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PUMPKIN SEED PASTE WITH IMPROVED CONSUMER PROPERTIES

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Abstract. According to the opinion of nutritionists, human health depends on a number of factors: the structure of nutrition by 40–45%, genetics by 18%, the state of health care by 10%, environmental factors by 8%, from other reasons – by 19–24%. That is, the nutrition factor is the leading one, and the health of the nation mainly depends on it. In recent decades, the pace of life of people in the developed countries of the world has accelerated significantly, and this is a significant lever in favor of the use of so-called "fast foods". Their composition includes peanut paste, which is very popular among the population of many countries, and its modifications containing various additives. The purpose of the work was to substantiate the feasibility of obtaining paste from domestic raw materials – pumpkin seeds with the addition of berry powders, as well as the characteristics of the obtained products. Analysis of the amino acid composition of pumpkin seed protein paste, its comparison with that of peanuts and the FAO/WHO standard shows that pumpkin seed protein is characterized by greater biological value. The oil components of the pumpkin and peanut seed pastes had almost the same qualitative fatty acid composition, but the latter was significantly inferior in terms of the ratio of different groups of acids – it was characterized by a low content of polyunsaturated linoleic acid and at the same time a large amount of saturated acids. Peanut paste had a higher oil content and higher calorie content compared to pumpkin seed paste. Three samples were obtained on the basis of pumpkin seed paste: 25% of the mass of the product was replaced with berry powders, namely dried and crushed viburnum, cranberry, sea buckthorn berries. They outperformed the original sample in terms of their sensory properties and had a reduced calorie content compared to it. The results of the study of changes in the physico-chemical parameters of the oil component of products during storage indicate that the introduction of berry powders significantly slows down the process of its oxidation. The best result was observed for the sample containing sea buckthorn powder, which is probably due to its high content of tocopherol, an effective antioxidant.

Key words: pumpkin seed paste, nutritional value, viburnum, cranberry, sea buckthorn, sensory properties.

Introduction. Formulation of the problem

According to the results of the conducted research, human health depends on the structure of nutrition by 40–45%, genetics by 18%, the state of health care by 10%, environmental factors by 8%, and the influence of other factors by 19–24%. That is, the nutrition factor is the leading one, and the health of the nation mainly depends on it. Based on this, domestic scientists are faced with the task of creating products based on regional raw materials that would meet the concept of "healthy nutrition", and this should primarily apply to mass consumption products that are available to the general population and are regularly used in daily nutrition.

Analysis of recent research and publications

In recent decades, the pace of life of people in the developed countries of the world has accelerated significantly, and this is a significant lever in favor of the use of so-called "fast foods". Breakfast cereals are very common, helping to save time both directly in the morning and throughout the day. However, as you know, breakfast should be high in calories and at the same time come as close as possible to the requirements of "healthy nutrition". That is, the content of salt, sugar, hydrogenated fats, animal products in it should be minimal or completely absent [1-4]. The last factor limits the demand for such products among certain segments of the population who, due to their health, life principles or religious beliefs, do not

consume products of animal origin at all or are very limited in their list.

In connection with the above, it becomes clear that there is an increase in demand for various nuts and seeds, which previously the population considered only as supplements, and mainly for sweet dishes. By carefully grinding different types of this raw material, a number of pastes have been obtained, which differ from each other both in terms of taste and price range. In particular, the production of pastes from such nuts as peanuts, pistachios, cashews, walnuts, etc. has been established. Sunflower and pumpkin seeds are also used. The most popular, widely known in the countries of the Western Hemisphere is peanut paste. In the first half of the 20th century, the American government made a lot of efforts to popularize peanuts as a source of cheap vegetable protein [5]. As a result, peanut paste became an attribute of the table of the average American family. During breakfast, peanut paste is eaten in its pure form, as a sandwich paste on white bread or in sandwiches with jam. It is also widely used as a semi-finished product for the production of peanut-flavored crackers and confectionery, cheese products, ice cream, and also in restaurants [5,6]. At first, peanut pastes were made from peanut beans without any additives, but then, when this product gained popularity, manufacturers began to produce many of its modifications. The vast majority of producers add a sweetener (sugar, honey, syrup) and oil, most often hydrogenated, to their composition, which allows you to avoid delamination and increases the shelf life. You can find products with the addition of candied fruit, chopped nuts, coconut shavings.

Today, a recipe for peanut pastes with a variety of spicy flavors is also offered, which takes into account the traditions of food in Asian countries. In their composition, in particular. contains garlic, hot pepper, salt. Other recipes provide for the inclusion of such components as sesame, nuts: cashew, walnut and cedar, honey, apples, bananas, carrots, broccoli, soybean oil, salt, vinegar, garlic, and ginger [6].

