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ҒТАМР: 65.33.03 https://doi.org/10.48184/2304-568X-2024-2-33-43

APPLICATION AND SAFETY OF PECTIN SUBSTANCES FROM VEGETABLE RAW MATERIALS IN BREAD PRODUCTION

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Currently, pectin substances and their compounds are often used in cooking as an anionic surfactant. In the technology of food preparation, such properties of pectin substances as swelling, thickening, gel-forming, crystal-forming, water-absorbing ability, and emulsifying ability are of great importance. Like any gel-forming fiber, pectin helps remove heavy metals from the body such as lead, mercury, cadmium, etc. MCP may be better suited for these purposes, as it has been used in four clinical studies of heavy metal detoxification. Considering the accumulation of radioactive elements, heavy metal salts and pesticides in the environment and the human body, Jerusalem artichoke, which is rich in pectin substances, carotene and dietary fiber, is of particular interest. It is also economically beneficial as it is a domestic raw material. The goal of scientific research is to obtain a new type of functional bread with the addition of vegetable pectin. In this article, it was determined that the addition of pectin to dough has an effect on biochemical, colloidal, as well as microbiological processes. It also affects the physicochemical and rheological properties and reduces the content of contaminants. The work investigated that when pectin substances are added to the dough, its initial acidity increases. Acidity varied 2.2-2.4. It was also noted that in the test sample the fermentation process was more active; the activity of the fermentation process was associated with the addition of sugar along with pectin. As a result of this work, in order to improve the quality of bread and extend shelf life, pectin from raw materials of plant origin was added, the properties of bread samples with Jerusalem artichoke pectin with high performance were studied, and their organoleptic, physicochemical and safety indicators were studied. It was revealed that pectin reduces the content of some toxic elements by up to 100%. Practical significance: the conducted studies showed that the obtained samples of functional bread can be recommended for introduction into production to expand the range of bakery products.

Keywords: pectin, modified citrus pectin (MCP), complexation, heavy metal salts, Jerusalem artichoke, properties of pectin, bread.

ӨСІМДІКТЕКТІ ШИКІЗАТТАН АЛЫНҒАН ПЕКТИНДІК ЗАТТАРДЫҢ ЖӘНЕ ОЛАРДЫ НАН ӨНДІРІСІНДЕ ҚОЛДАНУ ҚАУІПСІЗДІГІН ЗЕРТТЕУ

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Қазіргі кезде пектинді заттар және оның қосылыстары аниондық, беттік активті зат ретінде көбінесе пісіру кезінде пайдаланылады. Өнімді дайындау технологиясында пектиндік заттардың ісіну, тұтқырлану, гель түзгіштік, кристалл түзгіштік, суды сіңіргіштік қабілеттерін, сондай ақ эмульгаторлық қабілеттері тәрізді қасиеттерін арттыру өте маңызды. Кез келген гель түзетін талшық сияқты, пектин денеден қорғасын, сынап, кадмий және т.б. сияқты ауыр металдарды шығаруға көмектеседі. МЦП осы мақсатта жиірек қолданылады, өйткені ол ауыр металдарды детоксикациялаудың төрт клиникалық зерттеулерінде қолданылған. Қоршаған ортадағы радиоактивті элементтердің, адамның ағзасында ауыр металл тұздары және пестицидтердің жиналып қалуын ескере отырып, құрамы пектинді заттар, каротин мен тағамдық талшықтарға бай топинамбур өніміне ерекше қызығушылық туып отыр. Сондай ақ, ол отандық өнім болғандықтан экономикалық тиімді. Берілген мақалада қамыр құрамына құрғақ пектиндік затты қосу биохимиялық, коллоидты, сонымен қатар микробиологиялық үрдістерге әсер беретіні анықталды. Сонымен қатар, физика-химиялық, реологиялық қасиеттеріне әсер етіп, контаминанттар мөлшерін төмендетеді. Қамыр құрамына пектинді заттар енгізгенде, оның бастапқы қышқылдылығы жоғарылайтыны зерттелді. Қышқылдық 2,2-2,5 аралығында өзгерді. Сынақ үлгісіндегі ашыту үрдісі анағұрлым белсенді болатыны байқалды, үрдіс белсенділігі пектинді затпен қатар қантты қосумен байланысты болатыны анықталды. Берілген жұмыс нәтижесінде нанның сапасын жақсарту және сақтау мерзімін ұзарту мақсатында өсімдік тектес шикізаттан алынған құрғақ пектин қосылды, жоғары өнімділікпен топинамбур пектині бар нан үлгілерінің қасиеттері зерттелді, олардың органолептикалық, физика-химиялық және қауіпсіздік көрсеткіштері зерттелді. Жекелеген уытты элементтердің құрамын 100% - ға дейін төмендетеді. Практикалық маңыздылығы: жүргізілген зерттеулер нан өнімдерінің ассортиментін кеңейту үшін алынған функционалды мақсаттағы нан үлгілерін өндіріске енгізуге ұсынуға болатынын көрсетті.

