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TECHNOLOGY FOR MAKING DRINKS BASED ON PECTIN RICH FRUITS AND VEGETABLES GROWN IN AZERBAIJAN

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The chemical composition of pumpkin has always differed from other plants. Given the potential of pumpkin, the possibility of developing a new range of products from it was explored. As a result of the research, the presented recipe was created, where the main components are fermented pumpkin, orange juice, milk powder and pectin. Such a recipe is recognized as more appropriate. Their chemical composition played a key role in the choice of components, so each component performed its respective function. Since pectin was a stabilizer in the product, milk was a protein fortifier, and orange juice was a flavor enhancer and antioxidant.

The addition of orange juice to the finished product increased its vitamin content, and the use of probiotics enhanced the bactericidal effect of the product, which gave it functional nutritional properties. The purpose of developing such a technology was to obtain a high-quality food product, which was achieved on the basis of the complementarity of the selected raw materials and components. From this point of view, studies have shown that the drink prepared according to the proposed recipe meets the accepted regulatory requirements for such products, both in terms of nutritional value and environmental friendliness.

The effect of the types and concentrations of pectic substances on the probiotic properties of the prepared fruit and vegetable drinks was also studied. Products with a better bifidogenic effect can be obtained when using 2 % liquid pectin in the preparation of beverages.

The organoleptic and microbiological analysis of the finished food product showed that this drink can be used both for children and for preventive purposes

Keywords: enzyme-treated pumpkin puree, orange, probiotics, pectinase, skim milk, beverage

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1. Introduction

It is difficult to meet the needs of the population in everyday food products. This problem can be solved through the preparation of functional foods rich in biologically active substances and beneficial microorganisms. From this point of view, the expansion of the range of fruit and vegetable beverages that can be prepared using simpler technology creates great opportunities to meet such needs. It is known that the richness of the chemical content of fruits and vegetables can be further enhanced by adding additional components to their products. Such beverages are considered to be very promising as functional products.

Pulp-free beverages are currently widely produced, but it is known that beverages with pulp are considered healthier due to their composition and high nutritional value. Besides, the preparation of such beverages by mixing with other types of raw materials in the optimal ratio also increases their physiological effect.

It should be noted that the disadvantage of drinks with pulp is their stratification during storage, which does not harm the quality of the finished product, but reduces its consumer appearance. Considering the ability of pectin to regulate the structure, its use in the product seems to be more beneficial in this regard since pectin-rich raw materials in the recipe of the finished product, rather than artificially obtained pectin are very useful.

To give bifidogenic properties to beverages, fruit and vegetable-based beverages with probiotic and prebiotic effects are being developed in large numbers all over the world, because such a combination increases the biological value of the finished drink.

In general, the preparation of beverages, consisting of fruit and vegetable raw materials, rich in chemical components and metabolites of lactic acid microorganisms, is one of the most pressing issues in the provision of the population with functional food products.

Natural juices are rich in vitamins and microelements. Being very beneficial to the human organism, they strengthen the immune system, have a positive effect on all organs [1]. On the other hand, the studies have shown that pectic substances are good probiotics. The effectiveness of using natural pectin in vegetables and fruits has been determined [2, 3]. It is also important to note that natural-ecological pectins have a high complex-forming ability and are more important in terms of replacing chemical methods with ecological methods. Pectic substances bind heavy metals, penetrate into the digestive tract, prevent resorption of metals and remove them from the organism.

Currently, to increase the range of juices, the juice industry is focused on producing non-alcoholic beverages on the basis of juice nectar and juice puree using vegetables and fruits as raw materials.

The mentioned non-alcoholic beverages are optimal foods, enriching the human organism with biologically active ingredients.

When choosing a juice-based non-alcoholic beverage, the consumer basically focuses on its functional properties. Such drinks should have prophylactic and healthy effects on the human organism, and the use of them should create a positive emotion.

Vegetable and fruit juices and purees rich in vitamins and minerals should be chosen purposefully to form high taste characteristics in drinks.

