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TECHNOLOGY AND NUTRITIONAL VALUE OF A FUNCTIONAL PURE-LIKE SEMI-PRODUCT FOR DESSERTS AND BEVERAGES

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ТЕХНОЛОГІЯ ТА ХАРЧОВА ЦІННІСТЬ ФУНКЦІОНАЛЬНОГО ПОРЕПОДІБНОГО НАПІВФАБРИКАТУ ДЛЯ ДЕСЕРТІВ ТА НАПОЇВ

Objective. The objective of the article is the scientific substantiation and practical development of the technology of a functional semi-finished product for sweet dishes and drinks based on pumpkin, quince and sea buckthorn puree.

Methods. Sampling was carried out in accordance with DSTU ISO 874-2002, preparation of samples for laboratory analyzes – in accordance with DSTU 7040:2009. Physico-chemical indicators were determined in accordance with DSTU 8639:2016 "Fruit purees and semi-finished products. General technical conditions", as well as: content of dry substances in raw materials - according to DSTU ISO 751-2004; mass fraction of soluble solids – by refractometric method according to DSTU ISO 2173:2007; mass fraction of titrated acids (in terms of malic acid) – according to DSTU 4957:2008; content of ascorbic acid – according to B. P. Pleshkov; protein content was determined by the Kjeldahl method; pectin substances were determined by the titrimetric method; ash was determined according to DSTU 4913:2008 "Fruits, vegetables and processed products. Methods of determining mineral impurities"; fiber – according to Henneberg and Shtomann according to DSTU ISO 5498:2004 "Food and agricultural products. General method for the determination of crude fiber content" (ISO 5498:1981, IDT); carotene – by spectrometric method 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).

Results. The technology of a functional vegetable semi-finished product based on pumpkin, quince and sea buckthorn puree has been developed. The use of semi-finished products will simplify the technological process of preparing sweet dishes and drinks, as well as improve the nutritional

and biological value. The developed semi-finished product has a high nutritional value and is a source of functional ingredients: pectin substances, carotenoids, flavonoids, fiber, minerals.

Key words: *functional mashed semi-finished product, desserts, drinks, nutritional value.*

Formulation of the problem. Humanity is faced with an ever-increasing increase in the consumption of sweets, which undoubtedly affects the overall the state of people's health, including the state of the cardiovascular, digestive, and hormonal systems of the body. Excessive sugar consumption leads to an increase in the number of bacteria in the oral cavity, which, in turn, causes caries and thinning of tooth enamel. The use of vegetable purees in food production has great practical benefits, as it will help make a traditional dessert not only tasty, but also healthy, enriching the product with fiber, pectin, vitamins, enzymes, mineral salts, antioxidants. Vegetable purees have a high content of vitamins C and P, which is the basis for their use to fortify finished products. This technology can also be useful from an economic point of view, since its use entails a reduction in the use of egg-containing mixtures, sugars, food colors and flavors [1].

The source of natural biologically active substances are purees, juices, extracts, decoctions of fruits, vegetables, cultivated and wild berries, medicinal herbs, etc. Therefore, an urgent issue for this type of product is the improvement of the recipe of the existing assortment of sweet dishes due to the use of natural plant components of high biological value.

According to the type of raw material, plant additives can be divided into vegetable, fruit (fruit and berry) and grain, and according to the type of processing, plant additives are in the form of purees, pastes, jams, juices, extracts, wort, syrups, decoctions, infusions, powders, grits, flour, meal, pomace, in some cases – in its natural form [2].

Sweet dishes and desserts are in great demand among consumers. However, these products, as a rule, have an unbalanced chemical composition, high calorie content, high content of fats and carbohydrates, relatively low protein content and insufficient amount of biologically active substances.