The addition of sugary substances and especially trans-fats – hydrogenated oils – significantly changes the quality of the product. Instead, there is an increase in demand for such products among certain segments of the population in connection with the improvement of their sensory properties without a significant change in price. However, their popularity among other circles of consumers is correspondingly decreasing, since their composition contains components that do not meet the requirements of "healthy nutrition". This, in particular, is fundamentally important for athletes, people who follow a certain diet due to their health, etc.

In order to expand the taste spectrum of peanut pastes and increase their nutritional and biological value, product recipes have been developed that include linseed oil, skimmed milk powder, powdered sugar, and cocoa powder [6].

Instead, it should be noted that the results of examinations conducted by the Institute of Nutrition of the National Academy of Sciences of Ukraine, medical institutions, indicate extremely insufficient consumption of vitamins, bioflavonoids, and minerals by the majority of the population of our country.

One of the ways to solve this problem can be the inclusion of berry powders in the composition of food products, which are finely ground appropriate raw materials or by-products of their processing, in particular, squeezes of apples, grapes, citrus fruits, blueberries, etc.

Berry powders can be in demand as ingredients in a number of food products [7-9], where they naturally provide a pleasant taste, color, texture, smell characteristic of the raw material, and also enrich products with vitamins, polyphenols, dietary fibers and other compounds. which are lacking in the modern man's diet. Therefore, with the aim of maximum preservation of biologically active substances of raw materials, in particular compounds of phenolic nature, the technology of manufacturing berry powders is being researched [9].

Based on the global problems, the growing concern about the loss of food products and food waste, as well as the related environmental problems, the specialists faced the need to introduce measures aimed at reducing the volume and expanding the directions of use of by-products of food processing [9-11].

The production of pastes based on nuts and seeds is also organized in Ukraine. Among the products of this line, pumpkin seed paste attracts attention. Its advantages include the fact that the raw material for its production is a by-product of pumpkin processing, which is widespread in our climate zone and is not picky about growing conditions.

A number of studies have been devoted to the study of the composition of seeds obtained from pumpkin grown in different regions of the world, a significant part of which was conducted by scientists from the Asian region [10-13]. The content and characteristics of the macronutrients of the raw materials were determined, and the qualitative and quantitative characteristics of vitamins, macro- and microelements were given. In general, this raw material attracts attention as a source of oil and protein substances.

The vast majority of studies are devoted to the characteristics of oil and methods of its extraction from raw materials. The fatty acid composition of pumpkin seed oil was studied, it was shown that it has a high content of tocopherols, carotenoids, is resistant to oxidation and can be used for food purposes. [10-16]. Cold-pressed oil is of better quality, its use is recommended for food purposes, low-quality varieties – for technical purposes. Works [10-12] discuss both the expediency of obtaining oil from pumpkin seeds and the possibility of directly adding seeds to various

dishes, both in crushed and uncrushed form. Pumpkin seeds crushed to the state of flour are added to bread, cookies, muffins as a protein additive [10,11]. An opinion has been expressed about the expediency of extracting protein substances from seeds and their further use in the composition of food products [17,18]. The expediency of complex processing of raw materials is discussed. According to the proposed technology of its processing, the target products were obtained in the amount: oil – 34%, flour – 5%, protein powder – 15%, fiber – 46% [18].

Studies of the physiological activity of pumpkin seeds have been conducted in vivo [12,19-21]. Based on the obtained results and its positive effect on health, a number of authors believe that pumpkin seeds can be considered as a natural functional product [13,22,23].

Taking into account the dietary traditions of the population of our country, as well as the price factor, which also has a significant impact on the demand for products, it is possible to predict the popularity of paste made from pumpkin seeds among a number of pastes offered by the retail network of Ukraine. Today, in particular, such paste is produced by the "Aumi" company using a technology that involves short-term heat treatment of seeds, grinding them, packing them in a hermetic container, and does not involve the addition of other components.

As for pastes from nuts and seeds with the addition of a berry component, there are no such products on the market today.

T**he purpose of the work** was to justify the feasibility of obtaining paste from domestic raw materials – pumpkin seeds with the addition of berry powders, as well as the characteristics of the obtained products. Achieving this goal involved solving the following problems:

1. Characterization of the composition of pumpkin seed paste in comparison with peanut paste.

2. Justification of pumpkin seed paste recipes with the inclusion of domestic berry raw materials.

3. Characteristics of the received samples.

Research materials and methods

In the research, cream-paste from pumpkin seeds produced by LLC "Aumi" (Ukraine) was used. Raw materials for obtaining berry powders were berries that are widespread and traditional for our country – viburnum, cranberry, sea buckthorn. The berries were carefully sorted, washed, and viburnums were pitted; cranberries and sea buckthorn were kneaded. Drying was carried out in a Hydraflow ezidri snackmaker dryer at a temperature of 60–63°C for 48 hours. The dried berries were ground in a laboratory mill, the particle size was less than 1 mm.

