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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

PURCHASE OF FUNCTIONAL PRODUCTS USING RESOURCE-SAVING TECHNOLOGIES

Specialty: **3309.01- Food technology**

Field of science: **Technical sciences**

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. It is known that when processing grapes, about 20% of the residues are obtained, which is a very large mass in the total production. According to the richness of the composition, these residues are called secondary raw materials reserves. On average, about 160 thousand tons of grapes are produced in Azerbaijan per year. If you process all these grapes, about 22 thousand tons of peel and about 6 thousand tons of scallops can be formed. Studies show that 1 kg of grape cake contains an average of 24 g of polyphenols, which are powerful antioxidants. It is known that it is estimated on the world market about 2 US dollars. Thus, during the processing of 160 thousand tons of grapes per year, about a billion US dollars are lost due to the fact that not only polyphenols are used, which come with residues. At the same time, dietary fibers and extracts obtained from residues are rich in biologically active substances and can be used as food fortifiers. As you can see, the residues formed during the processing of grapes have a rich com-position, with its return for processing, you can get a very diverse and valuable products. But due to the lack of cost-effective and affordable technologies that meet local conditions, thousands of tons of products are annually thrown into waste without use. Sometimes these residues are spilled near processing plants, polluting the environment and creating an unsanitary situation. Therefore, along with the economic aspects, the effective use of such residues also has environmental grounds.

From domestic and foreign scientists Valuiko G.G.. Razuvaev, Mekhuzla N.A., Ageeva N.M., Zaiko G.M. Donchenko L.V., Kasyanov D.G., Kvasnikov O. I. Gaponenko Ya.V., Butova S.N., Sheglov N. Q., Ispirova T.A., Ohio Ya.A., Chernousova I.V., Brenner-Weiss G, Franzeb M., Nusser M., Metivier R.P., Tataridis P. Apostolopoulos K. Sadikhov I. I. Khabulaev Sh., Khasanzade Ch. A., Suleymanov S. The research is devoted to the processing and effective use of residues formed during the processing of grapes. Although the conducted studies have yielded important results in this area, they have not been able to provide a radical solution to the problem. Such a promising issue as the production of functional food

products, especially with the use of residues formed during the processing of grapes, has not yet found its solution.

As you can see, the field faces an important scientific problem that is important to solve.

Purpose and objectives of the study. The aim of the study is to improve the technology of functional food products using residues formed during the processing of grapes.

To achieve this goal, it is planned to solve the following tasks:

1. Development of an analytical review of the literature on the research topic;
2. Research and evaluation of residues formed during the processing of grapes;
3. Research of technology for obtaining biologically active extracts and dietary fibers from grape seeds;
4. Functional products with the use of additives obtained from residues technology development;
5. Report on the hardware and economic efficiency of resource-saving technology.

Research methods. Some native and introduced grape varieties, the peel, peel, seeds formed during their processing, as well as their processing and hardware were taken as objects of research. The composition of the peel and seeds, the spectra of extracts and hydrolysates obtained from them at different wavelengths, as well as their chromatogram are determined by traditional and modern methods of analysis. In order to extract substances from cashew components, various modes and modules of extraction of water, alcohol, juice, wine and their mixtures in various proportions with the extractant and its solid part were used. A wide range of functional food products with the use of additives has been developed and studied. The determination of the main components of the chemical composition was carried out in accordance with the current standard methods and modern methods.

Main provisions to be submitted for defense:

- characteristics of the peel, seeds and other components obtained from local and introduced grape varieties:

- spectra of skin and seed extracts at different wavelengths, as well as images of chromatograms of bark hydrolysates;

- optimal operating parameters of the process of extraction of substances from solid parts of salts;

- biologically active compound of CJA components by extraction-the possibility of returning the material for reuse;

- with a rich content of cellular components (sugars, nitrogenous -, pectin -, phenolic compounds, fats, cellulose, minerals, etc.) solutions for the production of extracts and dietary fibers;

- the possibility of using extracts and dietary fibers in the production of various functional food products;

- solutions for the production of yoghurts and functional bakery products;

- ways to solve optimal quantitative ratios of the added amount of extracts and the composition of blends in the production of functional beverages;

- development of technology and hardware for the production of functional food products using extracts.

Scientific novelty of the research. The composition of the seeds formed during the processing of grape varieties cultivated in local conditions and their components, the spectra of extracts and hydrolysates obtained from them at different wavelengths, as well as a chromatogram are determined. The optimal parameters of the technolo-gical mode of extraction of biologically active substances from the peel and seeds, as well as the production of dietary fibers, are determined and the use of the obtained additives in the production of food products is experimentally justified. Optimal quantitative ratios of kcal and additives from its components in bones were determined, hardware and production of functio-nal food products with the use of extracts and dietary fibers were developed.