Comprehensive studies of some herbal additives have shown that their introduction increases the foaming and emulsifying ability of milk and egg proteins and improves the quality of finished products from them both in terms of organoleptic and physicochemical indicators. Explaining the positive effect of the introduction of berry purees, scientists assume the possibility of interaction of pectin substances contained in the puree with amino acids of proteins, and the formation of protein-carbohydrate complexes, which, due to surface-active properties, increase the foam-forming ability and stability of the foam. The negative effect with large dosages of berry puree is explained by further dilution of the protein-sugar mixture [3].

In the aspect of solving this problem, research in the field of developing new technologies for drinks and sweet dishes using non-traditional plant raw materials, which contribute to the stabilization of vision and the prevention of its diseases, are timely and relevant. Pumpkin, quince and sea buckthorn are a source of valuable components that are recommended for the prevention of eye diseases (carotenoids, pectin substances, phenolic compounds, macro- and microelements, etc.), but are almost not used in restaurants, which indicates the need to create semi-finished products based on them, which will allow to significantly simplify the technological process and rationally use valuable natural plant resources.

Analysis of recent research and publications. In summer and autumn, almost all fruits are available and relatively cheap, and in order to preserve these products for the cold season, it is enough to process them into berry and fruit semi-finished products. Subsequently, they will become an excellent raw material for the production of marshmallows, marmalade, jam, ice cream, jelly, pie fillings and many other products. Semi-finished products are made from cultivated and wild fruits and berries: pears, apples, raspberries, dogwoods, blackberries, lingonberries, oranges, lemons, etc. Only ripe fruits that are not damaged by pests or agricultural diseases are used for production. As a rule, semi-finished products are created from a single type of product [4].

Possibility to reduce storage and transportation costs, to smooth out the seasonality of canning production and the growing demand for purees, reconstituted juices with pulp, nectars, sauces and food fillers, contribute to the spread of concentrated semi-finished products throughout the world. On

the quality indicators of concentrated purees semi-finished products are affected, first of all, by the viscosity of the fruit masses, a sharp increase in which during concentration slows down the process of moisture removal, complicates the operation of vacuum evaporators, and contributes to the deterioration of the organoleptic characteristics of the finished product.

Viscous-plastic properties of pureed fruit masses determined by the content of pectin substances, their condition (protopectin, soluble pectin, intercellular substance pectin). Highly methoxylated pectin substances act as thickeners, low methoxylated ones act as electrolytes and, under certain conditions, can be separated from the liquid phase of the colloidal system. Cell wall protopectin does not have thickening properties and does not affect the viscosity of the puree-like fruit mass. Thus, with the same content of pectin substances in the raw material, the viscosity of the fruit mass depends on the ratio of the forms of pectin substances in it [5].

In recent years, vegetable semi-finished products and concentrates of various composition and functional purpose have become increasingly common in the production of culinary products, in particular, whipped sweet dishes. They make it possible to increase the biological value and reduce the cost of production by reducing energy consumption and reducing the number and duration of technological operations [6], have longer storage terms compared to fresh vegetables, fruits and berries [7].

The analysis of literary sources [8] shows that the range of semi-finished products for the production of whipped sweet dishes and products is quite narrow, but the growing market needs and supply of such semi-finished products are quite large, so it is advisable to study them in more detail and develop new technologies [9]. On the basis of in-depth research, the authors [10, 11] gave a scientific justification for the possibility of using pumpkin, carrot, sea buckthorn puree for the preparation of jellies, mousses, sambukas, jelly according to traditional technologies [12], which contain low-esterified pectins [13], which differ in pronounced protective properties [14].

Thus, vegetable, fruit and berry purees are valuable raw materials for the production of sweet whipped dishes and drinks for schoolchildren, therefore the work on the creation of new resource-saving technologies for the processing of vegetable raw materials is relevant and promising.

Objective of the article is the scientific substantiation and practical development of the technology of a functional semi-finished product for sweet dishes and drinks based on pumpkin, quince and sea buckthorn puree.

