 – sprouted grain mixture; 3 – premium wheat flour with 5% of SGM; 4 – premium wheat flour with 10% of SGM; 5 – premium wheat flour with 15% of SGM.

The results show that adding SGM to dough leads to the accumulation of water-soluble substances. Thus, the more SGM is added, the more water-soluble substances accumulate. Adding 5% of SGM increases the autolytic activity to 44% compared to wheat flour where the autolytic activity is 30%. This number increases with increased dosage of SGM. Increased autolytic activity in the test samples is explained by the fact that SGM has an autolytic activity of 55%, which is greater than in flour. The high autolytic activity of SGM is due to the processes that take place during grain germination, i.e. the activation of α-amylase. Therefore, when developing a multicomponent mixture, it is necessary to include organic acids in the formula.

The effect of SGM on the intensity of alcoholic fermentation in the dough has been determined by the amount of carbon dioxide released during fermentation and proofing of the dough.

The wheat dough has been prepared by straight method. SGM has been added in the amount of 5, 10, and 15% to the weight of flour. The gas-forming ability of the flour has been determined by volumetric method on the AG-1M device during 3 hours of fermentation. The results of studying the gas-forming ability are shown in Fig. 2, the dynamics of gas formation in Fig. 3.

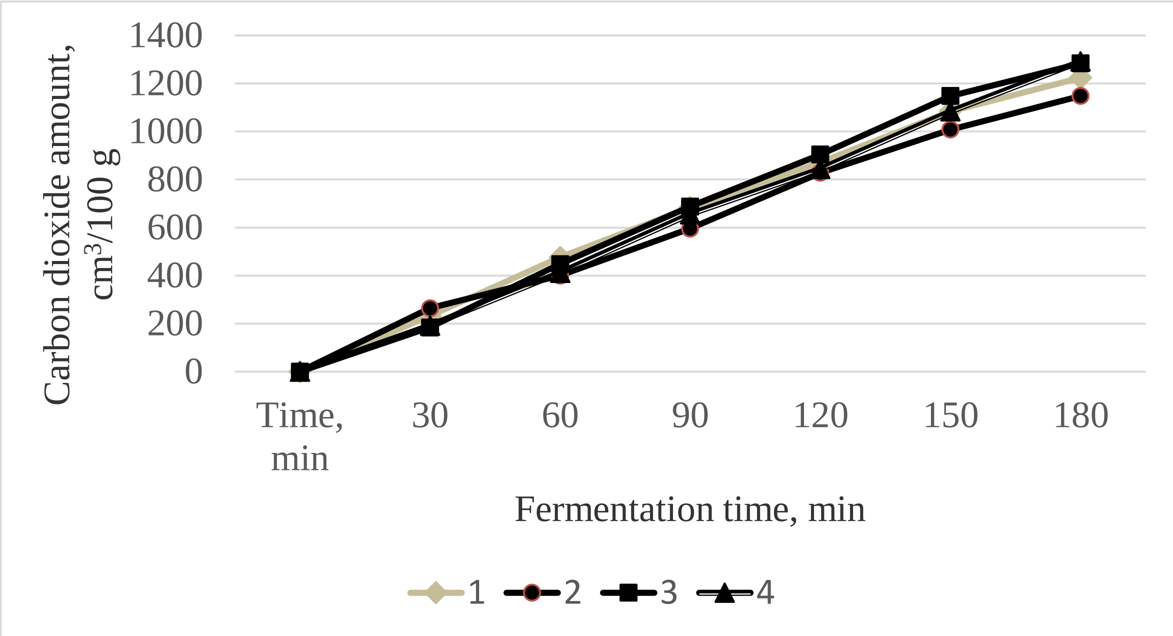

Fig. 2. The effect of sprouted grain mixture on the gas-forming ability of the dough: 1 – control sample without additives; 2 – sample with 5% of SGM; 3 – sample with 10% of SGM; 4 – sample with 15% of SGM.