Therefore, additional studies have been conducted to determine the effectiveness of the pectic supplements, the effect of the type and dose of pectic substance on the development of beneficial bacteria (bifidobacteria) and lactic acid microorganisms.

The Republic of Azerbaijan has very favorable soil and climatic conditions for the cultivation of fruits and vegetables. Since our country has a favorable zone for growing fruit and vegetable raw materials, the production of products from this raw material is cheap. Also, the use of powdered milk and subtropical fruits characteristic of our country in the preparation of the drink shows that the technological process of processing raw materials does not require large expenditures. Pumpkin is widely cultivated in gardens and farms [4, 5]. Pumpkins are rich in fats, macro- and microelements, vitamins, pectin and food fibers [6], which prevent various diseases. Pumpkin is useful in the treatment of the diseases related to the cardiovascular system, kidney, blood circulation [7], liver, biliary tract, hypertension, obesity, prostate, oncology, etc.

Pharmacological properties and the technology of the use of pumpkin are considered also in healthcare. Vitamins B1, B2, B5, B6, H in the food ration do not only serve as cofactors in the metabolic processes of the organism, they also directly participate in the metabolism of sulfur-containing amino acids and histamine, which leads to the radioprotective effect. Vitamin B6 is an additional source of sulfur and vitamin B1enhances radioprotective ability for the food substances [8].

Pumpkin is rich in β-carotene, cellulose and minerals [9] and including it in daily food ration is effective in solving problems caused by vitamin A deficiency. Pumpkin is the main source of carotene in the plant world. Beta-carotene has strong anti-oxidant properties, which allows neutralizing free radicals. Carotene is safer for the human organism than its A provitamin. Consumption of fruits and vegetables rich in carotenoids decreases the risk of hair loss, cardiovascular diseases, yellow spot, cataract and degenerative diseases such as various types of cancer. It suggests that the use of beta-carotene can prevent these diseases. Moreover, beta-carotene ensures the formation of the visual pigment rhodopsin [10]. A lot of orange trees are grown in the southern regions of Azerbaijan and on the Black Sea coast. Orange juice is indispensable for the prevention and treatment of cold and avitaminosis. It raises the tone, eliminates fatigue, strengthens blood vessels, kills bacteria, improves immunity, helps to remove cholesterol from the organism, normalizes the function of the intestines, reduces the risk of congenital formations in children and protects against many forms of cancer. Doctors advise drinking orange juice during atherosclerosis and hypertension as well as in liver diseases.

These plants are ecologically clean because no medicinal preparations were used in their cultivation [11]. However, very few food products, including juices are produced from them using industrial methods.

At present, it is very important to implement food production based on environmental requirements. Therefore, when preparing a new range of products, it is important to choose the right ingredients. Since, when compiling new formulations for each multicomponent system, such issues as their complementarity to each other, the stability of the reactivity of the mixture in the finished product, and minimizing the negative impact on the environment after consumption of the product should be taken into account.

2. Literature review and problem statement

The analysis of literature data revealed that high-quality fruit juices should be rich in simple sugars, organic acids, vitamins and minerals [12, 13]. Although the food value of fruit and vegetable-based pulp beverages is high, the preparation process faces certain difficulties. The drawback of such drinks is their propensity to stratification. Such a process depends on the size of the particles in the drink, the density of the liquid phase, the ratio of solid and liquid phases, the indicator of active acidity, etc. Sources [14] show that one of the ways to prevent the stratification of a beverage is the addition of a structural preservative providing stability to the product. An example of such stabilizers is pectin. However, this does not allow solving the problem easily, since a large amount of pectin is required to achieve the desired visual stability of the finished drink, which leads to a rise in the cost of the product. Therefore, the use of raw materials rich in structure-forming substances in the beverage recipe in addition to pectin is considered to be an option to overcome the problem.

Throughout the world, most of the technologies for producing juices use concentrated materials [15]. This affects the quality of the finished product in different ways. The authors of this paper use only technology for concentrated vegetables to produce juices. However, the authors do not describe the process of obtaining natural fresh juices. Although the development of technology for fruit and vegetable juices with antioxidant effects has been studied [16], their analytical safety indicators have not been presented. These indicators are important for human health.