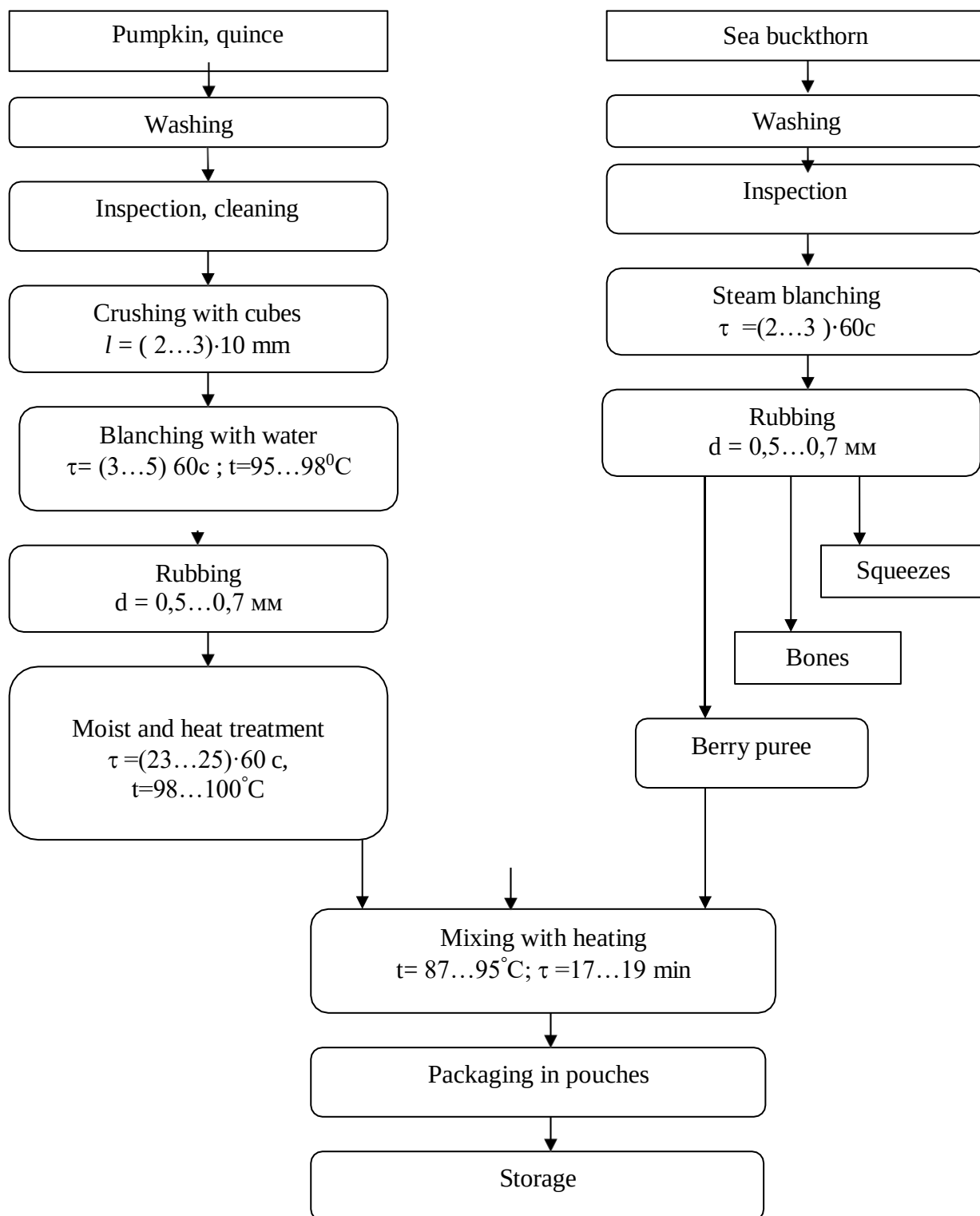
Presentation of the main study material. In recent years, more and more attention has been paid to the problem of finding fundamentally new additives during the preparation of dishes with a foam structure, which would allow saving traditional foam and structure formers and at the same time improve the nutritional and biological value of the final products [15, 16]. We have developed a semi-finished product (puree) based on pumpkin and quince with sea buckthorn, the raw material consumption standards for its production are given in the table. 1.