The research of the chemical composition of the paste ingredients was carried out according to generally accepted methods: mass fraction of moisture – drying to a constant mass in accordance with DSTU 4910:2008 "Confectionery products. Methods of determining mass fractions of moisture and dry substances"; the total content of protein substances – according to the Kjeldahl method according to DSTU 7169:2010 "Feeds, compound feeds, compound feed raw materials. Methods for determining nitrogen and crude protein content"; the amount of fat – by the Soxhlet method in accordance with DSTU 4941:2008 "Processed products of fruits and vegetables, canned meat and meat and vegetables. Methods of determining fat content"; sugar content – according to the Bertrand method in accordance with DSTU 5059:2008 "Confectionery products. Methods of determination of sugars"; carotene content – according to DSTU ISO 6558-2:2004 "Fruits, vegetables and processed products. Determination of carotene content. Part 2. Standard methods (ISO 6558-2:1992, IDT)", vitamin E content – according to DSTU EN 12822:2005 "Food products. Determination of vitamin E content by high-performance liquid chromatography. Measurement of a-, b-, y-, d-tocopherols (EN 12822:2000, IDT)"; the content of pectin substances – by the colorimetric method according to [24]; mass fraction of fiber – by weight method, according to [25]; starch content in the hydrolyzate according to [26]; of phenolic substances – by the colorimetric method according to [27].

The amino acid composition of the protein was determined by the method of ion exchange chromatography on an amino acid analyzer AAA-339M "Microtechna" (Czech Republic). The fatty acid composition of the fat was determined by extraction of lipids with a mixture of chloroform:methanol (1:2), methylation of fatty acids followed by their quantitative determination on a Shimadzu GC-14A chromatograph (Japan) according to DSTU ISO 5508-2001 "Animal and vegetable fats and oils. Gas chromatography analysis of methyl esters of fatty acids".

The energy value of the studied samples was determined by the calculation method. Quality indicators of paste oil were determined based on DSTU ISO 729:2005 "Seeds of oil crops. Determination of oil acidity" and DSTU 4570:2006 "Vegetable fats and oils. The method of determining the peroxide value".

Results of the research and their discussion

It is appropriate to discuss the composition of pumpkin seed paste in comparison with peanuts – a classic raw material for the production of nut pastes. Table 1 shows the composition of the tested sample of pumpkin seed paste, which was determined by the authors of the work, which was crushed seeds. The results are given in comparison with the composition of peanuts given in [6].

The content of macronutrients in the studied sample is close to the indicators given in the works of other researchers [10-13]. Compared to peanuts, pumpkin seeds contain significantly more protein and less fat. The last indicator gives preference to pumpkin

seeds. Nutritionists advise people who are prone to obesity, as well as patients with gout, arthrosis, arthritis, to use peanut paste carefully. Excess fat consumption leads to excess body weight and is a leading risk factor for cardiovascular diseases, atherosclerosis, hypertension, and diabetes [1-3].

Table 1 – Comparative characteristics of pumpkin and peanut paste

Index	Pumpkin seeds	Peanuts [6]
Moisture, %	2.2	3.5
Proteins, %	36.8	26.8
Fats, %	46.9	54.0
Carbohydrates absorbed %, including mono- and disugars, % starch, %	4.3 2.4 1.9	5.8 2.0 3.8
Calorie content, kcal / 100 g	581.2	608.9

The recommended amount of fat in the human diet is 90–107 g per day, which provides 30–33% of the energy value of the diet [2].

As can be seen from the data, given in the table 1, the samples differ little in terms of caloric content.

The determined composition of higher fatty acids of pumpkin oil compared to peanut oil is presented in table 2.

Table 2 – Fatty acid composition of oils

Fatty acid content, %	Pumpkin seeds	Peanuts
Palmitic	12.3	17.4
Stearic	4.7	27.1
Oleic	29.4	40.5
Linoleic	53.6	15.0

It should be noted the high content of polyunsaturated linoleic acid in pumpkin seed oil (Table 2), which belongs to the category of essential. Its content in the composition of peanut oil is much lower, which coincides with the data given in [6,13]. The value of linoleic acid is determined, in particular, by the fact that arachidonic acid is synthesized from it with the participation of vitamin B_6, which has the highest biological activity among essential acids. Some other higher fatty acids are also present in small amounts in the oils: saturated (myristic, behenic), as well as polyunsaturated linolenic acid.

According to experts, unlike pumpkin oil, peanut oil, as well as sesame and rapeseed oil, belongs to the group of the least useful vegetable oils [1,2]. They have much less polyunsaturated acids and relatively many saturated fatty acids with a large molecular weight.

