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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

IMPROVEMENT OF PRODUCTION TECHNOLOGY OF TOKAY WINES

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. Currently, providing the population with environmentally friendly, high-quality food, wines, and other alcoholic and non-alcoholic beverages is one of the most important problems of our time. Low-quality food prepared using preservatives has a negative impact on human health (Fataliev 2015, Nabiev 2008). It also creates conditions for the development of various diseases in humans. In this regard, the production of a variety of food products, as well as wines from technical grape varieties common in most regions of our country, not only enriches our economy, but also leads to the creation of new jobs (Fataliev 2015, Nabiev 2008). In addition, the development of winemaking can also contribute to the development of wine tourism in the country. Our country has favorable soil and climatic conditions for the development of viticulture and winemaking. High-quality wines that meet modern requirements have been produced in Azerbaijan recently. Table wines form the basis of the wines produced. However, the production of dark and dessert wines in our wineries has not yet become widespread. To do this, we set ourselves the goal of studying the technology of production of sweet dessert wines of the Tokai type in the Samukhsky and Goygol districts, in accordance with local conditions. In the production of Tokai-type wines, white technical Bayan-shira and Rkasiteli grapes rich in useful components, as well as red Cabernet Sauvignon and Madras grapes, were used as raw materials (Panakhov and Salimov, 2016). Goals and objectives of the study.

Purpose and objectives of the study. The aim of the research is to produce high-quality wine for the first time in our country, rich in useful components, based on a new technology. To achieve the goal, it is expected to solve the following issues:

• Select white and red technical grape varieties growing in the Samukhsky and Goygol districts for the preparation of Tokaitype wine materials;

• Use white Bayanshira and Rkasiteli grapes, as well as red Cabernet Sauvignon and Madras grapes, as raw materials for wine production.;

• Wilt the bunches of individual grape varieties by twisting them on the vine for a short period of time 3-4 days and 10-12 days;

• Prepare Tokai wine materials from fully ripened and wilted grape varieties;

Object and methods of research. It is designed to determine the main quality indicators of grape varieties and wines using modern analysis methods:

- To determine the mechanical composition of fully ripened, slightly wilted grape varieties for 4-5 days and 10-12 days, as well as juice yield with and without skin;
- Quantify dry matter, total sugar, glucose, fructose, titrated acidity, phenolic compounds, vitamin C, pectin substances, inclu-deing protopectin and pectin, in mature and wilted grape varieties cultivated in the Samukhsky and Goygol districts;
- To study the dynamics of changes in the activity of enzymes of the class of oxidoreductases: ascorbate oxidase, odiphenol oxi-dase, peroxidase and catalase in fully ripened and wilted grape varieties;
- To study changes in the activity of the enzyme pectinesterase, belonging to the class of hydrolases, in ripe and wilted grape varieties;

Main provisions to be submitted for defense:

We set a goal to conduct research on four production options for sweet dessert wines of the Tokai type.:

1. Prepare Tokai wine by adding alcohol, fully ripened white and red grape juice;

2. Prepare Tokai wine by adding alcohol, white and red grape juice obtained from dried grapes;

3. Prepare Tokai wine by adding alcohol, white and red grape juice obtained from slightly dried grapes;

4. Prepare Tokai wine by adding concentrated juice to white and red grape juice;

5. Create a technological scheme for the production of Tokai wines.

Scientific novelty of the research. The study showed that the juice yield in the preparation of Tokai-type wines was significantly higher in ripe grape varieties compared with dried grape varieties. If the juice yield of ripe grape varieties was 74.3-77.1 branches, then for withered varieties this indicator was 59.5-62.5 branches. The analysis of the research work revealed that the twisting and wilting of bunches of Bayanshira, Rkasiteli, Cabernet Sauvignon and Madras grapes cultivated in Samukhsky and Goygol districts affects the main quality indicators of grapes. At this time, although the total sugar content of dried grapes, including glucose and fructose, increases due to eva-poration of water, conditions are created for reducing extractive substances in it, phenolic compounds with antioxidant and antimi-crobial properties, total acidity, vitamin C and other useful organic and inorganic substances. The results of the study showed that the decrease in the nutrient content in wilted grapes is due to their consumption during respiration. The breakdown or decrease in the amount of nutrients in dried grape varieties undoubtedly occurs with the partici-pation of enzymes. The increased activity of the pectinesterase enzyme in dried grapes increases the likelihood of the formation of highly toxic methyl alcohol in juice and wine. A

comparative analysis of wines made from grapes grown in the Samukh and Goygol regions in various variants revealed that Tokai wine materials made from slightly withered and fully ripened grape varieties differ in quality from other variants.