Table 1 – Raw material consumption standards for the production of 100 kg of semi-product

The name of the raw material	Estimated bookmark rates raw materials, kg	Losses and waste, %		Consumption norms of raw materials per 100 kg of finished products, kg
		during primary processing, blanching, wiped	when mixing, packaging	
Pumpkin	105	25	5	73,5
Quince	130	25	5	91,0
Sea buckthorn	6	30	5	3,9
Sugar	10	-	-	10
Product output	257	–	–	184,4

An analysis of methods for concentrating puree-like fruit masses showed that the maximum degree of concentration of the mass is limited by its viscosity and the presence of pulp particles. The use of a relatively new method of concentration with fractionation of finely pureed fruit mass is

promising, but requires additional research and the search for opportunities to reduce the viscosity of the mass without negative consequences for the quality of products made from this semi-finished product.



The technological diagram of the semi-finished product is shown in fig. 1.

Figure 1 – Technological scheme of puree-like semi- product

During the thermal action in the process of culinary processing or industrial processing, changes in the chemical composition occur, associated with a change in the spatial orientation of

cellular structures, inactivation of enzymes, processes of oxidation of the pigment complex, partial destruction of some vitamins, etc.

Table 2 shows data on the nutritional value of the semi-finished product.

Table 2 – Chemical composition of puree-like semi-product

Name indicator		Units of meas.	Pumpkin puree (control)	Puree-like semi-product
Water		%	76,2±1,15	75,6±1,15
Protein		-//-	0,32±0,01	0,35±0,01
Lipids		-//-	0,2±0,02	0,1±0,02
Carbo-hydrates	general	-//-	21,31±0,04	21,17±0,04
	mono- and disaccharides	-//-	16,3±0,4	19,2±0,4
Cellulose		-//-	0,6±0,01	0,5±0,01
Pectin		-//-	1,04±0,03	1,28±0,03
Organic acids		-//-	0,63±0,03	0,94 ±0,03
Ash		-//-	0,30±0,01	0,40±0,02
β- carotene		mg/100 g	197,2±0,2	241,8±0,1
Ascorbic acid		mg/100 g	11,70±0,02	25,90±0,02
Energy value		kkal/100 g	94,9	90,7

The analysis of the data presented in Table 2 shows that the quince-pumpkin semi-finished product with sea buckthorn has a high nutritional value, which is largely determined by its mineral and vitamin composition. The results of the experiments showed that the use of sea buckthorn puree in the production technology of a semi-finished product based on pumpkin and quince gives it a certain color, that is, the puree can be considered as a source of natural dyes of phenolic origin. It is also advisable to use sea buckthorn as a raw material with a stable color effect for obtaining mashed potatoes with an increased content of biologically active substances. Generalized experimental data on the technological properties and nutritional value of the semi-finished product made it possible to develop the technologies of desserts, smoothies and drinks with the aim of their implementation in the practice of restaurant enterprises.

Thus, the conducted studies testify to the high quality of the developed semi-finished product, which makes it possible to recommend it for use in the production of a wide range of sweet dishes and drinks that are very popular among schoolchildren, which will allow to significantly enrich diets with biologically valuable functional ingredients. The introduction into the food industry of food products using plant raw materials that have functional properties is a very promising direction of the development of modern technology due to the variety, cheapness, widespread distribution of plant raw materials, as well as the peculiarities of its chemical composition and technological properties.

Conclusions. Thus, the developed semi-finished product, which is a source of carotenoids, pectin, fiber, and minerals, is recommended for the production of functional products (sweet dishes and drinks). In the future, it is planned to determine the rheological characteristics of the developed semi-finished product and prove its functional properties (physiological action).