Негізгі сөздер: пектин, модфикацияланған цитрусты пектин (МЦП), топинамбур, детоксикация, комплекс түзуші, ауыр металдар тұздары, пектиннің қасиеті, нан.

ИССЛЕДОВАНИЕ БЕЗОПАСНОСТИ ПЕКТИНОВЫХ ВЕЩЕСТВ ИЗ РАСТИТЕЛЬНОГО СЫРЬЯ И ПРИМЕНЕНИЕ ИХ В ПРОИЗВОДСТВЕ ХЛЕБА

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В настоящее время пектиновые вещества и их соединения часто используют в пищевой промышленности в качестве анионного ПАВ. В технологии приготовления продуктов большое значение имеют такие свойства пектиновых веществ, как набухаемость, загустевание, гелеобразующая, кристаллообразующая, водопоглотительная способность, а также эмульгирующая способность. Как и любая гелеобразующая клетчатка, пектин помогает вывести из организма такие тяжелые металлы, как свинец, ртуть, кадмий и т. д. Для данных целей может лучше подходить МЦП, так как его использовали в четырех клинических исследованиях детоксикации от тяжелых металлов. Учитывая накопление радиоактивных элементов, солей тяжелых металлов и пестицидов в окружающей среде и организме человека, особый интерес представляет топинамбур, который богат пектиновыми веществами, каротином и пищевыми волокнами. Он также экономически выгоден, так как является отечественным

сырьем. В данной статье отражено, что добавление сухого пектина в тесто оказывает влияние на биохимические, коллоидные, а также микробиологические процессы. Также вляет на физико-химические, реологические свойства и снижает содержание контаминантов. Исследовано, что при добавлении в тесто сухих пектиновых веществ повышается его исходная кислотность. Кислотность варьировала 2,2-2,5. Также отмечено, что в опытном образце процесс брожения протекал более активно. Активность процесса брожения связана с добавлением сахара вместе с пектином. В результате данной работы с целью повышения качества хлеба и продления сроков хранения был добавлен пектин из сырья растительного происхождения, были изучены свойства образцов хлеба с пектином из топинамбура с высокими показателями и их органолептические, физико-химические показатели, а также показатели безопасности. Показано, что поисходит снижение содержания некоторых токсичных элементов до 100%. Практическая значимость: Показано, что происходит проведенные исследования показали, что полученные образцы хлеба функционального назначения могут быть рекомендованы к внедрению в производство для расширения ассортимента хлебобулочных изделий.

Ключевые слова: пектин, модифицированный цитрусовый пектин (МЦП), комплексобразование, соли тяжелых металлов, топинамбур, свойства пектина, хлеб.

Introduction

The use of pectin substances in food production is widespread. Pectin substances etherified with high methoxyl groups are mostly (about 80%) used in confectionery production. To create a marmalade mass, the properties of pectin substances are utilized in the production of pastilla, marmalade confectionery products, jellies, and sweets with fruits. Pectin substances compensate for the "lack of natural pectins" in these products. [1].

The utilization of pectin substances in the production of various jelly confectionery products spans a range of 8 kilograms to 26 kilograms for citrus pectin, while the utilization of beet pectin reaches a maximum of one ton for the finished product.