Theoretical and practical significance of the study. It is known that grape varieties used for the production of Tokai wine must have a high total sugar content. As a result of the study, it was found that the total sugar content of fully ripened and wilted grape varieties grown in the Samukh district is significantly higher than in the Goygol district. In addition, the quality indicators of grapes wilted on the vine were significantly lower than those of fully ripe berries. If in Tokai wine materials made from dried white and red grape varieties, the content of phenolic compounds with high antioxidant properties was 0.32-0.44 g/cm³, then in wines made from fully ripened and dried grape varieties, this indicator was almost twice as high -0.56-0.82 g/cm³. Wines with a low content of phenolic compounds contribute to the intensity of the oxidation process. The amount of extractive subs-tances was high in wine materials made from mature and slightly dried grape varieties, whereas in wines from grape varieties dried for 10-12 days it was low. This affects the quality of the wine, its long-term stability, aroma, taste, fullness and other factors. Therefore, we con-sider it advisable to use fully ripened and slightly dried grape varieties for the preparation of Tokai-style wines.

Approbation and application of works. The main results of the dissertation work were published at scientific and practical conferences of the Azerbaijan University of Technology, at the International Scientific and Practical Conference "The Fourth Industrial Revolution and Innovative Technologies" dedicated to the 100th anniversary of the birth of national leader Heydar Aliyev (2023). In addition, this is reflected in the materials of the International Scientific and Practical Conference "Modern problems of technology and technology of food production" (2018, 2023) at Mogilev State University of Food of the Republic of Belarus. The prepared wine samples were made and tasted in the mini-production laboratory of the Department of Food Engineering and Expertise of the Azerbaijan Technological University. A new technology for the production of high-quality sweet dessert wine of the Tokai type has been proposed and tested in production at JSC Ganja Sharab-2.

The name of the organization in which the dissertation work was performed. The dissertation work was carried out at the Azerbaijan Technological Universitety at 2018-2023.

The total volume of the dissertation, indicating the volume of the structural sections of the dissertation separately. The dissertation consists of an introduction, five chapters, a conclusion, a list of 150 sources and appendices. It contains 16 figures, 32 tables and an appendix. The content of the dissertation consists of an introduction of 6 pages and 1179 characters, the first chapter of 29 pages and 66939 characters, the second chapter of 8 pages and 13293 characters, the third chapter of 30 pages and 51933 characters, the fourth chapter of 26 pages and 47868 characters, the fifth chapter of 34 pages and 49656 characters, the conclusion of 3 pages and 4420 characters, sentences of 1 page and 1023 characters, references of 150 pages and 17 pages and 29182 characters, as well as appendices of 12 pages and 20454 characters. The dissertation consists of 169 pages of computer text with a total volume of 285,947 characters (excluding the list of references and appendices - 236,311 characters).

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. The literature review reflects the main indicators of the quality of grapes and wine, a comprehensive comparative analysis of fully ripened and wilted grape varieties is carried out, the characteristics of Azerbaijani Tokai wine and its differences from others are given, as well as the characteristics of grape varieties used in the production process.

Second chapter. This chapter provides information on the object and methodology of the study. White technical grape varieties cultivated in Samukh and Goygol regions–Bayanshira, Rkasiteli, red technical grape varieties from Kaberne-Sovignon and Madrasah were used as research object for making Tokay type sweet dessert wine. In the process of production, Tokay sweet dessert wines were prepared from ripe and withered grape varieties in various variants. In the methodology of the research, the mechanical composition and main quality indicators of technical white and red grape varieties, fully ripe for the preparation of Tokay type sweet dessert wine, twisted the bunch on the tin and slightly wilted for 4-5 days, as well as relatively 10-12 days, were analyzed comparatively. The research work was carried out on 4 options:

I option. Study of the technology of preparation of Tokay wine materials by adding ripe white and red grape juice to alcohol together with mash;

II option. Study of the technology of preparation of Tokay wine materials by adding the dried white and red grape juice to the alcohol together with the mash;

III option. Investigation of the technology of preparation of Tokay wine materials by adding slightly dried white and red grape juice to alcohol together with mash.