Theoretical and practical significance of the study. The distribution of biologically active substances in the solid parts of the wort according to the studied grape varieties, their antioxidant and anti-radical properties, the determination of optimal technological parameters for the extraction of biologically active substances, the production of dietary fibers and the use in the production of

functional food products with the determination of enriching additives in accordance with the assortment of the finished product are of theoretical importance for research conducted in food production technology, especially in winemaking.

The applied technology of fermentation of grape seeds, yeast fer-mentation, production of dietary fibers and extracts, the module for mixing extractants with solid particles, the justification of the production of functional food products with optimization of the added amount of dietary fibers and extracts, the development of a hardware and technological layout that allows implementing the improved technology, and experimental justification of the regime parameters are of practical importance for winemaking and the food industry.

Approbation and application of works. The main provisions of the dissertation were presented at scientific and practical conferences of the teaching staff, doctoral students and masters of the faculty of Agrotechnology of the Azerbaijan State Agrarian University (Ganja, 2017-2020), İnternational scientific conferences on the topic "Actual problems of modern natural and Economic Sciences" (Ganja, 2018-2019), the II Republican scientific and practical Conference on the topic" Prospects for the development of the food and textile industry in Azerbaijan and upcoming tasks". (Baku, 2018), Report at the international scientific conference" scientific development JSC in the conditions of import substitution "(Saint-Petersburg, 2020) at the international scientific conference" Youth scientific chievements to the 21st century nutrition problem solution " (Kyiv, 2021).

Application LLC "Garachanag" technology and hardware and the technological scheme that allows to obtain a functional food products with the use of additives allowed to economic efficiency in 621 manats per 1 ton of grapes.

The name of the organization where the dissertation work is performed. The dissertation work was carried out at the department of " Engineering and examination of food products" Azerbaijan State Agrarian University.

The total volume of the dissertation with an indication of the volume of the structural sections of the dissertation separately. The dissertation work consists of an introduction, four chapters, a conclusion, a list of 147 references and appendices. There are 25 figures, 70 tables and 1 appendix. The content of the dissertation contains an introduction of 6 pages and 10841 characters, the first chapter is 24 pages and 48799 characters, the second chapter is 17 pages and 27660 characters, the third chapter is 47 pages and 66423 characters, the fourth chapter is 38 pages and 50783 characters, conclusions are 3 pages and 4034 characters, recommendations for production are 1 page and 810 characters, the list of references is 147 pages and 29449 characters. The volume of the dissertation is 158 pages of computer text, the total volume is 244383 characters (213529 characters excluding the list of references and appendices).

CONTENT OF THE WORK

In the introduction, the relevance of the topic, the problem statement and the general characteristics of the dissertation are given.

First chapter. This chapter is entitled «Literature review, research goals and objectives", here, the characteristics of secondary raw materials formed in winemaking, the composition and directions of use of grape seeds, the production of biologically active additives from secondary raw materials, the prospects for the production and use of dietary fibers are given, and, in conclusion, the results of the review are summarized, the goals and objectives of the work are determined. It was noted that the grape seed is a residue released from 7-17% of juice (sweet grinding) or wine (fermented grinding), forming most of the secondary products formed during the processing of grapes. It con-sists of bark, seeds, residual liquid (juice, wine), and sometimes a comb. Depending on the technology used, the stone can be sweet (fresh, unfermented) – obtained after pressing from fresh grapes, and unsweetened (fermented) – obtained after pressing (or after storage and fermentation). The ratio of the components of the grape seed depends on the grape variety, the area of its cultivation, metrological conditions, as well as the equipment used for squeezing. Depending on the grape seed used in the

production, the yield of bile from grapes may vary.Since the composition of the grape seed is extremely rich in nutrients, including antioxidants, it is sometimes called a secondary raw material resource. A number of domestic and foreign scientists have made a great contribution to the development of the problem of rational use of resources. Although these studies have brought important developments in this area, they have not been able to provide a radical solution to the issue. Currently, the residues formed during the processing of grapes to create functional food products are considered promising ingredients. But such an important problem has not been studied enough. This is one of the factors hindering the development of the industry. As you can see, the field faces a scientific problem, the solution of which is important.