There is a widespread trend toward the use of fermented metabolites in fruit and vegetable drinks. Pumpkin, as raw material, is a good nutritional medium for the growth of lactic acid bacteria, as it contains a large amount of various carbohydrates. The free amino acids, vitamins, and inorganic compounds contained in pumpkin are also factors influencing enzymatic activity [17]. Although nitrogenous compounds play a positive role in the formation of the product aroma, they also react with sugars and participate in the formation of dark-colored compounds, and this negatively affects the quality of the finished product. To avoid such reactions, the production process should be performed at a moderate temperature.

There are different technologies for the production of juices with pumpkin [18]. One of them is a product with a mixture of pumpkin juice (40 %)+orange juice (40 %)+carrot juice (20 %), as well as such a mixture, but with a difference in composition [19].

Taking into account the above, we can say that the prospects for developing a product in accordance with the proposed recipe are its low cost, easy access to components, high quality indicators, its functionality and environmental friendliness.

3. The aim and objectives of the study

The aim of the study is to substantiate methods for improving the technology for the production of functional food products, which will expand the range of products based on pumpkin.

To achieve this aim, it is necessary to accomplish the following objectives:

– to choose the optimal technological scheme for the production of fruit and vegetable drinks;

– to conduct experiments to determine the optimal number and type of microorganisms that must be added to the drink;

– to select the best sample of the drink;

– to conduct analyses to determine the amount of heavy metals in the selected drink.

4. Materials and methods

From the scientific point of view, the solution of the task in this way, so to speak, the choice of product recipes in the presented image, depends on the correct definition of the compatibility of the components of the prepared drink. Thus, the processes carried out before the final technological processing of raw materials were performed under organoleptic and chemical control. A large number of models played a key role in the selection of the optimal product. First of all, the importance of using pectin to select the optimal variant for the excretion of the solution in the preparation of the drink and orange juice to ensure its vitamin content, as well as on the basis of the model was selected quality.

In our example, milk was used instead of carrot juice, and lactic acid microorganisms were added to increase the bifidogenicity of the product.

The main component of the study was pumpkin subjected to lactic acid fermentation. As noted above, the use of raw materials rich in pectin is considered appropriate to maintain the structural stability of the finished beverage during further storage. Therefore, the addition of pectin and orange juice to the product helps to maintain this stability, because the charge of the beverage pulp and the active acidity of the medium, which are indicators of structural stability, complement each other thereby contributing to the preservation of such stability.

The development of the finished drink recipe depends on the correct choice of the optimal variants since the taste, appearance, aroma and other sensory indicators of the product are determined by this choice. Both organoleptic and chemical analyses revealed the most effective variant in achieving the desired result.

The use of lactic acid bacteria in the production of beverages gives the product not only bifidogenic properties but also acts as a body protector from external negative influences. The use of fermented pumpkin as the main material makes it possible to speed up the technological process since the preliminary fermentation of the raw material facilitates its further processing.

5. Results of the pectin-based beverage preparation technology from fruits and vegetables

5. 1. Development of optimal technological scheme for food drinks with increased nutritional value

Technological processing stages for each raw material and auxiliary materials have been identified for the process of preparing a new, range beverage. These stages are as follows:

a) the pumpkin was first subjected to organoleptic control, washed, cut into pieces, cleaned of seeds, and stewed for 10 minutes. In this case, due to the breakdown of protopectin in the raw material, it was softened and microbiological contamination was also prevented. Then the pumpkin parts passed through a two-stage grater with sieve holes having a diameter of 1.5÷1.2 and 0.8÷0.4 mm. The crushed mass (pulp) coming out of the grater was treated with 2 % Pectinex®Ultra SP-L, a pectolytic liquid enzyme. The fermentation of the pulp was carried out at 45÷55 °C for 120 minutes. The resulting mass was mixed with sugar and transferred to a homogenizer, and then after adding other components, it was placed in the pot. The purpose of homogenization, as mentioned above, is to eliminate the separation process that occurs in the finished product. In such products, the resulting mass is crushed to such an extent that the raw tissue particles can be held in suspension without settling or floating in the drink;