IV option. Research of production technology of Tokay wine materials by adding concentrated juice to slightly faded white and red grape juice. Mechanical composition and main quality indicators in grape varieties by variants have been determined with the help of modern analysis methods:

✤ The mechanical composition indicators of fully ripe, slightly wilted grape sots within 4-5 days and 10-12 days, as well as the juice production with and without spots have been determined;

✤ Dry matter, total sugar, glucose, fructose, titrating acidity, phenol compounds, vitamin C, pectin substances, including protopectin and pectin are determined in ripe and wilted grape varieties cultivated in samukh and Goygol regions;

✤ The dynamics of the activity of ascorbatoxidase, Odipheno-loxidase, peroxidase, catalase enzymes belonging to the oxido-reductase class in fully ripe and withered grape varieties has been studied;

✤ Changes in the activity of pectinesterase enzyme belonging to the hydrolases class in ripe and withered grape varieties have also been studied;

✤ Phenol compounds were determined by chromato-mass spec-trometry method in grape varieties. The economic efficiency of raw materials and prepared wines, mathematical and statistical reporting of the obtained results were studied using the Exsel program, the STATISTICS software package.

Third chapter. In this chapter, the mechanical composition indi-cators of grape varieties used in the production of Tokay type wine, fully ripe, withered grape varieties within 4-5 days and 10-12 days have been determined by quantity of opaque juice with and without spots. The study of opaque juice output in ripe and withered grape varieties as a result of the study is reflected in Table 1.

Tab 1.

№	Varieties of grapes	Fully ripe grapes	Withered grapes for 10-12 days	Difference	Percent	
		Option I	Option II			
1	Bayanshira	75,5	60,6	-14,9	19,7	
2	Rkasiteli	77,1	62,5	-14,6	18,9	
3	Kaberne-	74,3	59,5	-14,8	19,9	
	Sovinyon					
4	Madrasa	75,2	59,6	-15,6	20,7	

Opaque juice from grape varieties deduction, %

From the figures of Table 1, it was found that in comparison with grape varieties withered in 10-12 years, the yield of opaque juice without spots is much higher in fully ripe grape varieties. If the juice output in fully ripe grape varieties was 74.3-77.1%, then this indicator was 59.5-62.5% in withered grape varieties. Opaque juice

obtained from fully ripe grape varieties was 18.9-20.7% or 14.6-15.6% more than juice obtained from Withered grape varieties. Comparative analysis of quality indicators of ripe and wilted white grape varieties cultivated in samukh region is presented in Table 2 and Figure 1.

Tab 2.

N₂	İndicators	Bayanşira			Rkasiteli				
		Ripe	With ered	Differ ence	%	Ripe	wither ed	Differ ence	%
1	Dry matter, g/100 cm ³	23,7	32,4	+8,7	36,7	29,8	37,9	+8,1	27,2
2	Total sugar, g/100 cm ³	21,6	29,6	+8	37,3	28,5	35,2	+6,7	23,5
3	Glucose , g/100 cm ³	8,7	12,2	+3,5	40,2	12,4	15,1	+2,7	21,8
4	Fructose, g/100 cm ³	9,6	14,8	+5,2	54,1	13,6	17,5	+3,9	28,6
5	Titirating aci- dity, g/ dm ³	6,2	5,1	-1,1	17,7	5,8	5,0	-0,8	13,8
6.	Active acidity (pH)	3,3	3,5	+0,2	6,1	3,2	3,5	+0,3	9,4
7.	Phenol compounds, g/100 cm ³	0,76	0,46	-0,30	39,5	0,70	0,42	-0,28	40,0
8.	C vitamin, mg/100 cm ³	7,8	4,2	-3,6	46,1	7,4	4,1	-3,3	44,6
9.	Pectin subs- tances,g/100 cm ³	0,27	0,16	-0,11	40,7	0,25	0,14	-0,11	44,0
10	Protopectin, g/100 cm ³	0,14	0,06	-0,08	57,1	0,13	0,05	-0,08	61,5
11	Pectin, g/100 cm ³	0,13	0,10	-0,03	23,1	0,12	0,09	-0,03	25,0