Second chapter is entitled It is called “Object and methods of research". Here, first, the object of research and the scheme of conducting the study are given, then the analysis and methods of research. The objects of the study were selected white and red grape varieties, seeds, comb, seeds, peel, extracts extracted from them, vinegar, diet-ary fibers, functional food products, devices and equipment used during their processing. At the first stage of the research, the analysis and systematization of scientific and technical literature and patent information corresponding to the topic of the dissertation work was carried out. At the second stage, the choice of secondary stocks of raw materials for the production of biologically active extracts and dietary fibers is justified. The methods of preparation of the best samples of extracts with the determination of technologically justified parameters of extraction of biologically active substances used after fermentation of the brush and bone in accordance with existing methods are presented. The development of effective methods for processing residues, functional products with the production and use of additives and the maintenance of economic reporting with the development of a hardware and technological scheme constitute the third stage of the study. It also reflects traditional and modern methods of analysis and the specific features of some of them. At the same time, the production of dietary fibers from secondary raw materials is being studied, as well as the

production of vinegar from low-quality raw materials and residues using resource-saving technologies. Then the production of functional products with the use of extracts and dietary fibers was developed. With the study of the physico – chemical antioxidant and antiradical properties of the finished product, the hardware of the technology, production tests and an economic report are carried out.

Third chapter under the title "Experimental research". Here, the study of secondary raw materials formed during the processing of grapes, physical and chemical parameters of the structural components of cashews, the study of the stone and wood flour, the distribution of phenolic compounds in certain parts of the stone and its antioxidant properties, the study of the technology for obtaining biologically active extracts of the stone, the study of the polyphenolic composition and antioxidant activity of the stone and seed extracts, the isolation, composition and processing of seeds from grape cashews is carried out, production of acetic acid from low-quality raw materials and waste.a study of its production was conducted.

The method of processing grapes does not affect the number of components included in the wort (fig.1).

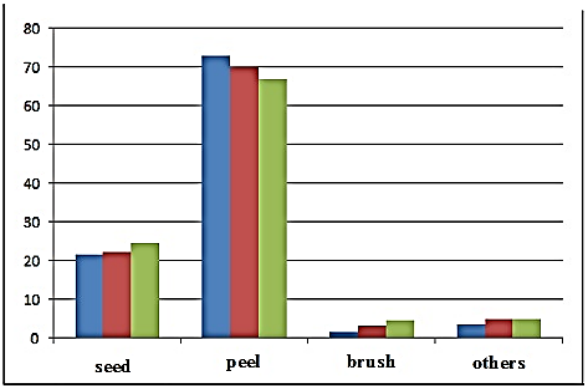

Figure 1. Mass fraction of components in various bone samples:

1. White sweet bones (a mixture of Rkatsiteli and Bayanshira);
2. Red sweet bones (a mixture of Madrasah and Merlot);
3. Red fermented bones (a mixture of Madrasah and Merlot).

As can be seen, in the first variant, the amount of peel was significantly higher than in the other two (67-72%), then came seeds (21-

23%), comb (1-3%) and other mixtures (2.1-3.1%). The number of seeds and scallops is noticeable by the fact that there are more of them in the third variant than in the others. The data obtained indicate that, in general, more grape skins per sweet stone were obtained during the approach.

When stored in brine, many components of the peel turn into juice, which made itself felt more than in the second version. At this time, the shell contains mainly insoluble polishes, including cellulose, hemicellulose, etc. it remains. Such a shell may be more valuable for the preparation of dietary fibers. The dry matter content in the grape peel varied from 14.0 to 31.0%, depending on the variety, and it consisted of many compounds. One of the compounds contained in the bone samples are pectin substances. It turned out that pectin substances are distributed unevenly in the bark, seeds, etc.of the nightshade part. In the Merlot and Madrasa grape varieties, the content of pectin substances was significantly higher than in the Bayanshira and Isabella varieties (table 1).

Table 1. Indicators of the physical and chemical composition of the grape peel

Composition indicators	Grape varieties			
	Bayanshira	İzabella	Madrasa	Merlo
Dry ingredients, %	14,0	17,1	25,1	31,0
Protein, mg / cm^3	5,4	6,2	6,9	7,5
Total nitrogen, mg/dm^3	6,3	6,9	7,9	8,7
Titrated acids,%	6,5	6,4	6,7	7,3
Amount of hemicellulose, %	4,6	5,1	5,8	6,7
Vitamin C, mg/100g	4,0	5,1	4,8	5,0
Lignin, %	0,11	0,20	0,22	0,25
Pectin, %	0,20	0,30	0,36	0,40
Flavanoids, %	0,35	0,86	1,1	1,40
Antosians	0,30	0,83	1,1	1,40
Phenolic compounds,mg/100 cm^3	0,55	1,4	1,8	2,7

It was found that by hydrolysis it is possible to increase the amount of pectin that is dissolved in the bone. The hydrolysis of bone protopectin occurs in two stages. First, the connection between protopectin macromolecules and other structural elements is broken.