To assess the quality of the protein substances of pumpkin seeds, we analyzed its amino acid composition. 18 amino acids have been identified, among them all are essential. The composition of essential amino acids of the studied raw materials in comparison with peanuts is presented in Table 3.

As can be seen from the results presented in Table 3, the first limiting amino acid in the composition of pumpkin seed protein is lysine, the content of which is 75.2% of the "ideal" protein. Instead, the content of the first limiting amino acid in peanut protein, which characterizes the total content of sulfur-containing amino acids, reaches only 40.9%. Based on data characterizing the quality of protein substances, there are reasons to believe that pumpkin raw materials have obvious advantages.

It should also be noted that peanuts contain proteins that can cause an allergic reaction in the body [5,6]. That is why peanut paste manufacturers in the USA made certain efforts to eliminate or at least reduce the content of allergenic proteins in raw materials.

Today, pumpkin seed paste is not yet in great demand. In order to diversify the assortment of pumpkin seed pastes, improve their sensory properties, which for the vast majority of consumers is decisive when choosing a particular product, and at the same time enrich them with biologically active compounds, we received a line of pastes with the addition of domestic berry raw materials.

Viburnum, cranberry and sea buckthorn berries dried and ground into powder were used. When obtaining experimental samples, 25% or 30% of the paste was replaced with berry powder. The characteristics of the samples that contained 25% of berry raw materials are given in Table 4.

Table 3 – Composition of essential amino acids of pumpkin and peanut seed proteins

Amino acid	FAO /WHO, mg/g of "ideal" protein	Amino acid content, mg/g of protein		Amino acid rate, %	
		Pumpkin seeds	Peanuts [6]	Pumpkin seeds	Peanuts
Isoleucine	40	37.5	29.5	93.8	73.9
Leucine	70	71.0	54.1	101.4	77.2
Lysine	55	37.6	38.9	75.2	77.6
Methionine + cysteine	35	19.7 7.0	9.3 5.0	76.3	40.9
Phenylalanine + tyrosine	60	54.0 36.0	38.8 24.0	150.0	104.7
Threonine	40	31.0	48.1	77.5	120.5
Tryptophan	10	20.0	10.4	200.	104.4
Valine	50	46.0	48.1	92.0	96.8

Table 4 – Characterization of sensory properties of pastes based on pumpkin seeds

Sample	Indicator				
	Taste	Odor	Color	Consistency	Secondary aftertaste
Pumpkin seed paste (control)	roasted seeds, somewhat astringent	somewhat astringent pleasant as roasted seed	greeny	dense, flat, with the release of a layer of oil	–
Paste with 25% viburnum powder	the astringent aftertaste is eliminated, acidity is added	faint smell of berries	brownish red	quite thick, with spots, without stratification	sour-bitter
Paste with 25% sea buckthorn powder	a characteristic sour taste appears	faint smell of berries	dark yellow		noticeable sourness
Paste with 25% cranberry powder	a characteristic sweet-sour taste appears	unchanged	dark red		soft sour-sweet

Comparative characteristics of sample properties using the descriptor-profile method on a five-point scale is presented in Figure 1

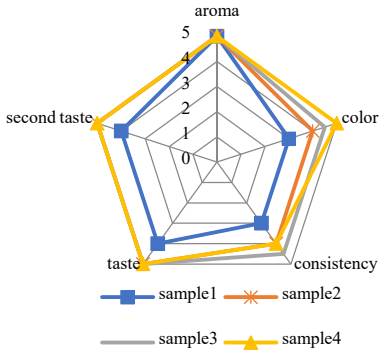

Fig. 1. Profile assessment of sensory properties of samples: 1 – pumpkin seed paste (control), 2 – paste with 25% cranberry powder, 3 – paste with 25% viburnum powder, 4 – paste with 25% sea buckthorn powder

Based on the data given in the Table 4 and obtained using the descriptive-profile method (Fig. 1), it is clearly visible the improvement of the sensory properties of all tested paste samples due to the introduction of berry powders into its composition. Better results were obtained for samples of paste with the addition of viburnum and sea buckthorn powders compared to the product that contained cranberry powder.

When receiving samples where 30% of the paste was replaced with berry powders, the products had a too thick consistency. Such changes were noticeable even in the process of mixing the components during the preparation of samples. This made it impossible to use them, in particular, for greasing crackers, sandwiches, adding to salads as a dressing. Such products would not meet the needs of a wide range of consumers and food establishments and, accordingly, would have a very limited demand. Therefore, in the future, these samples were not examined.

Characteristics of the nutritional value of the berry powders used in the research are presented in Table 5.