Nowadays, many other ingredients are added to bread and pastry products to improve their nutritional value. Mineral artificial chemical compounds are used to increase the nutritional value of bread and bakery products.

The value of bread and confectionery products is determined by the value of nutrients needed by the human body. These include protein, amino acids, vitamins, minerals, calories, and the training ability of the human body. In addition, the nutritional value of bread can be affected by the following indicators: quality, taste, smell, and appearance [2].

In many countries, the norm of bread consumption ranges from 150 to 500 grams per capita. Furthermore, bread is a staple food in numerous nations. Let us examine the nutritional value of bread in greater detail.

Bread contains approximately 45% carbon. The carbon content of bread is primarily derived from starch. Starch is a complex sugar (polysaccharide) that contains numerous simple sugars. It is subsequently broken down into simple sugars through the action of amylolytic enzymes. Starch is distinguished by its capacity to retain water during the preparation of dough and to bind water during baking.

The value of bread is not only characterized by its energy value [3]. Bread products provide complete proteins needed by the human body. Protein is a macronutrient that cannot be replaced by other nutrients. The exogenous amino acids that enter the body are utilized to synthesize the proteins that are necessary for the human body. Furthermore, it performs several essential functions. For instance, proteins perform the functions of energy transfer and energy regulation. Proteins are not stored in the human body; therefore, they must be consumed daily. If the protein intake is below the requisite amount, the vitamins and minerals essential for metabolic processes will be insufficient.

Currently, pectin substances and their compounds are often used in cooking as an anionic surfactant. In the technology of product preparation, properties of pectin substances such as swelling, thickening, gel-forming, crystal-forming, and water-absorbing abilities, as well as emulsifying abilities are very important.

Given the accumulation of radioactive elements in the environment, as well as heavy metal salts and pesticides in the human body, a cost-effective product made from topinambur (*Helianthus tuberosus*) is of particular interest due to its richness in pectin substances, carotene, and dietary fiber. The World Health Organization (WHO) has recognized pectin substances as toxicologically safe and has recommended them as beneficial for human health. [4].

Among the non-traditional types of plants, topinambur is one of the most effective plants for domestic use. The revival of interest in this plant is associated with the emergence of new aspects

of its use, including as the main raw material for pectin production.

The purpose of this work is to utilize dry pectin substances derived from vegetable raw materials in the preparation of bread products. This involves developing the technology for incorporating these substances and studying the nutritional value and safety of the resulting bread products.

Materials and research methods

In the research work, the goal was to enhance the physicochemical and rheological properties of bread products while improving safety indicators by adding vegetable pectin substances. These substances, derived from topinambur, were used to create new functional bread products. The change in the rheological properties of the dough was measured using the Alveolab instrument, depending on the composition of the pectin substance. The assessment of physicochemical indicators of the samples was conducted according to GOST 21094-75 and GOST 5670-96 standards, while safety indicators were evaluated per the requirements of KO TR 021/2011 [5].

Literature review

The addition of pectin to the dough has been demonstrated to exert an effect on a number of biochemical, colloidal, and microbiological processes. It was demonstrated that the addition of pectin substances to the dough results in an increase in its initial acidity. It was observed that the fermentation process in the test sample was more active than in the control sample. It was demonstrated that the fermentation process is dependent on the addition of sugar in conjunction with pectin. Additionally, the study examined whether the quantity of pectin in the finished bread product differed from the initial amount incorporated into the dough composition. This indicates the separation of biopolymers during dough fermentation. It can be assumed that this is carried out by the formation of monosaccharides, which affect the activity of the fermentation process [6,7].

With an increase in the amount of pectin substance, there is a noticeable decrease in the final volume of the bread product and a decline in its quality indicators. This phenomenon is attributed to the pectin's water-absorbing capacity, which consequently affects the moisture content of the dough and the overall quality of the bread [8, 9]. It is essential to consider this factor when incorporating pectin into bread recipes.

The impact of pectin esterification on the quality indicators of wheat flour-based bread has been determined. It was noted that the highest quality bread is achieved when pectin substances are added in minimal quantities.