When considering the individual elements of the bone, it turns out that the main amount of phenolic compounds is contained in the bark and seeds, and a small part is in the bark. It seems that the bulk of lignin is in the seeds (16.5-28.5%), and a small amount is in the peel (0.11-0.25%). According to the varieties of the stone, it is not accidental. More biologically active substances (polyphenols, vitamins, organic acids) are found in Merlot grapes, Madrasas. Biologically active substances are found mainly in the bark and seeds of grapes. As a result of the conducted analyses, Merlot, Madrasah and Isabella were selected to obtain an extract rich in biologically active substances, and Bayanshira and Rkatsiteli were selected from white ones. In terms of chemical composition, the stone flour was richer than the flour obtained from tanek wood. If the content of amino acids in cedar flour of the Bayanshira variety was 8.0%, and in madrasah-9.15%, then in wood flour of these varieties these indicators were 5.39 and 5.94, respectively. In other words, the total amount of amino acids in the Bayanshira variety was 2.61% higher, 3.21% higher than in the Madrasa variety. This was also manifested in the amount of minerals, especially iron, iodine and other useful elements.

According to the number of flavanoids, the leading positions were taken by the varieties of Madrasa and Merlot, and by the number of tannins-the Merlot variety. From white varieties, both in terms of the number of phenolic compounds and in terms of anti-radical properties, the Rkatsiteli variety differed in higher indicators. According to the number of flavanodides in the seeds of the Madrasa grape variety, Merlot and Isabella consistently accompany each other. The amount of anthocyanins mostly coincided in the bone of the madrasa variety, and in Merlot-in the bark and in certain quantities also in the late one. More regenerating properties were observed in the seeds of the Merlot grape variety, and then in Isabella. And a lower recovery capacity for all varieties is found in the middle part. According to the indicator of anti-radical activity Ec50 (the viscosity of the extract required for binding 50% of free radicals) the lat of white and red grape varieties lags behind parts of the seeds and peel. The lowest anti-radical activity was in the seeds

of Bayanshir (4.5), and the highest was in the seeds of the madrasa grape variety (0.5). The antiradical activity was greater in Merlo varieties and less in Bayanshire varieties. The extraction process and the factors affecting it are determined-the hydromodule, the duration of extraction, the extraction temperature, the type of extractant, the composition of the extractant, the method of pretreatment of raw materials. Reducing the amount of extractant in the hydromodule to a certain stage increases the extraction of phenolic compounds. In this regard, it was a module of 1:5, and better 1:3. The optimal amount of exposure for the shell is 40 minutes, for seeds-120 minutes, for whole grape-180 minutes. The optimal extraction temperature for all objects of study is 60^0C. The subsequent increase in temperature leads to the decomposition of biologically active substances. Water and ethyl alcohol are used as extractants, 30%, 50%, 70%-water solutions of wine and juice and 95% rectified ethyl alcohol. It turned out that extraghent rectified ethyl alcohol is more effective for the peel, for seeds – water, 30% water-alcohol and 30% wine-alcohol solution for whole grapes. More effective extraction from whole clay occurs without the addition of tartaric acid, with the addition of 0.5% tartaric acid from the bark and 2.0% from the seeds. The analysis of the obtained extracts showed that they have a high antioxidant activity. Extracts, in particular, are burnt, the light resistance is greater in the seeds, relatively less in the bark and moderate in the botoid grape. The largest amount of volatile acids, which are the most important indicator for vinegar, was observed in vinegar samples from the Hadogni grape variety (3.17 g/100 cm^3), and less-in the samples of the Rkatsiteli grape variety (2.96 g/100 cm^3), the intermediate position was occupied by the Bayanshir grape variety (3.12 g/100 cm^3).

The fourth chapter is called "Development of technology for functional products with the use of additives obtained from residues"**.** It reflects such issues as the study of the use of grape seed as a food additive, the study of the production of various functional products using additives, including dairy, bakery, juice and alcoholic beverages, the hardware and technological scheme of the production of

functional beverages and the economic assessment of the production of functional beverages with the addition of extracts.

Samples of bark and peel obtained from grape varieties were dried by various methods and subjected to comparative analysis. The peel obtained from the studied grape varieties was dried in a drying cabinet at various temperatures (50, 70, 90^0C) and duration (50, 30 and 20 hours, respectively), as well as by sublimation. The obtained dry bone samples are ground in a coffee grinder to a powdery state and sifted through a sieve with small cells (0.3-0.5 mm). The resulting bucket powder is stored in closed plastic bags at a temperature of minus 20^0C before analysis.Cow's milk for yogurt is pasteurized at 90^0C for 10 minutes. After cooling to 450C, its starter turns off (Chr.Hansen) added is. Pre-dried in a drying cabinet of 0,1,3 and 5% and in a lyofilter at-80^0C and-85^0C, the resulting cashew powder was added to milk and diluted in an incubation chamber at 45^0C and until 4.4-4.6 pH was reached. As a result of the analysis of samples of yoghurts prepared by sublimation (24 h) and with the addition of cupcakes dried in drying cabinets (70^0C, 30 h) (control-without addition, 2, 4 and 6%), it was found that the amount of dry matter and other indicators changed (table 2).