b) to obtain the juice, the orange was washed, peeled, chopped, and squeezed. The juice was filtered, separated, deaerated, pasteurized, and concentrated under vacuum (up to 60 % dry matter). When peeling, the essential oils should not be mixed with the juice;

c) skim milk was poured into another container with water (up to half the amount specified in the recipe). The mass in this container was mixed with a mixer at 20 °C until completely dissolved. When the milk was completely dissolved, it was added to water (the other half of the amount prescribed in the recipe) heated to a temperature of 70÷80 °C. The obtained milk mass was heated at 85÷90 °C for 5 minutes with stirring;

d) in another container, the homogenized pumpkin puree, orange juice, water, and pectin extract (dry or liquid) were mixed and heated to 80÷85 °C as described above.

The process continued until complete dissolution. Then, dissolved milk was added to this fruit and vegetable mass and mixed, and the resulting product was heated to 90 °C for 10 minutes. In order to study the prebiotic properties of the fruit and vegetable components, the mixture was cooled to a temperature of 37±2 °C, which made possible lactic acid fermentation, then probiotic Bifilakt-PLUS 1EA concentrate was added up to 5 % of the total mass and kept for 9 hours. Active acidity (pH) of 4.3÷4.7 indicated the end of the process. The obtained finished drink was aseptically canned and sent for further operations (Fig. 1).

To study the effects of microorganisms, different ingredients of the product were used. The number of both lactic acid bacteria and bifidobacteria (CFU/g) was determined in the test samples. MRS, a dense semi-liquid nutrient medium, was used to determine the number of lactic acid bacteria. The sample was planted in a Petri dish using the Surface Technology. The incubation period of microorganisms lasted 72 hours at 37±2 °C.

Detection of bifidobacteria is based on the method of deep culture in a test tube, containing their nutrient medium. Blaurok medium, a modified hepatic cysteine mixture, was used as the nutrient medium. The incubation period of bifidobacteria lasted 48÷72 hours at a temperature of 37±1 °C. To ensure the presence of these bacteria, swabs were prepared from grown colonies and stained according to the Gram's method.

5. 2. Experiments to select the optimal number and type of microorganisms

Microbiological analyses were performed following the accepted standard and the results obtained are presented in Table 1. As seen in the table, the high content of microorganisms in all samples favorably affects the fermentation process. The presence of pectic compounds also affects their growth rate. When compared, the best result in terms of the number increase was observed in sample number 4 (with the addition of 2 % liquid pectin). Therefore, it is recommended to use 2 % liquid pectin in the recipe when preparing such drinks, as the guaranteed shelf life of such a product is usually 10 days.

Table 1

The number of lactic acid bacteria and bifidobacteria in the samples (CFU/g)

No.	Samples	Indicators	Acceptable level	Results of the analysis		
				4 days	9 days	Expiration date 10 days
1	No. 1	Lactic acid bacteria, CFU/g	$1 \cdot 10^7$	$1.2 \cdot 10^{10}$	$1.2 \cdot 10^{10}$	$1.2 \cdot 10^{10}$
		Bifidobacteria, CFU/g	$1 \cdot 10^6$	$5.1 \cdot 10^8$	$6.2 \cdot 10^{10}$	$6.2 \cdot 10^{10}$
2	No. 2	Lactic acid bacteria, CFU/g	$1 \cdot 10^7$	$1.15 \cdot 10^{10}$	$1.15 \cdot 10^{10}$	$1.15 \cdot 10^{10}$
		Bifidobacteria, CFU/g	$1 \cdot 10^6$	$2.1 \cdot 10^8$	$3.2 \cdot 10^9$	$3.2 \cdot 10^9$
3	No. 3	Lactic acid bacteria, CFU/g	$1 \cdot 10^7$	$1.15 \cdot 10^{10}$	$1.15 \cdot 10^{10}$	$1.15 \cdot 10^{10}$
		Bifidobacteria, CFU/g	$1 \cdot 10^6$	$2.6 \cdot 10^9$	$2.1 \cdot 10^{10}$	$2.1 \cdot 10^{10}$
4	No. 4	Lactic acid bacteria, CFU/g	$1 \cdot 10^7$	$1.2 \cdot 10^{10}$	$1.2 \cdot 10^{10}$	$1.2 \cdot 10^{10}$
		Bifidobacteria, CFU/g	$1 \cdot 10^6$	$4.2 \cdot 10^9$	$3.2 \cdot 10^9$	$3.2 \cdot 10^9$
5	No. 5	Lactic acid bacteria, CFU/g	$1 \cdot 10^7$	$1.17 \cdot 10^{10}$	$1.17 \cdot 10^9$	$1.17 \cdot 10^9$
		Bifidobacteria, CFU/g	$1 \cdot 10^6$	$1.9 \cdot 10^9$	$3.1 \cdot 10^8$	$3.1 \cdot 10^8$