References

1. Ushchapovskyi, A.; Ivchuk, N. (2020). Use of semi-finished cherry-beet puree in technology of sweet dishes and desserts. *Technology Audit and Production Reserves*, 3 (3 (53)), 42–44. <http://doi.org/10.15587/2706-5448.2020.205176>.
2. Mark-Herbert, C. (2002). Functional food for added value. Developing and marketing a new product category: Doctoral dissertation. URL: https://www.researchgate.net/publication/31732394_Functional_Foods_for_Added_Value_Developing_and_Marketing_a_New_Product_Category_C_Mark-Herbert.
3. Bondar M. (2020). Regulations on functional products in different countries. *Norwegian Journal of Development of the International Science*, (51-1), 16-23. <https://doi.org/10.24412/3453-9875-2020-51-1-16-23>.
4. Zhakova, K.; Mironova, N. (2017). New development of functional products, *Science and innovation*, 171, 21-23.
5. Zahorulko, Andrii; Zagorulko, Aleksey; Mikhaylov, V.; Rudska, N.; Dmytrevskyi, D.; Ibaiev, E.; Tytarenko, N. (2023). Improved method of brewing peanut mouth with blending fruit drink of a high degree of readiness, *EUREKA: Life Sciences*, 33-39. <https://doi.org/10.21303/2504-5695.2023.002784>.
6. Pap, Nora; Fidelis, Marina; Azevedo, Luciana; Wang, Dongxu; Mocan, Andrei; Pereira, Eliene; Xavier-Santos, Douglas; Sant'Ana, Anderson; Yang, Baoru; Granato, Daniel. (2021). Berry polyphenols and human health: evidence of antioxidant, anti-inflammatory, microbiota modulation, and cell-protecting effects, *Current Opinion in Food Science*, 42. <https://doi.org/10.1016/j.cofs.2021.06.003>.
7. Bilenka, I.; Lazarenko, N.; Zolovska, O.; Dzyuba, N. (2019). Complex processing of jerusalem artichoke into functional products. *Food Science and Technology*, 13. <https://doi.org/10.15673/fst.v13i4.1559>.
8. Zahorulko, And.; Zagorulko, Al.; Kasabova, K.; Gordienko, I. (2021). Creation of multi-component fruit and vegetable semi-finished products and confectionery on their basis with health properties. *BIO Web Conf.*, 30, 01024. <https://doi.org/10.1051/bioconf/20213001024>.
9. Bucher, Tamara; Van der Horst, Klazine; Siegrist, Michael. (2012). Fruit for dessert. How people compose healthier meals, *Appetite*, 60. <https://doi.org/10.1016/j.appet.2012.10.003>.
10. Rudska, N.; Cherevko, O.; Pugach, A.; Ponomarenko, N.; Tesliuk, H.; Zakharchenko, R.; Postadzhiev, A.; Tytarenko, N. (2023). Improvement of the Manufacturing Method of Multi-Component Paste-Like Vegetable Semi-Finished Products with a High Degree of Readiness, *Eastern-European Journal of Enterprise Technologies*, 1 (11(121)), 41–49. <https://doi.org/10.15587/1729-4061.2023.273673>.
11. Balestra, F.; Cocci, E.; Marsilio, G.; Dalla Rosa, M. (2011). Physico-chemical and rheological changes of fruit purees during storage, *Procedia Food Science*, 1, 576-582. <https://doi.org/10.1016/j.profoo.2011.09.087>.
12. Nindo, C. I.; Tang, J.; Powers, J. R.; Takhar, P. S. (2007). Rheological properties of blueberry puree for processing applications. *LWT – Food Science and Technology*, 40, 292-299.
13. Jimenez, D.; Miraballes, M.; Gámbaro, A.; Lobo, M.; Samman, N. (2020). Baby purees elaborated with andean crops. Influence of germination and oils in physico-chemical and sensory characteristics, *LWT*, 124, 108901, <https://doi.org/10.1016/j.lwt.2019.108901>.
14. Wani, Shefali; Bakshi, Rayees Ahmad; Khan, Zakir S.; Fayaz, Shemilah, Khalid Muzaffar, B. N. Dar. (2021). Physiochemical, sensorial and rheological characteristics of puree developed from Kashmiri peaches: influence of sugar, KMS and storage conditions, *Heliyon*, 7 (8), e07781. <https://doi.org/10.1016/j.heliyon.2021.e07781>.
15. Colin-Henrion, Muriel; Cuvelier, G.; Renard, Catherine. (2007). Texture of pureed fruit and vegetable foods, *Stewart Postharvest Review*, 3, 1-14. <https://doi.org/10.2212/spr.2007.5.3>.
16. Mateescu, A.M.; Mureșan, A.E.; Pușcaș, A.; Mureșan, V.; Sestras, R.E.; Muste, S. (2022). Baby Food Purees Obtained from Ten Different Apple Cultivars and Vegetable Mixtures: Product Development and Quality Control. *Applied Sciences*, 12, 12462. <https://doi.org/10.3390/app122312462>.