Quality indicators of ripe and dried white grape varieties in lowland zone of Samukh region

From the figures of Table 2 and Figure 1, it was found that the content of dry matter, total sugar, glucose and fructose in the dried grape varieties compared to white grape varieties grown in Samukh region was significantly higher due to evaporation of water in grape berries. But general acidity, phenol compounds, vitamin C and other nutritional components, which are the main quality indicators of

grapes, were present in the composition of ripe grapes in large quantities, and in small quantities in the composition of wilted grapes. Comparative analysis of the activity of some enzymes belonging to oxidoreductase class in white and red grape varieties grown in samukh and Goygol regions was also studied.



Figure 1. Ripe and wilted white grape varieties comparative analysis of quality indicators:

1-ripe, 2-withered Bayanshire; 3-ripe, 4-withered Rkasiteli

From the result of the study, it was found that compared to ripe grape varieties, the activity of the studied enzymes is higher. The increase in the activity of fermets leads to a decrease in the amount of nutrients contained in grape berries spent on the respiratory process.

Forth chapter. Tokay wine material production technology has also been studied by adding concentrated juice to ripe, wilted and slightly wilted white and red grape juice. Chemical-organoleptic indicators of Tokay wine material prepared by adding ripe grape juice to alcohol along with mash and fermenting it for 3-4 days in samukh region are reflected in Table 3.

Tab 3.

Comparative analysis of chemical and organoleptic parameters of Tokai wine materials made from white technical grape varieties cultivated in the conditions of the Samukh district according to various options

S/s	Indicators	Bayanshira			Rkasiteli		
0/5	maleutors	1	2	3	1	2	3
1	Total sugar of grapes, $g/100 \text{ cm}^3$	21,6	28,4	27,6	28,5	35,2	33,8
2	Alcohol added to grape juice in advance, h.%	12,5	7,9	8,5	7,8	3,3	4,3
3	Taking into account the contractual coefficient (k=0,08) h.%	11,5	7,3	7,8	7,2	3,0	3,9
4	Loss of alcohol during contraction h.%	1,0	0,6	0,7	0,6	0,3	0,4
5	Alcohol output in wine material, h.%	3,5	7,7	7,2	7,8	12,0	11,1
6	Alcohol in Tokay wine, h.% (total)	15,0	15,0	15,0	15,0	15,0	15,0
7	Sugar in Tokay wine, g/cm ³	16,0	16,0	16,0	16,0	16,0	16,0
8	Titrating acidity, g/dm ³	6,4	4,2	5,7	5,8	3,9	5,6
9	Volatile acidity, g/dm ³	0,58	0,86	0,42	0,60	0,88	0,44
10	Active acidity (pH)	3,1	3,3	3,2	3,2	3,4	3,1
11	Extract, g/dm ³	36,2	31,8	35,4	36,1	32,4	37,3
12	Phenol compounds, g/cm ³	0,61	0,32	0,56	0,64	0,36	0,58
13	Methyl alcohol, g/dm ³	0,21	0,76	0,31	0,24	0,81	0,36
14	Evaluation, points	8,7	8,0	9,1	9,5	8,3	9,8

From the data in Table 3, it can be seen that when preparing Tokai-type wine materials, alcohol consumption is high with a low total sugar content in grapes, and vice versa, alcohol consumption is low. If the Bayanshir grape variety contains 21.6 g/100 cm³, then the alcohol consumption in the preparation of Tokai wine is 12.5% vol. Unlike the Bayanshira grape variety, the alcohol content in the Rkasiteli grape variety was significantly lower - 7.8% alcohol. The main goal of our research is to reduce alcohol consumption in the preparation of Tokai wine materials. Our main goal is to achieve better alcohol absorption in juice. The research results show that Tokay wine material made from the Rkassiteli grape variety had the highest score among the prepared samples, with a score of 9.8 points.