Table 5 – Characteristics of berry powders

Index	Viburnum	Cranberry	Sea buckthorn
Sugars including monosaccharides, % disaccharides, %	51.7 2.4	22.9 1.2	26.5 2.9
Pectin substances, %	7.8	6.2	2.4
Fiber, %	13.5	17.0	28.2
Proteins, %	2.8	2.7	5.3
Fats, %	1.4	3.4	14.7
Calorie content, kcal / 100 g	245.6	139.8	271.7

Carbohydrates are known to make up to 90% of the dry matter of vegetable raw materials [28-30]. As can be seen from the obtained data, digestible carbohydrates are represented mainly by monosaccharides – glucose and fructose, a small amount of sucrose is also present. Pectin compounds and fiber are contained less in berry raw materials. The results of the analysis of the chemical composition of the studied berry powders (Table 5) are consistent with the literature on the composition of this raw material [7,28-30].

The combination of a rather high content of sugary substances and food acids, which is characteristic of berries [29,30], gives the products a pleasant taste. This is reproduced in the sensory characteristics of samples of pumpkin seed paste with the addition of berry powders (Table 4). Although it is known that the existing ratio of sugars and acids in the composition of cranberries does not contribute to pleasant taste sensations and interferes with the direct use of these berries in food, on the other hand, paste with the addition of cranberries has a pleasant taste. It is noted that the presence of intense, but natural color of

products stimulates digestion processes and digestibility of food [1].

Protein, which is determined by the Kjeldahl method, is more correctly called nitrogenous substances, since they actually contain less than half of proteins [28]. The total protein content in the powders is negligible (Table 5). Fat is mainly concentrated in the seeds, it is present in a small amount in viburnum and cranberry, much more in sea buckthorn.

The characteristics of the chemical composition and caloric content of paste samples with the addition of berry powders are given in Table 6.

Table 6 – Characteristics of pumpkin seed paste samples with the addition of berry powders

Index	Paste with added of powder		
	viburnum	cranberries	sea buckthorn
Proteins, %	28.3	28.3	28.9
Fats, %	35.6	36.1	38.9
Carbohydrates – including mono- and disugars, % – starch, %	13.3 1.4	7.8 1.4	9.2 1.4
Calorie content, kcal / 100 g	497.3	470.9	503.8
Reduction in caloric content compared to control, %	14.4	19.0	13.3

Regarding changes in the chemical composition of the paste, it should be noted that due to the introduction of berry components into the system, which are characterized by a low content of nitrogenous substances and for viburnum and cranberry also fat, there is a redistribution between macronutrients in the composition of products: the content of proteins and fats decreases, instead, the mass fraction of the carbohydrate component increases. In particular, the sugar content increases. The decrease in the mass fraction of the oil component is 17.1–24.15% of its content in the original sample. This is significant and an attractive indicator for people who have certain restrictions on the recommended daily intake of fat.

As can be seen from the data (Table 5), the calorie content of berry powders is significantly lower compared to pumpkin seed paste (Table 1). Therefore, a decrease in the caloric content of paste samples when berry powders are added to their composition is natural (Table 6).

An important indicator of the quality of the obtained products is the stability during storage of one of the most labile components – oil. Changes in the peroxide number, which characterizes the course of fat oxidation processes, are regulated by DSTU, since the products of fat oxidation, especially secondary ones, are dangerous for the human body.

Changes in the quality indicators of the oil component of the products were determined after the sealing of the packaging was broken, during their further storage at room temperature. The results are shown in Table 7.

According to the obtained results (Table 7), the acid value of the oil naturally increases during the storage of the samples at room temperature. However, for 6 weeks, the acid value of the control sample remains within the limits that meet the requirements of the State Technical and Technical Regulations (no more than 2.5 mg of KOH / g of oil). The increase in the values of the acid number of samples with the addition of berry powders occurs a little faster. Although it is possible that the value of this indicator may be influenced by the content of food acids contained in the composition of berry powders.

Table 7 – Changes in the physico-chemical parameters of the oil during the storage of pumpkin seed paste

Index	Weeks						
	0	1	2	3	4	5	6
Pumpkin seed paste (control)							
Acid number, mg KOH /g	0.5	0.7	0.9	1.1	1.4	1.7	2.0
Peroxide number, mmol ½ O/kg	2.3	2.5	3.3	4.5	5.5	6.7	7.7
Paste with viburnum powder							
Acid number, mg KOH /g	0.6	0.9	1.1	1.4	1.8	2.2	2.6
Peroxide number, mmol ½ O/kg	2.3	2.5	2.8	3.0	3.7	4.6	4.8
Paste with sea buckthorn powder							
Acid number, mg KOH /g	0.6	0.8	1.0	1.2	1.5	1.8	2.0
Peroxide number, mmol ½ O/kg	2.3	2.4	2.5	2.7	2.8	3.0	3.2
Paste with 25% cranberry powder							
Acid number, mg KOH /g	0.6	0.9	1.2	1.5	1.9	2.3	2.7
Peroxide number, mmol ½ O/kg	2.3	2.5	2.9	3.2	3.5	3.7	4.0