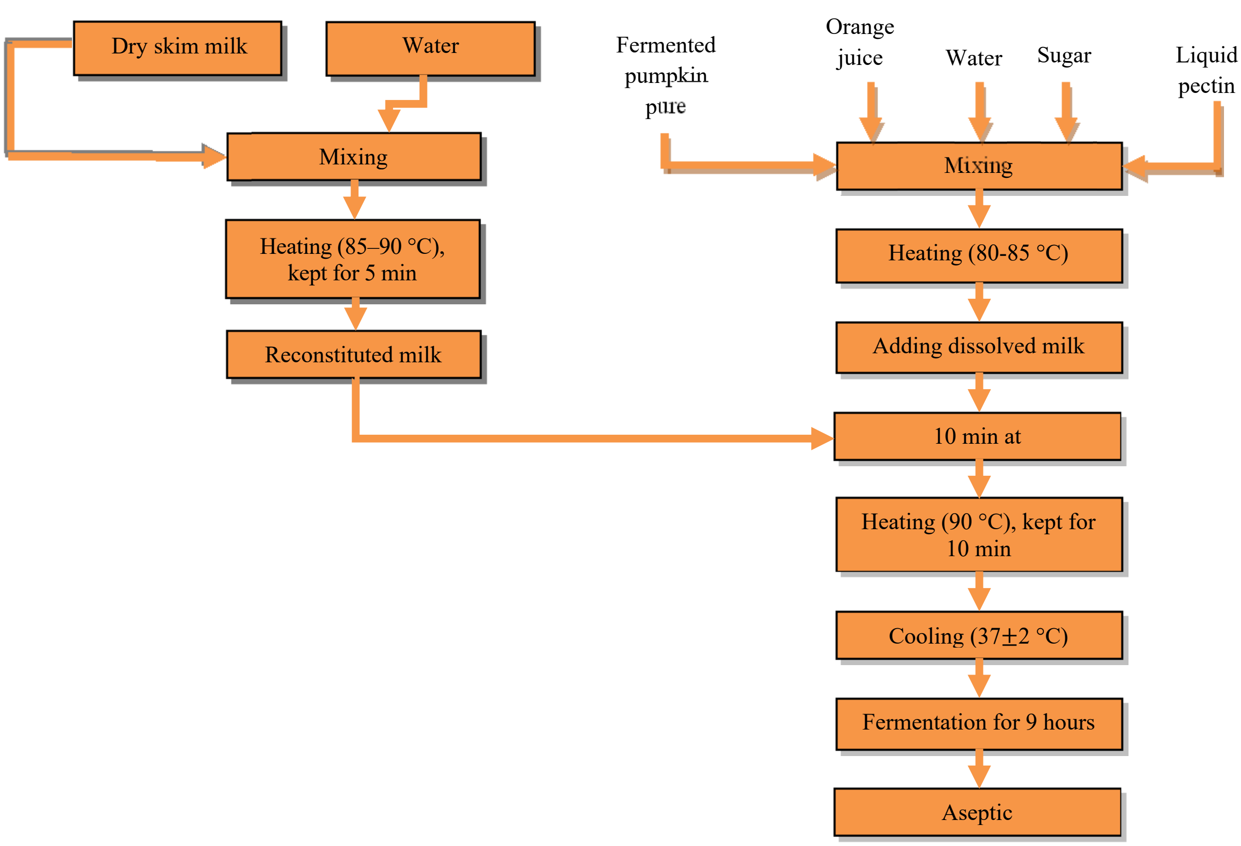

Fig. 1. Technological scheme of the drink prepared with the addition of a mixture of fruits and vegetables rich in pectin