Fifth chapter. The main purpose of preparing Tokai wine materials for various variants in this chapter is to determine the optimal option. The study shows that wine materials made from fully ripened and slightly dried grape varieties contain significantly less volatile acids than wines made from long-dried grapes. If in wines made from fully ripened and slightly dried grape varieties, the volatile acidity was $0.38-0.46 \text{ g/dm}^3$, then in wines made from grapes dried for 10-12 days, this indicator increased almost twice and reached 0.86–0.88 g/dm³. If the total sugar content of Bayanshira grapes grown in the Samukhsky district was 21.6%, then this indicator was 28.5% for the Rkasiteli variety. When the Bayanshira grapes were dried on the vine for 10-12 days, the total sugar content was 28.4%, and for the Rkasiteli variety, this indicator was 35.2%. In the 3rd variant, the sugar content of the slightly wilted Bayanshira grape variety was 27.6%, while in the Rkasiteli variety this indicator was significantly higher - 33.8%. When wilting grapes for 10-12 days, there was no significant difference in the percentage of sugar compared with a short wilting period of 4-5 days. As you can see in the picture, making wort with less sugar requires more alcohol. The amount of methyl alcohol according to the variants is shown in Figure 2.



Figure 2. The amount of methyl alcohol according to the options.

From the data in Figure 2, it can be seen that the amount of methyl alcohol in wine materials made from both grape varieties according to variants 1 and 3 was low, whereas in variant 2 and in wines made from grape varieties dried for 10-12 months, it was significantly higher. As a result of the research, it was found that the content of phenolic compounds in wine materials made from red Cabernet Sauvignon and Madras grapes according to the 1st and 3rd variants was significantly higher. These indicators are shown more clearly in Figure 3. So, in the conditions of the Samukhsky district, wines made from Rkassiteli grapes according to the 1st and 3rd variants received a score of 9.5-9.8 points, and wines aged for 10-12 days according to the 2nd variant received a score of 8.0-8.7 points.



Figure 3. Quantitative changes in phenolic compounds in Tokai wine materials made from white grape varieties cultivated in the Samukh region.

So, in the conditions of the Samukhsky district, wines made from Rkassiteli grapes according to the 1st and 3rd variants received a score of 9.5-9.8 points, and wines aged for 10-12 days according to the 2nd variant received a score of 8.0-8.7 points. Wines from red Cabernet Sauvignon grapes 9.2; 8.5; Wines made from Madras grapes received a score of 9.4 points, and wines made from Madras grapes received a score of 9.3; 8.7; 9.6 points.

Processing of research results using mathematical and statistical methods. In the course of the research, the optimal option was determined using mathematical statistics methods based on the main quality indicators of Tokai wines made from Bayanshira and Rkasiteli grapes. The correctness of the regression equation expressing the degree of accuracy of the obtained results has been verified. The study examined the effect of total grape sugar, wine extractivity, and volatile acids on wine quality. Although the percentage of sugar in grape varieties in option II was slightly higher than in option III, the quality of wines obtained in option III was

significantly higher than those obtained in option II. The main reason for this is that there are fewer extractive substances in option II than in option III, and there are twice as many volatile acids (mainly acetic acid) and methyl alcohol with high toxicity.

In addition, phenolic compounds with antioxidant and antimicrobial properties were less abundant in wines prepared according to option II and significantly more abundant in wines prepared according option III. Thus, in comparison with other wines, Tokai wine made from Rkassiteli grapes grown in the Samukh district and aged for 4-5 days received a score of 9.8 points.

Results

1. The indicators of the mechanical composition of grape varieties used for the first time for the production of high-quality Tokai-type wines, as well as the yield of opaque juice with and without skin, were studied. The study showed that the weight of fully ripened grapes significantly exceeds the weight of wilted grapes. In addition, the yield of opaque juice obtained from ripe grapes was higher compared to juice obtained from pre-ripened grapes.