As for the changes in the peroxide number, it increases throughout the entire period of observation, but in the composition of all samples it remains within the limits defined by DSTU (no more than 8.0 mmol ½ O/kg of oil). In addition, it should be noted that the presence of berry powders in the composition of products significantly slows down the process of oil oxidation. This is most clearly seen on the example of paste with sea buckthorn powder. Apparently, this is due to the presence of compounds with antioxidant properties inherent in berry raw materials [28-32]. Natural antioxidants include, in particular, tocopherols, ascorbic acid, bioflavonoids, etc. It was established that with the introduction of some antioxidants in the amount of 0.01%, the resistance of fats to oxidation can increase 10–15 times.

The content of tocopherols in the composition of sea buckthorn powder was 60.3 mg%, for viburnum and cranberry powders this indicator was much lower and did not exceed the value of 2.0 mg%. Similarly, sea buckthorn powder contained 42.2 mg% of carotenoids, viburnum and cranberry powders contained almost ten times less carotenoids.

Therefore, the enrichment of the paste with fat-soluble vitamins-antioxidants in the composition of sea buckthorn powder effectively inhibited the oxidation of the oily component. This is consistent with data from literary sources [30,32,33]. Primary and especially secondary products of fat oxidation are harmful to human health, therefore the peroxide value is one of the indicators that determines the safety of food products [32,33]

Obviously, the slowing down of the oil oxidation process when viburnum and cranberry powders are added to the paste is due mainly to the content of antioxidants of a different nature. It is known that berry raw material has a fairly high content of ascorbic acid [29-31], and it is also rich in phenolic compounds. Thus, 5.3% of phenolic compounds were found in cranberry powder, 4.4% in viburnum. Using the example of many fruits and berries, it is shown that usually the contribution of vitamin C to the total antioxidant activity is much smaller than that of polyphenolic compounds [28,30].

The activity and duration of action of antioxidants increases in the presence of synergists, which include hydroxy acids, amino acids, citric acid, ascorbic acid, phospholipids, etc. [2,3,32]. When evaluating the antioxidant properties of bioflavonoids in relation to oils, their interaction with ascorbic acid must be taken into account. In fats that do not contain moisture, it acts as a reducing agent, on the other hand, in the water-oil phase, it can manifest itself as an oxidant and accelerate the oxidative deterioration of fats [1,2]. Therefore, in our experiments, conditions were created for the manifestation of a synergistic effect.

It should be noted that according to the principles of rational nutrition, the daily diet should include 4 groups of food products. One of them is fruits and vegetables as sources of vitamins, minerals, and bioflavonoids [1,3,4]. An approximate set of products that meet the physiological needs of the body involves the consumption of fresh fruit 260 g/day and dried fruit 10 g/day throughout the year. Therefore, the consumption of paste with berry powders will reduce the deficit of fruit and berry raw materials and, accordingly, a number of biologically active substances in the diet of our compatriots.

Conclusion

It is shown that pumpkin seed paste is not inferior to the widely known peanut paste in terms of the quality of protein and oil components, but has obvious advantages.

The compositions of pumpkin seed paste with viburnum, sea buckthorn, and cranberry berry powders were studied. It is shown that when 25% of pumpkin seed paste is replaced by powders from domestic berry raw materials, the consumer properties of the products are significantly improved: their color, taste, aroma become more attractive, the consistency becomes more stable, without stratification, and their calorie content decreases. In addition, the samples are enriched with biologically active substances that are characteristic of berries.

It has been proven that the introduction of berry powders into the composition of the paste inhibits the oxidation process of the oily component of the paste during storage. The best result was noted for the paste with the addition of sea buckthorn powder.

Thus, it has been proven that an alternative to peanut paste can be a paste based on domestic raw materials – pumpkin seeds with the addition of berry powders. Berry raw material not only significantly improves the sensory properties of the paste, but also enriches it with biologically active substances and can contribute to the expansion of the range of consumers of this product.

References:

1. Rozhko SG. General theory of health and health care: a collective monograph: edited by Boychuk Yud. Kharkiv: 2017 (in Ukrainian).
2. Dudenko NV, Pavlotska LF, Kovalenko VO, etc. Scientific basis of technology and systematic use of food products of health-improving effect for different segments of the population: monograph. Kharkiv: KhSUFT; 2015 (in Ukrainian).
3. Webster-Gandy J, Madden A, Holdsworth M. Oxford Handbook of Nutrition and Dietetics. Oxford: Oxford University Press, 2006.
4. Peresichnyi M, Fedorova D, Kandaley O. Functional nutrition: theory and practice. Bulletin of KNTEU. 2015;2:96-104 (in Ukrainian).
5. Arya SS, Salve AR, Chauhan S. Peanuts as functional food: a review. Journal of Food Science and Technology. 2016;53(1):31-41.
6. https://doi.org/10.1007/s13197-015-2007-9
7. Dubinina A, Lenert S, Khomenko O. Modeling of the composition of peanut pastes of increased biological value. Goods and markets. 2016;1:193-207 (in Ukrainian).