Table 2. The effect of the amount of added calories on the physico-chemical parameters of yogurt

Examples	pH	Titrated acidity, %	Common phenolic compound, mg /kg	QM, %	Anti-radical activity, mg/dm^3	Prices for Hunter colors		
						L	A	b
Control (without adding bone powder)	4,05	0,72	106,20	10,36	2306,5	90,61	-1,55	7,68
2% add	4,14	0,70	192,31	11,41	1230,05	70,91	3,96	3,66
4% add	3,95	0,75	305,60	13,01	520,60	57,22	6,75	2,40
6% add	3,96	0,73	501,30	14,90	312,44	49,11	7,45	1,80

The addition of bone powder does not pass without a trace on the physico-chemical parameters of yogurt. Apparently, as the amount of added cashew powder in the yogurt samples increased, an increase in the amount of dry substances and acidity in the titer was

observed, as well as a decrease in the pH value. Yogurt prepared with the addition of 4% cashew powder of the fragrant Isabella grape variety is highly appreciated for various nutritional and organoleptic indicators. The re-sulting yogurt attracts with its specific aroma, characteristic of the Isabella variety.10-20 days of storage did not negatively affect the composition and quality of yogurt samples, and after storage, the product was distinguished by high taste and other organoleptic indicators.

The possibility of using cumin powder obtained during the processing of white and red grape seeds, as well as protein-lipid extract obtained from seeds, in the production of bakery products is investigated. To do this, the obtained samples of jelly are fermented separately according to a special method. Excellent varieties of wheat flour are used and bread samples are prepared using additives obtained from well-ground shells and seeds that have undergone fermentation. Samples of bread prepared with the use of various additives are evaluated in comparison with the control ones. To clarify the effect of the pectin extract, serial cooking was carried out in the laboratory. It turned out that as the amount of pectin extract added to the dough increases, the amount and quality of gluten increases. The tensile strength of bread yeast was 4.09 min with the addition of 3% pectin extract, 4.0 min with the addition of 5 %, 5.49 min with the addition of 7 % and 8.53 min with the addition of 10%. It turned out that the dough with the addition of 5% pectin extract has the best lifting force. A test baking of the dough with the addition of pectin extract was carried out in the laboratory and its quality was studied. It turned out that as the number of pectin extracts added to the dough increases, the acid-collecting ability and fermentation of the samples also become more active. The lifting force of the dough, the absolute capacity of bakery products, as well as the structural and mechanical properties of the test part are improved. During the organoleptic analysis of laboratory samples, it turned out that the shape of the product was preserved in all experimental variants. With an increase in the amount of additives (by 10 %), the dough and crust acquire a matte color. The volume of bread and the porosity of the dough decreases.

Based on these indicators and the results of organoleptic analysis, we consider it appropriate to introduce pectin extract in an amount of 5% by weight into the dough for the preparation of functional bakery products. At this dosage, the taste and aroma inherent in the product acquire a weakly pronounced pleasant taste. It also turned out that the sample, in which a small amount (3%) of bone powder was added, does not fundamentally differ from the control one. The production of functional beverages using extracts was investigated. For this purpose, extracts in the amount of 3, 5 and 7% were added to the wine material obtained by the "white method" from a mixture of Bayanshir and Rkatsiteli grape varieties. The antioxidant capacity, the mass fraction of phenolic compounds, the mass concentration of resveratrol, the mass density of vitamins, the mass density of amino acids were determined in the finished drink, and the orga-noleptic parameters of the samples were also evaluated. As a control, a sample of wine was taken without the addition of an extract (table 3).

Table 3. Physical and chemical parameters of wine samples prepared with the addition of extract

Indicators and its parameters	Variant			
	Con-trol	with the addition of an extract 3 %	with the addition of an extract 5 %	with the addition of an extract 7 %
Sugar, %	9,8	9,8	9,7	9,7
Alcohol, x %	16,5	16,5	16,6	16,7
Titrated acid, g/dm^3	6,52	6,55	6,58	6,60
Mass fraction of phenolic compounds, mg/dm^3	170,4	230,0	270,0	290,8
Mass fraction of rasperutrol, mg/dm^3	-	8,5	18,6	21,3
Antioxidant capacity, mmd of trolox-eq/dm^3	308,6	520,5	7,66	850,1
Brought extract g/dm^3	21,40	21,45	21,48	21,50
Tasting price in points	7,55	7,80	7,90	7,85