The improvement in the quality indicators of bread with the introduction of a lower amount of pectin substance is attributed to the prevalence of free carboxyl groups within its molecule, compared to higher amounts of pectin substance. These groups exhibit high reactivity and actively engage with diol test samples, forming numerous compounds that influence the properties and quality attributes of bread. Consequently, when formulating the final product, both high- and low-dose pectin substances derived from apples can be utilized. However, unlike confectionery products, employing a low-dose pectin substance proves to be more effective in bread production [10,11].

It has been shown that the change in the preservation of structural and mechanical properties of crumbs containing pectin in an amount of 0.05-1.0% occurs 1.04-1.9 times slower than in bread without pectin [12].

The incorporation of high-dose and low-dose pectin substances derived from apples has been demonstrated to enhance the quality of gingerbread. Gingerbread containing 0.1% low pectin substances of apple origin has been identified as the optimal product in terms of quality.

Fruit yogurt preparations utilize modest quantities of pectin to achieve a soft, semi-thixotropic jelly-like consistency. This consistency is adequate to facilitate even distribution of the fruit while allowing its free integration into yogurt. Enhancing the texture of yogurt can be achieved by incorporating a small amount of methoxylated pectin. It's worth noting that low-methoxylated pectin does not impede the syneresis process [13].

The highly methoxylated pectic substance is used as a stabilizer for fat emulsions and fruit suspensions in concentrated fruit drinks.

The ability of highly methoxylated pectin substances to change the consistency (viscosity) of a product is used in recombined drinks to restore a new drinking product. Pectin is also used to give instant fruit drinks a natural consistency. Many types of jellies, mousses, and gel-like products are made based on pectin substances.

During the analysis of literary sources, it was discovered that there is limited availability of development methods and formulations utilizing pectin substances derived from plant sources such as pumpkin and carrots, as well as products containing these substances like carrot, beet, and pumpkin powder [14, 15].

The diverse functional properties of pectin substances, including their role in stabilizing the consistency of food systems and their ability to form complex complexes, render them invaluable biopolymers in various applications. While pectin substances may not always be effective universally, they can be employed as food additives to enhance the structural properties of foods. Additionally, as previously mentioned, they can serve as valuable therapeutic agents for skin-related applications.

Results and discussion

The object of the study is a bread product with the pectin substance of topinambur from vegetable raw materials. According to local and foreign experts, since topinambur is a domestic product for the food industry, it is one of the available types of raw materials. topinambur tubers are rich in carbohydrates, primarily inulin and pectins. The chemical composition of topinambur is given in Table 1.

Table 1. The chemical composition of topinambur

Contents	Amounts	
	Early ripening species	Late ripening species
Moisture content, %	75,90	72,80
Mass fraction of dry matter, %, including:	24,10	27,19
proteins	2,63	2,65
ash	2,01	2,42
carbohydrates, including:		
inulin	8,35	10,11
monosaccharides	6,28	6,51
pectin	1,08	1,28
hemicellulose	1,01	1,21
cellulose	2,74	3,01

Table 2 shows the characteristics of the dry topinambur pectin we obtained.

Table 2. Analytical characteristics of topinambur pectin

Contents	Topinambur pectin
Moisture content, %	8,0
Number of carboxyl groups, %	
- free	5,0
- methoxylated	8,39
Degree of methoxylation	37,43
Ability to form a complex, mg Pb^{2+}/g	370 ± 10
Group composition:	
- methoxy	6,48
- acetylated	0,51

From the data presented in Table 2, it is evident that topinambur pectin contains 5.0% free carboxyl groups, 8.39% methoxylated carboxyl groups, and 6.48% methoxy components. The complexation capacity of Jerusalem artichoke pectin was found to be 370 mg Pb2+/g, indicating its high detoxification properties and ability to bind and remove harmful substances, including heavy metal ions, radionuclides, and pesticides.

In this regard, the use of topinambur pectin in the baking industry contributes to the reduction of environmental problems and the removal of heavy metals in the human organism.