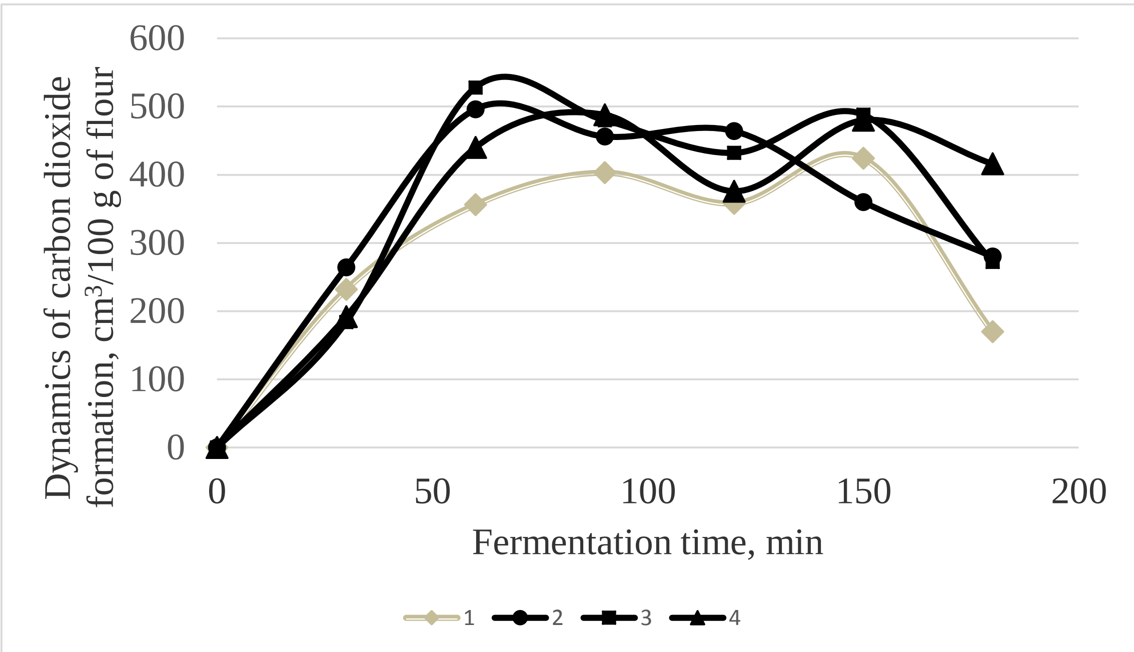

Fig. 3.
The effect of sprouted grain mixture on the dynamics of carbon dioxide formation over time: 1 – control sample without additives; 2 – sample with 5% of SGM; 3 – sample with 10% of SGM; 4 – sample with 15% of SGM.

Fig. 2 and 3 show that the second and third samples have the best results with the 2% difference between them. From 90 minutes onwards, the second sample significantly differs from the control, which can be explained by the start of a more intensive fermentation process as a result of adding 10% of the mixture containing sugars and amylase, which served as nutrients for yeast. Adding 5% of the mixture does not cause a positive effect due to the small amount of sugars. Adding 15% of the mixture causes negative effect due to excessive amount of sugars suppressing vital activity of yeast. At the end of fermentation, the second sample exceeds the control by 164%, which allows to reduce the fermentation time of the second sample. Therefore, this can be useful for making bread by accelerated technology: the fermentation process can take 20 minutes.

Analyzing the results of research establishes that 10% of SGM to the weight of flour is preferable to ensure quality, but increasing the dosage to 15% is recommended to improve the nutritional value.

In order to ensure the sensory and physicochemical quality of bakery products with 15% of SGM, it is necessary to develop a multicomponent mixture.

Firstly, a literature analysis has been held on the possibility of using certain additives and their dosage, in order to establish the optimal dosage of the active part of the multicomponent mixture.