8. Myroshnyk Yu, Medvid I, Shidlovska O, Dotsenko V. The use of viburnum, rowan and sea buckthorn powders in the technology of semi-finished biscuits. Scientific works of ONAFT. 2015; 46(1):166-170 (in Ukrainian).
9. Calabuig-Jiménez L, Hinestroza-Córdoba LI, Barrera C, Seguí L, Betoret N. Effects of Processing and Storage Conditions on Functional Properties of Powdered Blueberry Pomace. Sustainability. 2022;14:1839. https://doi.org/10.3390/su14031839
10. Eliasson L, Oliveira G, Ehrnell M, Höglund E, Alminger M. Tailoring bilberry powder functionality through preprocessing and drying. Food Sci Nutr. 2019;00:1-8. https://doi.org/10.1002/fsn3.972
11. Lemus-Mondaca R, et al. Pumpkin seeds (Cucurbita maxima). A review of functional attributes and by-products. Rev Chil Nutr. 2019;46(6):783-791. https://doi.org/10.4067/S0717-75182019000600783
12. Dhiman AK, Sharma K, Attri S. Functional constituents and processing of pumpkin: A review. J Food Sci Technol. 2009;46(5):411-417.
13. Syed QA, Akram M, Shukat R. Nutritional and Therapeutic Importance of the Pumpkin Seeds. Biomed J Sci & Tech Res. 2019;21(2). https://doi.org/10.26717/BJSTR.2019.21.003586
14. Habib et al. Nutritional and Lipid Composition Analysis of Pumpkin Seed (Cucurbita maxima Linn.). J Nutr Food Sci. 2015;5:4 https://doi.org/10.4172/2155-9600.1000374
15. Gedi AM, Gedi MA. Pumpkin seed oil components and biological activities. Multiple Biological Activities of Unconventional Seed Oils. 2022;171-184. https://doi.org/10.1016/B978-0-12-824135-6.00030-1
16. Rezig L, Moncef Ch, Kamel M, Salem H, Chemical compositionand profile characterization of pumpkin (Cucurbita maxima) seed oil. Ind Crops Prod. 2012;37(1):82-87. https://doi.org/10.1016/j.indcrop.2011.12.004
17. Amoo I, Eleyinmi A, Ilelaboye N, Akoja, S. Characterization of oil extracted from gourd (Cucurbita maxima) seed. J Food Agric Environ. 2004;2:38-39.
18. Vinayashre S, Prasanna V. Biochemical, nutritional and functional properties of protein isolate and fractions from pumpkin (Cucurbita moschata var. Kashi Harit) seeds. Food Chemistry. 2021;340:128177. https://doi.org/10.1016/j.foodchem.2020.128177
19. Kalyna VS, Kondratiuk NV, Uvarova NV, Rozghon OG, Bohuslavskyi VV, Lytsenko MV. Characteristics and composition of fractional products from pumpkin seeds. Journal of Chemistry and Technologies. 2021;29(4):660-670
20. Nishimura M, Ohkawara T, Sato H, Takeda H, Nishihira J. Pumpkin Seed Oil, Extracted From Cucurbita maxima Improves Urinary Disorder in Human Overactive Bladder. J Tradit Complement Med. 2014;4(1):72-74. https://doi.org/10.4103/2225-4110.124355
21. Ristic-Medic D, Perunicic-Pekovic G, Rasic-Milutinovic Z, Takic M, Popovic T, Arsic A, Glibetic M. Effects of dietary milled seed mixture on fatty acid status and inflammatory markers in patients on Hemodialysis. Sci. World J. 2014;ID563576:9. https://doi.org/10.1155/2014/563576
22. Cerqueira P, Freitas M, Pumar M, Santangelo S. The pumpkin (Cucurbita maxima, L.) seed flour effect on the rat glucose and lipid metabolism. Rev Nutr Campinas. 2008;21(2):129-136. https://doi.org/10.1590/S1415-52732008000200001
23. Dotto JM, Chachab JS. The potential of pumpkin seeds as a functional food ingredient: A review. Scientific African. 2020;10: e00575. https://doi.org/10.1016/j.sciaf.2020.e00575
24. Patel S, Abdur R. Edible Seeds from Cucurbitaceae Family as Potential Functional Foods:Immense Promises, Few Concerns. Biomed Pharmacother. 2017;91:330-337. https://doi.org/10.1016/j.biopha.2017.04.090
25. Dong D, Zhang X, Yao X, Huang Y, Lin C. Determination of sisal pectin content by carbazole colorimetric method. Food Res. Dev. 2010;31:138-140.
26. McCleary BV, Sloane N, Draga A, Lazewska I. Measurement of Total Dietary Fiber Using AOAC Method 2009.01 (AACC International Approved Method 32-45.01): Evaluation and Updates Cereal Chem. 2013;90(4):396-414. https://doi.org/10.1094/CCHEM-10-12-0135-FI
27. Latimer GW, editor. Official Methods of Analysis of AOAC International. AOAC, Arlington, VA; 2012.
28. Howard LR, Clark JR, Brownmiller C. Antioxidant capacity and phenolic content in blueberries as affected by genotype and growing season. Journal of the Science of Food and Agriculture. 2003;83:1238-1247. https://doi.org/10.1002/jsfa.1532
29. Simakhina GO, Stetsenko NO, Naumenko NV. Biologically active substances in food technologies. K.: NUFT; 2016 (in Ukrainian).
30. AM Grodzinsky, editor. Medicinal plants: Encyclopedic guide.K.: UVKC Olymp; 1992. ISBN 5-88500-055-7 (in Ukrainian).
31. Skrovankova S, Sumczynski D, Mlcek J, Jurikova T, Sochor J. Bioactive Compounds and Antioxidant Activity in Different Types of Berries. International Journal of Molecular Sciences. 2015;16(10): 24673-24706. https://doi.org/10.3390/ijms161024673
32. Simakhina G, Naumenko N, Bazhaj-Zhezherun S, Kaminska S. Impact of cryoprotection on minimization of ascorbic acid losses in freezing of berries. Ukrainian Food Journal. 2019;8(2):271-283. https://doi.org/10.24263/2304-974X-2019-8-2-7
33. Melnyk O, Radzievska I, Galenko O, Peshuk L. Investigation of vegetable oils to oxidative degradation of varying degrees of saturation with tocopherol. Carpathian Journal of Food Science and Technology. 2018;10(3):163-170.
34. O'Brien RD. Fats and oils. Formulating and processing for applications. Third edition. Boca Raton : CRC Press. 2009. https://doi.org/10.1201/9781420061673
35. Smolyar VI. Modern problems of the quality of food fats. Nutritional problems. 2008; 3-4:5-12 (in Ukrainian).