5. 3. Organoleptic analyses of the finished product

Based on the data presented in Table 1, taking into account the great number of lactic acid microorganisms and bifidobacteria in all samples, as well as the effectiveness of the use of liquid pectin, using the mathematical modeling, the recipe of the proposed drink was developed by optimization, and the quality indicators of the samples were determined (Table 2).

Table 2

Prepared recipe variants (content, %)

No.	Components	Samples									
		1	2	3	4	5	6	7	8	9	10
1	Orange juice	25	–	10	30	10	–	8	20	–	–
2	Fermented pumpkin puree	50	50	58	40	60	70	60	50	75	50
3	Sugar	10	10	10	10	10	10	10	10	10	15
4	Liquid pectin	2	2	2	2	2	2	2	2	2	2
5	Dry skim milk	–	23	5	3	–	3	5	3	3	18
6	Yeast	3	5	5	5	8	5	5	5	–	5
7	Water	10	10	10	10	10	10	10	10	10	10

Based on the recipe, 10 samples of drinks were prepared and their components are given in Table 2. Samples 3 and 7 were distinguished by their organoleptic properties. In color, taste, and aroma, these selected drinks are reminiscent of the fruits and vegetables from which they are made.

The chemical composition was examined and the quality indicators of beverage sample No. 7 were determined (Table 3). Each indicator was determined by chemical analysis: proteins by the Kjeldahl method, oils by Soxhlet apparatus, total sugars by the Bertrand method, total dietary fiber by the Enzymatic-gravimetric method, pectin by the Calcium Pectate method, total acid by titration, lactose by Polarimetry.

Table 3

Organic compounds of ingredients and the fruit-vegetable beverage containing pectin, g/100 g

Indicators	Pumpkin puree	Orange juice	Dry skim milk	Finished drink
Proteins	1.68	1.0	33.2	2.96
Oils	6.1	0.2	1	3.776
Total sugars	6.29	9.5	52.6	7.394
Dietary fiber	1.21	0.3	0	0.75
Pectin	0.3	–	–	2.18
Total acids	0.1	1.3	1.2	0.224
Lactose	0	0	49.3	2.465
Bifidobacteria, CFU/g	–	–	–	2.510^9

The amount of vitamins and minerals in beverage sample No. 7 was found by various chemical methods (Table 4). The amount of β-carotene was determined by spectrophotometer, thiamine and riboflavin – by fluorimetry, nicotinic acid – by the colorimetric method based on the color reaction of nicotinic acid with rhodanide and bromide, ascorbic acid – by iodometry, sodium, potassium, calcium, phosphorus by the potentiometric method and ferrum was determined with phenanthroline.

Organoleptic evaluation of the products was based on the following indicators: color, aroma, taste, texture, outward appearance. A 35-point grading system was used for this purpose (Table 5).

Table 4

Vitamin content and minerals in ingredients and the fruit-vegetable beverage containing pectin, g/100 g

Indicators	Pumpkin puree	Orange juice	Dry skim milk	Finished drink
β-carotene	1.310	0.062	–	0.79
Thiamine, B_1	0.042	0.043	0.32	0.045
Riboflavin, B_2	0.060	0.024	1.84	0.13
Nicotinic acid, PP	0.400	0.34	7.6	0.65
Ascorbic acid	3.900	42.4	4.7	6.0
Sodium	190	178	540	155.28
Potassium	170	12	1785	192.21
Calcium	60	19	1258	127.32
Magnesium	13.0	12	115	14.51
Phosphorus	54	15	975	82.35
Ferrum	2.25	0.4	0.41	1.402