A baking test has been done to determine the optimal dosage of food additives and ingredients to develop a multicomponent mixture "Solodok SUPER". Wheat bread has been used as a control sample for the wheat bread enriched with 15% of SGM to the weight of flour. The optimal dosage of each ingredient has been determined by analyzing the following parameters of the finished products: specific volume, shape, crust color, staling after 72 hours of storage, crust condition, crumb color, porosity structure, shape stability, crumb rheological properties, aroma, and chewiness.

Using dry whey enriched with magnesium and manganese is recommended for the multicomponent mixture [15]. Carboxymethylcellulose, dry wheat gluten, apple pectin, and inulin are proposed as moisture-retaining additives [11, 12, 21, 22, 23], dry non-fat phosphatide concentrate as an emulsifier [7, 9], lactic acid to increase the acidity [6, 8], and enzyme preparation Deltamalt FN-A 50 is proposed to neutralize the effect of sprouted grains [24].

In order to determine the optimal dosage, a baking test has been done. The complex quality indicator of the resulting product has been studied, which determined the optimal dosage of each ingredient. The results are summarized in Table 1.

Table 1

Studying the optimal dosage of the ingredients in the multicomponent mixture "Solodok SUPER" by complex quality indicator,

n=3, p≥0,95, δ 3…5 %

Parameter	Control sample(without additives)	Dosage (%) to the weight of flour				
Complex quality indicator	78.4	Dry milk whey enriched with Mn and Mg				
		0.25	0.5	0.75	1.0	1.25
		80.6	82.1	82.2	82.6	82.8
Complex quality indicator	78.4	Enzyme preparation Deltamalt FN-A 50				
		0.001	0.0015	0.002	0.0025	0.003
		84.4	89.6	92.2	92.2	92.2
Complex quality indicator	78.4	Carboxymethylcellulose				
		0.1	0.2	0.3	0.4	0.5
		80.6	82.9	84.3	86.7	86.2
Complex quality indicator	78.4	Dry wheat gluten				
		0.2	0.3	0.4	0.5	0.6
		79.2	80.6	81.4	82.3	82.3
Complex quality indicator	78.4	Apple pectin				
		0.2	0.4	0.6	0.8	1.0
		80.8	82.2	84.9	84.8	84.5
Complex quality indicator	78.4	Inulin				
		0.2	0.4	0.6	0.8	1.0
		82.2	83.1	843	86.6	86.8
Complex quality indicator	78.4	Phosphatide concentrate				
		0.10	0.20	0.30	0.40	0.50
		80.5	81.9	82.6	82.6	82.5
Complex quality indicator	78.4	Lactic acid				
		0.01	0.015	0.02	0.025	0.03
		80.8	81.6	81.6	81.5	81.4

Manufacturers and scientists recommend to halve the amount of active additives and food ingredients in complex baking improvers due to the synergistic effect of co-administration.

As a result of this research, multicomponent mixture "Solodok SUPER" has been developed. It is intended to improve the quality of wheat bread and its formula includes 15% of SGM to the weight of flour (Table 2).

Table 2

Formulation of a multicomponent mixture "Solodok SUPER"

Ingredients	Optimal dosage (%) to the weight of flour in the formula of "Wheat bread from premium flour" with 15% of SGM
Inulin	0.50
Dry milk whey enriched with Mn and Mg	0.25
Enzyme preparation Deltamalt FN-A 50	0.001
Carboxymethylcellulose	0.20
Dry wheat gluten	0.25
Apple pectin	0.30
Phosphatide concentrate	0.15
Lactic acid	0.01
Total	1.66

The optimal dosage of the active part (% to the weight of flour) has been established according to the complex quality indicator: inulin – 0.50; dry milk whey enriched with Mg and Mn – 0.25; enzyme preparation Deltamalt FN-A 50 – 0.001; carboxymethylcellulose – 0.20; dry wheat gluten – 0.25; phosphatide concentrate – 0.15; apple pectin – 0.3, and lactic acid – 0.01.