Apparently, the addition of extracts did not have a significant effect on the amount of sugar, there was only a decrease in the sugar content to 0.1% with an increase in the amount of the added extract and an increase in the alcohol content by 0.1-0.2%. This decrease

may be due to the fact that the added extract at least slightly increases the volume. The increase in the amount of alcohol was associated with the high viscosity of the added extract. In the experimental samples, compared with the control ones, an increase in the content of titrated acids was observed by 0.03-0.08 g/dm^3, and in the given extract-by 0.05-0.10 g/dm^3.A hardware and technological scheme for the production of functional beverages has been developed (fig. 2). The scheme includes the following main stages. The grapes enter the receiving and feeding hopper with a screw (1). From there the comb is transferred to a crusher with teeth (2). There the comb is separated, and the grapes are crushed, falling between the shafts. The resulting crumb is fed to a pneumatic diaphragm press (4) with a screw monopompa (3). The compression process in the press lasts 4.5-6.0 hours.Here, high-quality juice is taken, which is separated by its own jet. This is done on the condition that there are no more than 60 branches per ton of grapes. There is no oxidation tone in this juice, there is a very small amount of suspension in the juice containing clay crumbs, colloids, etc. That's not so. The juice is fed by a screw pump (5) to a tubular type heat exchanger (6). The juice is cooled here to 5^{0}C and, after transferring it to the receiving tank (7), put at rest for 24 hours. Then, by a pump (8), the perlite vacuum is pumped into the filter (9), where it is separated from the sediment and collected in the receiving tank (10). From there, it is taken by a pump (11) and fed into a plate pasteurizer (12). Here, the juice is first pasteurized at 1.5-3.0 c for 82-85^0 minutes, and then cooled to-2^{0}C. The cooled juice is transferred for storage (for 6 months) to a horizontal storage tank (13). Then it is pumped by a pump (14) into a blending tank (15). There, a blender is launched from the dispenser (16) to inject the ingredients into the juice with the addition of an extract, the amount of which is known in advance. The juice pumped out by the pump (17) is taken and fed to the receiving tank (18), and from there again with the sauce (19) to the membrane tangential filter (20). The functional juice filtered at the animation level in the filter is directed to filling. If necessary, the juice can be treated with bentonite and gelatin, or only gelatin, and then transferred to a filter that cleanses it to a sterile state.

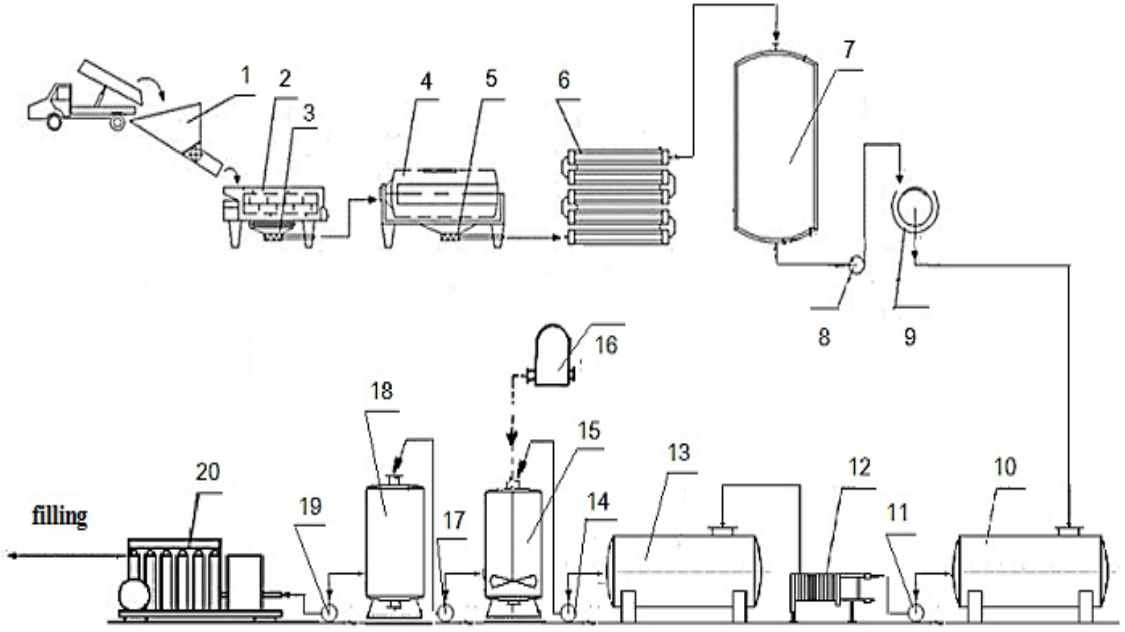

Figure 3. Hardware and technological scheme of the production of functional beverages based on juice

1-screw receiver-feed hopper; 2-comb crusher; 3-screw monopompa; 4-diaphragm press; 5-screw pump; 6-pipe-heat exchanger into the pipe; 7-receiving tank; 8-pump; 9-perlite vacuum filter; 10-receiving tank; 11-pump; 12-plate pasteurizer; 13-horizontal storage tank; 14-pump; 15-blending tank; 16-dispenser for pumping ingredients; 17-pump; 18-receiving tank; 19-pump; 20-membrane tangential filter

The resulting drink is poured into glass bottles with a capacity of 0.5 liters or liter cans made of painted metal.