Список літератури

1. Ushchapovskyi A., Ivchuk N. Use of semi-finished cherry-beet puree in technology of sweet dishes and desserts. *Technology Audit and Production Reserves*. 2020. №3 (3 (53)). P. 42–44. <http://doi.org/10.15587/2706-5448.2020.205176>.
2. Mark-Herbert C. (2002). Functional food for added value. Developing and marketing a new product category: Doctoral dissertation. URL: https://www.researchgate.net/publication/31732394_Functional_Foods_for_Added_Value_Developing_and_Marketing_a_New_Product_Category_C_Mark-Herbert.
3. Bondar M. Regulations on functional products in different countries. *Norwegian Journal of Development of the International Science*. 2020. №51-1.
4. Zhakova K., Mironova N. New development of functional products. *Science and innovation*. 2017. №171. P. 21-23.
5. Zahorulko And., Zagorulko Al., Mikhaylov V., Rudska N., Dmytrevskyi D., Ibaiev E., Tytarenko N. (2023). Improved method of brewing peanut mouth with blending fruit drink of a high degree of readiness. *EUREKA: Life Sciences*. 2023. P. 33-39. <https://doi.org/10.21303/2504-5695.2023.002784>.
6. Pap Nora, Fidelis Marina, Azevedo Luciana, Wang Dongxu, Mocan Andrei, Pereira Eliene, Xavier-Santos Douglas, Sant'Ana Anderson, Yang Baoru, Granato Daniel. Berry polyphenols and human health: evidence of antioxidant, anti-inflammatory, microbiota modulation, and cell-protecting effects. *Current Opinion in Food Science*. 2021. №42. <https://doi.org/10.1016/j.cofs.2021.06.003>.
7. Bilenka I., Lazarenko N., Zolovska O., Dzyuba N. Complex processing of jerusalem artichoke into functional products. *Food Science and Technology*. 2019. №13. <https://doi.org/10.15673/fst.v13i4.1559>.
8. Zahorulko And., Zagorulko Al., Kasabova K., Gordienko I. Creation of multi-component fruit and vegetable semi-finished products and confectionery on their basis with health properties. *BIO Web Conf*. 2021. №30. 01024. <https://doi.org/10.1051/bioconf/20213001024>.
9. Bucher T., Van der Horst Klazine, Siegrist M. Fruit for dessert. How people compose healthier meals. *Appetite*. 2012. №60. <https://doi.org/10.1016/j.appet.2012.10.003>.
10. Rudska N., Cherevko O., Pugach A., Ponomarenko N., Tesliuk H., Zakharchenko R., Postadzhiev A., Tytarenko N. Improvement of the Manufacturing Method of Multi-Component Paste-Like Vegetable Semi-Finished Products with a High Degree of Readiness. *Eastern-European Journal of Enterprise Technologies*. 2023. №1 (11(121)). P. 41–49. <https://doi.org/10.15587/1729-4061.2023.273673>.
11. Balestra F., Cocci E., Marsilio G., Dalla Rosa M. Physico-chemical and rheological changes of fruit purees during storage. *Procedia Food Science*. 2011. №1. P. 576-582. <https://doi.org/10.1016/j.profoo.2011.09.087>.
12. Nindo C. I., Tang J., Powers J. R., Takhar P. S. Rheological properties of blueberry puree for processing applications. *LWT – Food Science and Technology*. 2007. №40. P. 292-299.
13. Jimenez D., Miraballes M., Gámbaro A., Lobo M., Samman N. Baby purees elaborated with andean crops. Influence of germination and oils in physico-chemical and sensory characteristics. *LWT*. 2020. №124. 108901, <https://doi.org/10.1016/j.lwt.2019.108901>.
14. Shefali Wani, Rayees Ahmad Bakshi, Zakir S. Khan, Shemilah Fayaz, Khalid Muzaffar, B.N. Dar. Physiochemical, sensorial and rheological characteristics of puree developed from Kashmiri peaches: influence of sugar, KMS and storage conditions. *Heliyon*. 2021. Vol. 7. Is. 8. e07781. <https://doi.org/10.1016/j.heliyon.2021.e07781>.
15. Colin-Henrion Muriel, Cuvelier G., Renard Catherine. Texture of pureed fruit and vegetable foods. *Stewart Postharvest Review*. 2007. №3. P. 1-14. <https://doi.org/10.2212/spr.2007.5.3>.
16. Mateescu A.M., Mureșan A.E., Pușcaș A., Mureșan V., Sestras RE, Muste S. Baby Food Purees Obtained from Ten Different Apple Cultivars and Vegetable Mixtures: Product Development and Quality Control. *Applied Sciences*. 2022. №12 (23). P. 12462. <https://doi.org/10.3390/app122312462>.