Further research concerned the effect of the multicomponent mixture "Solodok SUPER" on the technological process and the quality of wheat bread. Research samples: 1 – wheat bread from premium flour (control sample without additives); 2 – wheat bread from premium flour with 15% of SGM to the weight of flour; 3 – wheat bread from premium flour with 15% of SGM to the weight of flour and developed multicomponent mixture "Solodok SUPER". The research results are presented in Table 3 and Figure 4.

Table 3

The effect of the multicomponent mixture "Solodok SUPER" on the technological process and product quality, n=3, p≥0,95, δ 3…5 %

Parameters	Control sample without additives	Added	
		15% of SGM to the weight of flour	Multicomponent mixture "Solodok SUPER"
Dough			
Moisture content, %	43.0		
Fermentation time, min	20		
Titrated acidity, degrees: starting	1.6	2.2	2.2
final	2.0	2.6	2.4
Proofing time, min	50	50	45
Gas formation during dough fermentation and proofing, cm^3/100 g of the dough	812	992	1058
Finished products			
Specific volume, cm^3/100 g	298	263	312
Shape stability, H/D	0.47	0.25	0.48
Porosity, %	78.0	64.0	82.0
Acidity, degrees	1.8	2.4	2.2
Total crumb deformation, penetrometer units, after: 4 hours	84	98	106
72 hours	42	74	88
Sensory qualities:			
state and color of crust	Smooth without cracks, light yellow color	Smooth without cracks, golden color	
crumb color	Light-white	Grey	Light-grey
form	Bread with a noticeably convex upper crust		Bread with a domed upper crust
porosity structure	The pores are small, thin-walled and medium, fairly evenly distributed	Pores of different sizes, medium thickness, distributed unevenly	The pores are small, thin-walled and medium, fairly evenly distributed
aroma	Typical for the product	Pleasant, with a flavor of sprouted grains	
taste	Typical for the product	Pleasant, with a flavor of sprouted grains	

Fig. 4. Finished products with the multicomponent mixture "Solodok SUPER": 1 – control sample of wheat bread; 2 – wheat bread with 15% of SGM; 3 – wheat bread with the multicomponent mixture "Solodok SUPER".

Conclusion. As a result of this research, it has been determined that increasing the dosage of SGM to 15% to the weight of flour leads to excessive amylase activity and intensification of the fermentation process. Multicomponent mixture "Solodok SUPER" has been developed in order to neutralize the amylase activity and improve the quality of products with the maximum possible amount of SGM, i.e. 15% to the weight of flour. The formula includes inulin, enriched dry whey, enzyme preparation Deltamalt FN-A 50, carboxymethylcellulose, dry wheat gluten, phosphatide concentrate, apple pectin, and lactic acid. The developed multicomponent mixture "Solodok SUPER" has a positive effect on the quality of wheat bread enriched with sprouted grain mixture of wheat, barley, oats, and corn. Using this multicomponent mixture increases the specific volume of bread products, improves their porosity and shape stability. Introducing SGM and multicomponent mixture "Solodok SUPER" also changes the taste of the products: they acquire the flavor of sprouted grains.