Table 5

Organoleptic evaluation of finished drinks

No.	Organoleptic indicators	Samples									
		1	2	3	4	5	6	7	8	9	10
1	Color	25	20	30	30	20	20	35	25	25	30
2	Aroma	30	30	35	20	35	35	35	25	35	30
3	Taste	20	25	35	25	20	20	35	30	20	25
4	Texture	20	20	30	30	25	25	35	25	25	25
5	Outward appearance	25	25	30	30	30	30	35	30	30	25

As seen in Table 5, the organoleptic characteristics of samples 3 and 7 were better (Fig. 2). The products had a soft and harmonious taste, a pleasant aroma of orange juice used, and the golden color of pumpkin puree.

In order to determine the level of delamination of the finished product, a control experiment was carried out. Drinks numbered 3 and 7 were used for comparison. The control sample was prepared according to the developed recipe, but without the addition of pectin. Comparative monitoring of finished products was carried out every four months during the year. It has been found that in the control sample, starting from the 8th month, there is a violation of the uniformity of the drink, as a result of which the liquid accumulates in the upper part of the container. This once again confirms the stabilizing role of pectin in prepared drinks.

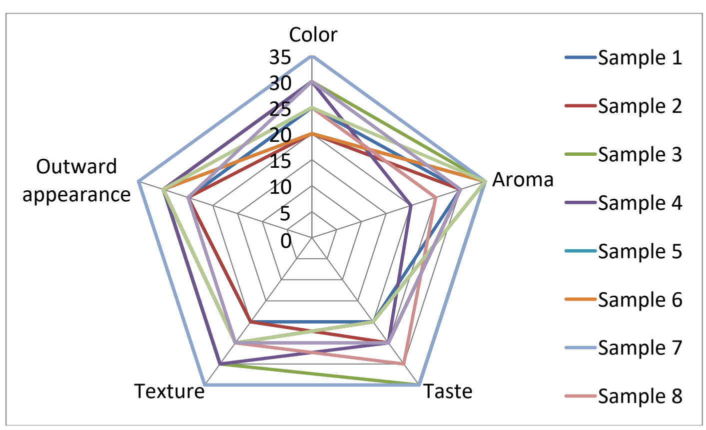

Fig. 2. Diagram of organoleptic evaluation of finished beverages

The product prepared according to the recipe was chemically analyzed to determine whether it was ecologically clean food. Lead was quantified by nephelometry, arsenic – by mercury bromide, cadmium – by polarography, and mercury by colorimetry. As seen in Table 6, the content of toxic elements in the product was within acceptable limits.

5. 4. Analyses on the ecological compliance of the finished drink

Recently, along with increasing productivity in agriculture, ensuring food safety is another priority. In almost all regions of the world, as a result of increased anthropogenic impact, there is a sharp deterioration in the environmental situation, which has led to a change in the composition and quality of food products (Table 6). Excessive pollution of the environment and air also negatively affects the raw materials that are widely used in the production of vegetable food [20, 21].

Table 6

Safety indicators of beverage sample number 7

No.	Indicators	Acceptable amount, mg/kg	Amount of toxic elements in sample No. 7, mg/kg
1	Lead	1.0	<0.01
2	Arsenic	0.1	<0.002
3	Cadmium	0.03	<0.001
4	Mercury	0.02	<0.002

In connection with the widespread use of chemicals in agriculture, and the increase in industrial and transport waste, the problem of contamination of raw materials with pesticides, nitrates and nitrites, antibiotics, herbicides and dioxins, as well as toxic heavy metals has become acute. In terms of danger, toxic metals are currently second only to pesticides and well ahead of common pollutants such as carbon oxides and sulfur. Toxic heavy metals are predicted to be considered more dangerous than even nuclear waste. Such metals include lead, cadmium, mercury, arsenic, copper, etc. Such elements are considered the main source of danger to human health. The impact of these metals on human health is being studied by international organizations such as the WHO and the Codex Alimentarius [20, 22, 23]. In the last two decades, as a result of such studies, it has been increasingly noted that toxic heavy metals cause serious environmental problems.

Toxic heavy metals have a high ability to accumulate in living organisms over a certain period of time, causing an increase in harmful effects over the years.