Мета. Метою статті є наукове обґрунтування та практична розробка технології функціонального напівфабрикату для солодких страв і напоїв на основі пюре з гарбуза, айви та обліпихи.

Методи. Вибір проб проводився відповідно до ДСТУ ISO 874-2002, приготування проб до лабораторних аналізів – відповідно до ДСТУ 7040:2009. Фізико-хімічні показники визначали відповідно до ДСТУ 8639:2016 «Пюре-напівфабрикати фруктові. Загальні технічні умови», а також: вміст сухих речовин у сировині – за ДСТУ ISO 751-2004; масову частку розчинних сухих речовин – рефрактометричним методом за ДСТУ ISO 2173:2007; масову частку титрованих кислот (у перерахунку на яблучну кислоту) – за ДСТУ 4957:2008; вміст аскорбінової кислоти – за Плешковим Б. П.; вміст білка визначали методом К'ельдаля; пектинові речовини визначали титриметричним методом; золу визначали згідно з ДСТУ 4913:2008 «Фрукти, овочі та продукти перероблення. Методи визначення мінеральних домішок»; клітковину – за Геннебергом і Штоманном за ДСТУ ISO 5498:2004 «Продукти харчові сільськогосподарські. Загальний метод визначення вмісту сирової клітковини» (ISO 5498:1981, IDT); каротин – спектрометричним методом за ДСТУ ISO 6558-2:2004 «Фрукти, овочі та продукти перероблення. Визначення вмісту каротину». Частина 2. Стандартні методи (ISO 6558-2:1992, IDT).

Результати. Розроблено технологію функціонального рослинного напівфабрикату на основі пюре гарбуза, айви та обліпихи. Використання напівфабрикату дозволить спрощувати технологічний процес приготування солодких страв і напоїв, а також поліпшувати харчову та біологічну цінність. Розроблений напівфабрикат відрізняється високою харчовою цінністю та є джерелом функціональних інгредієнтів: пектинових речовин, каротиноїдів, флавоноїдів, клітковини, мінеральних речовин.

Ключові слова: функціональний пюреподібний напівфабрикат, десерти, напої, харчова цінність.