References

1. Белецкая Н.М., Догаева Л.А., Марченко О.Б. Функциональные продукты питания : учеб. пособ. под ред. В.И. Теплова. – М. : А-Приор, 2008. – 240с.
2. Патент 46340 Отримання біологічно активного продукту «Пророщені зерна»/ Мілютін О. І., Варганова І. В. , Потапенко С. І.. – опубліков. 10.12.2009, Бюл. №23.
3. Пророщені зерна. Режим доступу: https://choice.if.ua/shop/ua/zdorovoe-pitanie/proroshye-zerna-v-korobke.html
4. Food Additives and Processing Aids used in Breadmaking / Luis Carlos Gioia, José Ricardo Ganancio и Caroline Joy Steel, 2017. – P. 21. Режим доступу: http://dx.doi.org/10.5772/intechopen.70087
5. Овсянікова Т.О., Кричковська Л.В. Влияние молочной кислоты на качество хлебобулочных изделий и потери микроэлементов при выпекании и хранении. Food Science and Technology. – 2016. – №2 (10). – С.26
6. Регламент (ЄС) № 1333/2008 Європейського парламенту і ради від 16 грудня 2008 р. по харчовим добавкам. Режим доступу: https://fishquality.ru/assets/files/Documents%20on%20activities/Legislation/EU/%D0%A0%D0%B5%D0%B3%D0%BB%D0%B0%D0%BC%D0%B5%D0%BD%D1%82%201333-2008.pdf
7. Ефективність використання лецитину в хлібопеченні / В. С. Полодюк, Л. Ю. Арсеньєва, В. Ф. Доценко // Наукові праці НУХТ. – 2004. – № 15. – С. 35–38.
8. Пищеві інгредієнти у виробництві хлібобулочних та мучних кондитерських виробів / А. П. Нечаев, С. В. Краус, Э. Фихтнер и др. - М .: ДеЛи плюс, 2013. – 527 с.
9. Технологічний ефект використання фосфатидних концентратів у виробництві хлібобулочних виробів / Л. М. Бурченко, О. А. Білик, О. В. Кочубей-Литвиненко, В. І. Бондар, В. О. Іскрицька //Харчова промисловість, №24, 2018, с.40-47.
10. Харчові добавки та цукристі речовини в технології хлібобулочних виробів : монографія / В. І. Дробот, О. А. Білик, Н. І. Савчук, Ю. В. Бондаренко ; за ред. В. І. Дробот ; М-во освіти і науки України, Нац. ун-т харч. технол. – Київ : АртЕк, 2017. – 253 с.
11. Использлвание пектина с целью улучшения качества хлеба / С. Н. Силко, Н. В. Сокол, Л. В. Донченко // Успехи современного естествознания, № 5, 2005, с. 60.
12. Food Stabilisers, Thickeners and Gelling Agents. Edited by A. Imesin. Wiley-Blackweel: Oxford, 2010. – 372 p.
13. Sensory profile and evaluation of the degree of acceptability of bread produced with inulin and oligofructose / Kelli de Souza-Borges, Patricia & Conti-Silva, Ana. // Brazilian Journal of Food Technology. – 2018. Vol. 21. Режим доступу: https://doi.org/10.1590/1981-6723.4016 .
14. Биологические механизмы влияния инулина на качество пшеничного хлеба / А. А. Артамонов, А. Ю. Крыницкая // Вестник технологического университета. – 2017. – №15 (20), – С. 134-135.
15. Исследование влияния обогащенной сухой сыворотки на качество хлеба специального назначения / А. И. Украинец, О. В. Кочубей-Литвиненко, Е. А. Билык, В. Б. Захаревич, Т. А. Васильченко //

Восточно-Европейский журнал передовых технологий. – 2016. – №2/1(80), – С. 32-41.

16. Хліб пшеничний із сухою сироваткою, збагаченою магнієм, для харчування людей літнього віку / О. В. Кочубей-Литвиненко, О. А. Білик, В. Б. Захаревич, Т. О. Васильченко // Проблемы старения и долголетия. – 2016. – №2 (25), – С. 253-262.

17. Молочна сироватка покращує якість хліба з суміші пшеничного і кукурудзяного борошна / В. І. Дробот // Хранение и переработка зерна научно-практический журнал. – 2014. – №10 (187).

18. Технологія хлібопекарського виробництва / В.І. Дробот. – К.: Логос, 2002. – 368 с.

19. Технохімічний контроль сировини та хлібопекарських і макаронних виробів : навч. посіб. / В. І. Дробот, В. Г. Юрчак, О. А. Білик та ін. // за ред. В. І. Дробот – К.: Кондор-Видавництво, 2015. – 972 с.