The proposed hardware and technological scheme has successfully passed production tests and provided economic efficiency of 621 manats per I ton of grapes. If 2 thousand tons of grapes are processed, the economic effect will be 2000×621=1 million 242 thousand manats.

Results

1. The main part of the wort obtained from grape varieties processed by various technological methods was the peel (67-72%), much less-seeds (21-37%), comb (1-3%) and other mixtures (2.1-3.1%). In the fermented stone, compared with the previous one, there was an increase in the amount of peel by about 15%, a decrease in the number of seeds-about 50%. Compared with sweet stone, the content of phenolic compounds in sour stone was lower by 8.0 g/kg.

2. The main amount of biologically active substances (polyphenols, vitamins, organic acids) is contained in the peel, seeds and a smaller part of the pulp of cherries; the bulk of lignin is contained in the seeds, much less in the peel. To obtain extracts with a rich composition, it is advisable to use seeds from the Merlot, Madrasa and Isabella grape varieties, and from white ones-Bayanshira and Rkatsiteli.

3. The total content of amino acids in the Bayanshir variety was 2.61% higher than in the woodcutter variety, and 3.21% higher than in the Madrasa variety. The flour obtained from the stone was not only a good source of protein, but also stood out for its richness of minerals. The flour from the grape juice of the Madrasah was superior to others in terms of iron content (170 mg/kg), and from Bayanshir-iodine (11.25 mg/kg).

4. The radical trapping properties were superior to Merlot and Madras seeds (58.01 and 30.01, respectively) and Madras bark (26.25 mmol of tralox/100 g of density). In this regard, all varieties have demonstrated an almost similar situation. Antioxidant properties prevailed in the seeds of Rkatsiteli (79.2%) and Bayanshir (75.6%), as well as in the seeds of Madrasah (87.1) and Rkatsiteli (86.9).

5. The optimal technological parameters of the extraction of biologically active substances from the grape berry and its structural components are determined. It turned out that the more effective result is the extraction of fermented wort with 30% wine-alcohol (juice-alcohol or water-alcohol solutions) extract for 1:3 minutes at a temperature of 60^0C in a hydromodule of 18^0C.

6. The production of functional food products using bone extracts was studied. It turned out that the addition of bone - pectin components in an amount of 5% had a positive effect on the quality of the dough and exemplary baked bread, increasing the absolute capacity, sorption capacity, volume and organoleptic indicators of the quality of bread.

7.The technology of preparing dairy products in an enriched composition using a powder obtained from a bone has been developed. It was found that the addition of bark powder in an amount of 4% leads to a decrease in free radicals in yogurt, an increase in the content of dietary fiber and phenolic compounds. The resulting product, even after 20 days of storage, retained its high organoleptic characteristics, differing in functionality, dietary properties and aroma.

8. The addition of 25-30% wine-alcohol hop extract to the processed wine material "white method" from a mixture of white grape varieties led to an increase in phenolic compounds by almost 100 mg/dm^3 in the experimental version compared with the control, and an increase in the amount of vitamin B2, C, PP and B6, as well as rasperatrol, was also observed. The experimental samples differed from the control ones by high organoleptic parameters.

9. The optimal dose added to the alcohol-juice extract of 25-30% concentration was determined for the first type of juice obtained during the processing of a mixture of Bayanshir and Rkatsiteli grape varieties. It turned out that a sample of the drink prepared using 90% juice and 10% extract in a blend surpasses its analogues in terms of high content, pink color, complex aroma, soft harmonious taste and pleasant aftertaste.

10. Based on the conducted research, a hardware and technological scheme for the production of functional beverages was

developed and “Garachanag” LLC successfully passed production tests. The economic efficiency obtained from the introduction of the technology and the production line that ensures its implementation amounted to 621 manats per 1 ton of processed grapes.

Recommendations for manufacturing

- optimal technological parameters of extraction of biologically active substances from seeds;
- technology for the production of functional food products using bone extracts;
- processing of high-quality raw materials, semi-finished products and residues into vinegar and ongoing processes;
- application of the technology of making functional yogurt with the use of berry skins;
- improvement of the quality and functional indicators of national bread samples with the use of pectin-pectin components;
- the use of optimal quantitative ratios of additives established in the blend for the production of juices and functional wines;
- technology for the production of functional food products using extracts obtained from residues, and its hardware.

The main provisions of the dissertation are reflected in the following published articles:

1. Fataliyev, Kh.K., Mammadova, S.M. Effect of electric treatment table wine materials for their stability and chemical composition // Baku: AAA -70, collection of scientific works,- 1999, p. 54-55.