The change in the rheological properties of the dough depending on the topinambur pectin content is presented in Table 3, where grade 1 flour was employed as a control (without added pectin). Consequently, with an escalation in pectin content to 0.5%, all dough parameters exhibit enhancement. However, beyond 0.6%, the flour's strength diminishes, and at 0.75% pectin content, the dough's rheological properties deteriorate sharply: elasticity increases significantly while

extensibility sharply declines. This underscores the potential recommendation to enhance the quality of flour composition.

With the increase of added pectin, the amount of gluten decreases, which affects the rheological properties of the dough (Table 3). With an increase in pectin content from 0.5% and above, the water absorption capacity, which affects the yield of bread, increases.

Laboratory baking with topinambur pectin from 0.25 to 1.0% was carried out using type 1 flour with a moisture content of 13.6%, gluten deformation index = 73, and the number of collapses was 456. The moisture content of topinambur pectin was 8%. The water in the dough was added depending on the measured average moisture content of the raw material. Cooking was carried out in a MIWE-GR rotary oven at a temperature of 220-2300 C.

Table 3. Changes in the rheological properties of the dough depending on the composition of the pectin substance obtained from topinambur in the alveolab device

Indicators	Control	Pectin content, %				
		0,25	0,5	0,6	0,75	1,0
P - resistance to deformation	125	131	148	149	167	165
L - extensibility	70	70	61	57	37	41
W - dough strength	315	321	345	299	274	329
Water absorption property	5	5	6	7	7	7
Gluten	7	7	6	5	5	4

The composition of the investigated bread containing pectin substance is detailed in Table 4. The ratio of components is given by weight of flour.

Table 4. Recipe and quality indicators of bread containing pectin

Raw materials	Control	Pectin composition, %					
		0,25	0,5	0,6	0,75	0,8	1,0
Flour, g	500	500	500	500	500	500	500
Topinambur pectin, g	-	1,25	2,5	3,0	3,75	4,0	5,0
Salt, g	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Sugar, g	-	3	3	3	3	3	3
Yeast, g	6	6	6	6	6	6	6
Water, g	316,0	318	326	328	331	333	339
Bread indicators							
Crumb moisture, %	43,0	44,0	44,5	44,5	45,6	46,0	46,5
Volume, sm^3/g	2,2	2,3	2,4	2,3	2,3	2,1	2,1
Crumb acidity, degree	2,0	2,1	2,3	2,5	2,7	2,7	3,0
Porosity, %	73	75	78	77	75	75	72

Based on the conducted research, the impact of adding topinambur dry pectin substance in varying amounts (0.25-1.0%) to bread composition on bread porosity compared to the control sample was determined. Effective porosity was achieved at a pectin substance concentration of 0.5%, resulting in a porosity of 78% (Table 4). However, adding pectin to bread in larger quantities led to deteriorated organoleptic characteristics. The soft part of the bread darkened, exhibiting a dense rather than loose consistency, and porosity decreased by 6% compared to the effective amount (0.5% pectin). Furthermore, an increase in pectin content resulted in higher moisture content in the soft part of the bread, rising from 44.0% to 46.5% when 0.25% pectin was added, and increased bread dough acidity from 2.1 to 3.0, indicating elevated acidity due to the pectin substance. Additionally, the bread volume increased with a specific amount of added pectin substance, peaking at 0.5% concentration, yielding 2.4 cm3/g, before beginning to decrease (Table 4).

The addition of dry pectin substance obtained from topinambur to bread gives it a more intense color because the pectin substance is black in the bread crust - an additional source of sugar that reacts with amino acids to form melanoids (Figure 1, 2).

Figure 1. Samples of baked bread with different amounts of pectin

Figure 2. Changes in the structure of baked bread with the addition of different amounts of pectin

Table 5. Functional parameters of the studied flour containing topinambur pectin

Amounts of pectin, %	Functional parameters, units of measurement				
	Water absorption property	Gluten	Viscosity	Elasticity	Retrogradation
Control	5	7	6	4	8
0,25	5	7	6	4	8
0,5	6	6	6	5	8
0,6	7	5	6	5	8
0,75	7	5	6	5	8
0,8	7	4	6	4	8

According to Table 6, the volumetric yield of bread increases at 0.5% pectin content compared to the control by 8.7%, then the bread yield decreases with increasing pectin content. This can be explained by the decrease in bread porosity and grain compaction (Figure 3).