ПАСТА З НАСІННЯ ГАРБУЗА З ПОЛІПШЕНИМИ СПОЖИВЧИМИ ВЛАСТИВОСТЯМИ

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Анотація. Згідно з думкою нутриціологів, здоров'я людини залежить від низки факторів: структури харчування на 40–45%, генетики – на 18%, стану охорони здоров'я – на 10%, чинників навколишнього середовища – на 8%, від інших причин – на 19–24% . Тобто фактор харчування є провідним, саме від нього переважно залежить здоров'я нації. Останніми десятиріччями темп життя людей в розвинених країнах світу значно прискорився, і це є вагомим важелем на користь використання так званих «фаст-фудів». До їх складу входить вельми популярна серед населення багатьох країн арахісова паста та її модифікації, що містять різні добавки. Метою роботи було обґрунтування доцільності отримання пасти з вітчизняної сировини – гарбузового насіння з додаванням ягідних порошків, а також характеристика отриманих продуктів. Аналіз амінокислотного складу білка пасти насіння гарбуза, його порівняння з таким арахісу і стандартом ФАО/ВООЗ свідчить, що білок гарбузового насіння характеризується більшою біологічною цінністю. Олійні складові паст насіння гарбуза і арахісу мали практично однаковий якісний жирнокислотний склад, проте остання значно поступалася за таким показником, як співвідношення різних груп кислот – характеризувалась низьким вмістом поліненасиченої лінолевої кислоти і одночасно великою кількістю насичених кислот. Арахісова паста мала більший вміст олії і більшу калорійність в порівнянні з пастою насіння гарбуза. На основі пасти з гарбузового насіння було отримано три зразки: 25% маси продукту заміщували ягідними порошками, а саме висушеними і подрібненими ягодами калини, журавлини, обліпихи. Вони перевершували вихідний зразок за своїми сенсорними властивостями і мали знижену в порівнянні з ним калорійність. Результати дослідження змін фізико-хімічних показників олійної складової продуктів при зберіганні свідчать, що внесення ягідних порошків суттєво уповільнює процес її окиснення. Найкращий результат спостерігався для зразка, що містив порошок обліпихи, що, ймовірно, обумовлено високим вмістом в ньому токоферолу – ефективного антиоксиданту.

Ключові слова: паста, насіння гарбуза, харчова цінність, калина, журавлина, обліпиха, сенсорні властивості