2. Fataliyev, H.K. Mammadova, S.M. Production of quality wine //- Baku: collection of scientific works of the faculty of agronomy. - 2000. - p..62-63.

3. Fataliyev, Kh. K. Mammadova, S.M. The use of residues formed during processing // - Baku: collection of scientific works of the Faculty of Agronomy. - 2003. p..49-50.

4. Mammadova, S.M. The second sourdough // - Baku: special issue of the collection of scientific works of the Faculty of Agriculture. -2004, - p.155-156.

5. Mammadova, S.M. The use of extracts of woody plants in the preparation of beverages // Scientific works of ASAU, Ganja 2011, No. 1, pp. 42-43.

6. Khasanova, S.H., Visali, R.F. Mammadova, S.M. Juice-its transparency in wine //-Ganja: scientific works of ASAU, - 2011, No. 3. - p.20-21.

7. Mammadov, S.M., Mikailov, Sh. Investigation of the influx of natural vinegar from grapes //Azerbaijan Agrarian Science, -2017, No. 4. - p..165-167.

8. Mammadova, S. M. Research of secondary raw materials and its rational use in winemaking // Azerbaijan Agrarian Science, - 2018, No. 1. - p..108-111.

9. Mammadova, S. M. The study of the vine in the direction of the production of functional products // - Ganja: scientific works of ASAU, - 2018, No. 1. - p..50-53.

10. Jafarov, F. N. Mammadova, S.M. Mammadova, M.R. Research of the production of functional beverages using some fruit and vegetable products // materials of the second Republican scientific and practical conference on the topic"Prospects for the development of the food and textile industry in Azerbaijan and the upcoming tasks "(April 25, 2018). - Baku: - 2018, - pp. 83-86.

11. Mammadova, S.M. Ways of effective use of residues formed during the processing of grapes // popular scientific conference on "Actual problems of modern natural and economic sciences" at the Ganja State University. Part I (May 04-05, 2018). Ganja:-2018, - p.370-371.

12. Mammadova, S.M. Fataliev, Kh.K. Research of the use of AMA in the processing of grapes for the production of functional bakery products // International scientific conference at the Ganja State University on the topic "Actual problems of modern natural and economic sciences".Part III of the degree (03-04 May 2019). - Ganja: - 2019, - pp..162-164.

13. Fataliyev, Kh.K. Mammadova, S.M. Development of technology for processing grapes // International scientific conference at the Ganja State University on the topic "Actual

problems of modern natural and economic sciences". Part III (03-04 May 2019). - Ganja: - 2019, - pp..130-132.

14. Mammadova, S.M. Fataliev, Kh.K. Research of grape seed flour //-Ganja: collection of news of the Ganja branch of the National Academy of Sciences of Azerbaijan. - 2019, №1(75).- p..176-181.

15. Mammadova, S.M. Analysis of residues formed during pruning of grapes //-Ganja: Scientific Works of ASAU,-2019, No.1. - p..41-44.

16. Jafarov, F.N., Allahverdiyev, Z.Gr. Mammadova, S.M. Mamedov, M.R. Use of additives functional purpose in the production of food // -Ganja: scientific works of ASAU,-2019, №3.- p.66-69.

17. Mammadova, S.M. Fataliyev, H.K. Qadimova, N.S. Alieva, G.R. Baloglanova, K.V. Production of functional products using processing of grape residues // food Science and Technologies: D https: // doi.org/10.1590/fst.30419, pp. 1-7.

18. Fataliyev, Kh.K. Mammadova, S.M. Gadimova, N.S. Imamguliyeva, M. M. Ismailov, M.T., Heydarov, E.El. Musaev, T. M. The study of resource-saving technologies in the processing of grapes //Advanjes in applied Scienc.imedpub.com buildings: 10.366 48/0976-8610. 11.3.2 Eh. London: -2020, Vol. 11. - No. 3:2.

19. Mammadova, S.M., Tagiyev, A.T., Mammadova, A.R., Fataliyev, Kh.K. Research of the use of grape pomace for the production of functional products // Scientific support for the development of agriculture in the conditions of import substitution: a collection of scientific papers based on the materials of the international scientific and practical conference "Development of the agro-industrial complex based on modern scientific achievements and digital technologies". Ch. I. SPbGAU. SPb.: - 2020. (St. Petersburg-Pushkin, January 23-25, 2020), - pp. 122-124.

20. Gadimova, N. S., Mammadova, S. M., Fataliyev, Kh. K. Development of resource-saving technologies in the processing of grapes // 87 International scientific conference of young scientist and students "Youth scientific chievements to the 21st century nutrition problem solution". - April 15-16, 2021, Part 1, Kyiv, NUFT: - 2021 p. 213.

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