Table 6. Effects of pectin on total bread volume

Parameters	Control	Amounts of pectin, %				
		0,25	0,5	0,75	1,0	1,25
Volumetric yield of bread, sm^3	2190	2280	2380	2100	2070	2050

Figure 3. Changes in appearance (layer), and porosity in a bread sample. Sample 1 – control sample. Sample 3 – sample with 0.5% vegetable pectin product added.

The quality and safety indicators of the investigated bread baked in the Almaty LLP "Nantokash Combine" were determined. As a control sample "Almatinsky" wheat bread was produced by LLP "Aksai" Nantokash Combine".

Based on the laboratory research, the organoleptic, physicochemical, and microbiological indicators of the bread products were summarized in the form of a table.

The organoleptic indicators of bread and bun products were determined according to GOST 5667-65 [16] (Table 7).

Table 7. Results of the organoleptic assessment of bakery products

Parameter	Description according to GOST 5667-65	Research results	
		Sample 1	Sample 3
Appearance Bread shape and form	The shape fits the shapes of bread and buns, the surface layer was raised and thoroughly baked	The shape fits the bread shape, with a slightly raised surface layer	The shape fits the bread shape, with a slightly raised surface layer
Softness and post-bakery condition	Moist, pliable, well cooked under hand pressure	Moist, well-baked under hand pressure	Moist, well-baked under hand pressure
State of the dough	No lumps	No lumps	No lumps
Porosity	The surface layer of bread and buns is fully cooked, must be uncracked	No cracks on the surface layer of the bread, the porosity is well-developed	The surface layer of the bread is not cracked, the porosity is well-developed, the bread is porous.
Taste	Typical of bread and buns, no foreign taste	Typical of bread	Typical of bread
Smell	Typical of bread and buns, no unfavorable smell	Typical of bread, no unfavorable smell	Typical of bread, no unfavorable smell

The organoleptic quality indicators of the studied sample were evaluated, and the following values were obtained. It was found that the organoleptic indicators of the samples were chosen per the GOST 5667-65 standard.

The physicochemical and safety indicators of the samples were evaluated per the requirements of the Technical Regulations of the Customs Union and its norms (Table 8-9).

Table 8. Physicochemical and safety indicators of the samples

Indicators	Permissible amounts according to the normative documents	Sample 3	Test methods according to the normative documents
Amount of mycotoxins, mg/kg:			
Aflatoxin B1	0,005	Not detected	GOST 30711-2001
HCH	0,2	Not detected	Methodological guideline 2142-80
DDT	0,02	Not detected	Methodological guideline 2142-80
Total moisture content by weight, %	42,0-48,0	45,8	GOST 5903-89
Acidity, %	2-7	2,5	GOST 5899-85

The physicochemical and safety indicators of the samples, as indicated in the aforementioned table, meet the requirements of the Technical Regulation of the Customs Union and the norms therein. If the physicochemical parameters of the product deviate from the given standard norms, this will have a negative effect on the quality of the product, impairing the organoleptic

assessment, taste, and smell. Furthermore, if the humidity exceeds the norm, it will cause the product to mold which will affect the shelf life.

Table 9. Heavy metal content in bakery products with vegetable pectin (Technical Regulation of the Customs Union 021/2011)

Heavy metals	Vegetable product (topinambur)		Pectin obtained from vegetable products		Bread with pectin	
	Permissible amounts according to the normative documents	Observed	Permissible amounts according to the normative documents	Observed	Permissible amounts according to the normative documents	Pectin 0,5%
Lead, mg/kg	0,50	0,02	1,0	Not detected	0,35	Not detected
Cadmium, mg/kg	0,03	0, 01	0,1	Not detected	0,07	Not detected

The physicochemical indicators were evaluated in accordance with the standards outlined in GOST 21094-75, and GOST 5670-96, and the safety indicators were found to comply with the requirements outlined in Technical Regulation of the Customs Union 021/2011.