20. Лебеденко Т. Є. Технологія хлібопекарського виробництва. Практикум : навч. пос./ Т.Є. Лебеденко, Г.Ф. Пшенишнюк, Н.Ю. Соколова – Одеса: «Освіта України». – 2014. – 392с.

21. Bread staling: Effect of gluten on physicochemical properties and molecular mobility / Curtiab E., Carinib E., Tribuzioc G., Vittadinib E. // LWT - Food Science and Technology. 2014. Vol. 59, Issue 1, P.P. 418-425. Режим доступу: https://doi.org/10.1016/j.lwt.2014.04.057

22. Shelf life extension of wheat bread by alhydwan flour and Carboxymethylcellulose and improvement of their quality characteristics, dough rheological and microstructure / Al-F. Ammarab, A.Siddeegbe, F. M. Aqland, S.M. Howladarc, M.Y. Refaia, M. A. Haytham, A.A.D.Hajjara, M. G.M.Sulamaind Moses, V.M.Chambabf, B.G.Kimanibg, A. Salehh, M.Baeshenc // International Journal of Biological Macromolecules. – 2020. - Vol. 156, P.P. 851-857. Режим доступу: https://doi.org/10.1016/j.ijbiomac.2020.04.023

23. Дослідження впливу інуліну з цикорію на якість пшеничного хліба / Yulia Bondarenko, Olena Bilyk, Volodymyr Bondar, Kateryna Lukyanenko // Технологічний аудит та резерви виробництва. – 2018. – Т. 3, N 3(41). – С. 50-54.

24. Почему число падения так важно? - Текст : непосредственный // Хлебопродукты. - 2021. - № 1. - С. 27.

ОПТИМИЗАЦИЯ ЗАЩИТЫ БЕСПИЛОТНОГО ЛЕТАТЕЛЬНОГО АППАРАТА В ЗАДАЧЕ МОНИТОРИНГА РАСПРЕДЕЛЁННЫХ ОБЪЕКТОВ НЕФТЕДОБЫЧИ

Аралбаев Т.З.,
Доктор технических наук, профессор кафедры вычислительной техники и защиты информации Оренбургского государственного университета, г. Оренбург, Россия
Гетьман М.А.
Магистрант кафедры вычислительной техники и защиты информации Оренбургского государственного университета, г. Оренбург, Россия

OPTIMIZING THE PROTECTION OF AN UNMANNED AERIAL VEHICLE IN THE TASK OF MONITORING DISTRIBUTED OIL PRODUCTION FACILITIES

Aralbaev T.,
Doctor of technical Sciences, professor of the Department of computer engineering and information security of Orenburg state University, Orenburg, Russia
Getman M.
Undergraduate of the Department of computer engineering and information security of Orenburg state University, Orenburg, Russia

Аннотация

В работе представлены результаты исследований по повышению уровня защищенности беспилотного летательного аппарата (БПЛА) на основе оптимизации его маршрутов с учетом рисков от угроз на различных участках его перемещения в процессе мониторинга распределенного промышленного объекта.

Abstract

The paper presents the results of research on improving the level of security of an unmanned aerial vehicle (UAV) based on the optimization of its routes, taking into account the risks from threats in various areas of its movement in the process of monitoring a distributed industrial facility.

Ключевые слова: беспилотный летательный аппарат, кластерный анализ, частные модели угроз, оптимальный маршрут, распределенные объекты нефтедобычи

Keywords: unmanned aerial vehicle, cluster analysis, private threat models, optimal route, distributed oil production facilities

Одним из важных этапов разработки систем защиты информации является построение модели угроз для объектов информатизации. Анализ публикаций по теме статьи позволил определить ряд особенностей разработки модели угроз для системы защиты БПЛА, используемых для мониторинга распределённых объектов нефтедобычи. В