Heavy metal diseases are mainly cancer and other high-level chronic diseases, many of which have very limited treatment options and often result in death. Therefore, in order to achieve a more successful result, it is important to carry out initial preventive measures and prevent people from coming into contact with toxic substances. One of the main issues is the joint struggle of specialists working in different fields [22].

Research methodology MU 31-04/04: Zinc, cadmium, lead and copper in food; MU 08-47/242 is based on the measurement of arsenic concentrations by the stripping voltammetric method on an analyzer of the TA type. Measurement of mass concentrations of toxic heavy metals was carried out by the stripping voltammetric method after the process of wet mineralization of samples at a temperature of 150–450 °C.

Identification of the factors that cause contamination of finished fruit and vegetable products with milk and pectin with excessively toxic metals allows us to optimize the processing process and its individual parameters, to develop environmentally friendly and safe products. This can be noted as a step towards providing the population with a healthy diet [24].

6. Discussion of the results of the study of the pectin-based beverage preparation technology from fruits and vegetables

Analysis of the finished product confirmed the advantage of our drink. To improve the quality of the prepared drink in terms of vitamin composition, pumpkin and orange juice were chosen as the main components of the product. Also known are studies carried out in this direction in order to preserve the necessary ingredients for the body in the finished product [25].

As a result of chemical (Tables 3, 4) and microbiological studies (Table 1), it was found that the drink prepared according to the proposed recipe is qualitatively different from other similar pumpkin-based drinks in terms of positive indicators. Such an advantage lies in the composition and quantity of the components of the prepared drink, since the optimal selection of a combination of raw materials and additional materials according to the chemical composition made it possible to create a better finished product. As shown in the tables above, the finished product is rich in both vitamins and minerals. And the dietary fiber and bifidobacteria contained in the drink give the product a functional focus. Due to the complementarity of the components of the finished drink, such results were achieved.

A feature of the proposed method is that the prepared drink, thanks to a well-chosen mixed component composition, is better suited for preventive purposes. In the product prepared on the basis of the presented recipe, the separation process inherent in drinks with pulp has not been bypassed. Stratification of such products during storage is the main issue in solving this process. It should be noted that the product we received is also prone to delamination, but this manifests itself during very long storage. This is proved by the organoleptic analyses (Table 5) of the finished product. It seems that in the future, to obtain a drink with a constant structure, it will be more appropriate to use a combination of stabilizers.

The multicomponent nature of the product (Fig. 2) and, consequently, the presence of organoleptic indicators corresponding to different compositions (Table 5), indicate the importance of using discrete mathematical methods in the selection of product samples. Methods such as graph theory, fractal geometry and other similar mathematical methods can be very useful in choosing the optimal recipe option.

7. Conclusions

1. The product obtained according to the presented technological scheme is special in comparison with other technologies for the production of pumpkin juices. Since, chemical and microbiological, as well as organoleptic analy-

ses of the finished product showed the advantage of this drink in terms of component composition. Each component included in its composition contributes its characteristic properties to the finished product. Some components act as an antioxidant, others as a bifidogen, and some as a taste improver, etc. Thus, this drink has the properties of a functional food product.

2. Studies of the bactericidal properties of the finished drink showed that all prototypes contain a large number of lactic acid microorganisms and bifidobacteria. This is due to the use of liquid pectin (2 %) in the technological processing. And the bifidogenicity of such a product is of great importance.

3. Organoleptic analysis of samples of finished products with different ratios of components showed that the sample containing 60 % fermented pumpkin puree has the best quality. This can be explained by the fact that the amount of orange juice in this sample is less than in other samples. Therefore, optimal acidity increases the stabilizing effect of pectin in the product.

4. The identification of factors causing contamination of the finished drink with excessively toxic metals made it possible to select raw materials with safe chemical components. This choice will allow continuing to comply with safety standards in the production of food products. After analyzing the presence of toxic metals in the finished product, we were able to determine the degree of contamination. It has been found that the content of toxic substances in the finished drink meets all the standards of environmentally friendly products.

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