Conclusion

The ecological situation in many regions of Kazakhstan is marked by the contamination of the environment and food products with toxic substances. This necessitates ensuring the safety of food products and promoting the production of pectin and pectin-containing products as natural detoxifying agents. In this work, pectin obtained from vegetable sources was added to bread products to improve their quality and extend their shelf life. The resulting bread products were studied, focusing on a sample with a high pectin index. The organoleptic, physicochemical, and safety indicators of this sample were thoroughly analyzed.

Based on the results of the research and analysis, the following conclusions were drawn:

1. The composition of raw materials with the addition of plant-based dry pectin (topinambur) was determined and the bread recipe was developed;

2. Enrichment of bread with topinambur pectin (0.5%) is safe and extends the shelf life by 24 hours;

3. The addition of topinambur pectin reduces the content of individual toxic elements up to 100%;

4. The incorporation of topinambur pectin into the bread-making process has been demonstrated to increase the yield of bread by 8.7%. This is of significant importance in addressing the issue of food and food security within the country.

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МРНТИ 65.53.33 https://doi.org/10.48184/2304-568X-2024-2-43-53

РАЗРАБОТКА ТЕХНОЛОГИИ ИЗГОТОВЛЕНИЯ ЯБЛОЧНЫХ ЧИПСОВ НА ОСНОВЕ РЕЗУЛЬТАТОВ ОЦЕНКИ ТЕХНОЛОГИЧЕСКИХ И ПОТРЕБИТЕЛЬСКИХ СВОЙСТВ ИСХОДНОГО ЯБЛОЧНОГО СЫРЬЯ

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Современные тренды в питании людей обусловлены прежде всего изменившимися условиями жизни, при которых стремление уменьшить время, затрачиваемое на решение бытовых вопросов, в том числе на приготовление пищи, привело к созданию новой номенклатуры продуктов питания, среди которых особенно отличаются фруктовые снеки. В странах дальнего зарубежья наиболее популярны яблочные чипсы, ставшие востребованными среди потребителей практически всех возрастных категорий. На казахстанских прилавках уже появились яблочные чипсы импортных производителей, что поставило перед отечественными учеными актуальную задачу налаживания собственных производств из яблок, произрастающих на территории нашей страны, так как сырьевая база южных регионов уже сейчас может обеспечить производство в промышленных масштабах различными сортами яблок. Яблочные чипсы отличаются от традиционных сухофруктов своими органолептическими характеристиками – их вкус более насыщен, с сохранением формы пластин и хрустящей корочкой, а витаминный и микроэлементный состав близок к составу свежих яблок. Цель наших исследований – разработка технологии изготовления яблочных чипсов из сортов яблок, выращиваемых в промышленных масштабах фермерскими хозяйствами Туркестанской области с применением технологических приемов бланширования нарезанных пластин яблок специальным раствором и их конвекционной сушкой. В качестве методологии исследований применены экспериментальные методы, включающие выбор исходного яблочного сырья, состава бланшированного раствора, режимных параметров обработки яблочных пластин в растворе и их сушки, применения экспертных методов определения потребительских характеристик готовых яблочных чипсов. В статье приведены результаты исследований по разработке технологии изготовления яблочных чипсов на основе оценки технологических и потребительских характеристик сортов яблок Джонаголд, Голден, Гренни и Джерамин. Установлено, что для переработки их в яблочные чипсы необходимо выбирать сорта зимнего и позднезимнего сроков созревания. Выбран ингредиентный состав бланшированного раствора - 30 мас. % сахарозы, 1,5 мас. % аскорбиновой кислоты, 0,5 мас. % лимонной кислоты. Толщина нарезки яблочных пластин должна быть в пределах 1,5-2,5 мм. Режимные параметры обработки яблочных пластин в растворе: t=45-50 ^{0}С, время обработки 3-5 мин. Установлены режимные параметры сушки бланшированных яблочных пластин: t=100-110 ^{0}С, время сушки 12-14 часов. Влажность готовых яблочных чипсов составила 15%.

Ключевые слова: яблоки, сорт, сырье, яблочные чипсы, фруктовые снеки, бланшированный раствор, рецептура, ингредиентный состав, сушка, органолептические и физико-химические показатели, технология, режимные параметры, результаты.