2. The sugar content in grape varieties used for the production of Tokai wine should be 38-42%. For this purpose, for the first time in our country, we dried grapes by twisting them on the vine. The main goal here is to increase the sugar content in grapes by evaporating water. Despite the fact that the total sugar content in wilted grape varieties is higher due to water evaporation, the main quality indicators included in the grapes are significantly lower than in fully ripened varieties.

3. The main cause of softening and loss of elasticity of grapes is considered to be pectinesterase, a representative of pectin enzymes. This enzyme hydrolyzes the methoxylated polygalacturonic acid, or pectin, found in grape berries, converting it into pectin acid and methyl alcohol. The resulting methyl alcohol leads to damage to the cellular structure of grape berries and a decrease in the quality of grapes. This undoubtedly has a negative impact on the quality of Tokai-type wines produced. 4. A comparison of grape varieties showed that the amount of dry matter, total sugar, including glucose and fructose, varies depending on soil and climatic conditions. If the total sugar content of Bayan-shira grapes grown in the foothills of the Goygol district was 18.5 g/100 cm³, then in the Samukh district this indicator was 21.6 g/100 cm³. If the total sugar content of Bayanshira grapes cultivated in the Goygol district was 26.4 g/100 cm³, then the Bayanshira grapes cultivated in the Samukhsky district had this indicator of 29.6 g/100 cm³. These indicators were similar to those of other grape varieties.

5. As a result of the study, it was found that even when the grape varieties used for the production of Tokai-type wine were dried for 10-12 days, up to 40% of sugar did not accumulate in the grape varieties. Therefore, we carried out the fermentation process by adding juice to a given small amount of alcohol during the fermentation of juices obtained from dried grapes for 10-12 days. At this stage, the fermentation process stops naturally when 15-15.5% alcohol is formed in the fermenting juice. The technological regime and accounting during wine production were such that 16 g/100 cm³ of natural sugar was preserved in the wine.

6. As a result of research, it was found that the percentage of sugar in grape varieties pre-dried in the Samukh district is higher than in grape varieties grown in the Goygol district. Thus, the amount of alcohol consumed during fermentation of all grades was lower in the Samukhsky district and higher in the Goygol district.

7. It is known that alcohol is added to the fermenting juice during the production of dessert wines. In our study, for the first time, we carry out the fermentation process by adding juice to a small amount of alcohol in the production of Tokai-type wine. When 15% alcohol is formed in the fermenting juice, the fermentation process stops, resulting in Tokai wine material containing alcohol and sugar in accordance with the conditions.

8. As a result of the research, it was found that a tasting of wines made from grapes of the Rkassiteli, Cabernet Sauvignon and Madras varieties cultivated in the Samukh and Goygol districts was carried out. During the tasting, Tokay wine made from slightly dried grapes of the Rkasiteli grape variety received a score of 9.8 points, Cabernet Sauvignon wine - 9.4 points, and Madras wine - 9.6 points.

Recommendations for producers

- 1. As a result of a comparative analysis of regions and grape varieties, it was found that, compared with the Goygol district, the white grape variety Rkasiteli, grown in the Samukhsky district, significantly surpasses the red grape varieties Madras and Cabernet Sauvignon in quality and organoleptic characteristics of wine materials prepared according to the 1st and 3rd variants.
- 2. The results of the study showed that the grape varieties used to make Tokai-type wine are more suitable for the conditions of the Samukhsky district than the Goygol district. Therefore, for the production of Tokai-type wine, it is more expedient to use white and red technical grape varieties grown in the conditions of the Samukhsky district.
- 3. The study of economic efficiency revealed that in the conditions of the Samukhsky district, when using one ton of fully ripened grapes, net income was received in the amount of 3044-3264 manats in the production of Tokai-type wine, while net income in the production of wines by drying grape varieties on the vine for 10-12 days was significantly less and amounted to 2324-2524 manats.

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

1. Baghirzadeh, A.S.. Mechanical composition indicators of grape varieties used in the production of Tokay wine. // Ganja branch of Anas" Journal of news " Ganja-2022 No. 4 (87) pp.63-68.

2. Bagirzadeh, A.S., Omarov, Y.A., Nabiyev, A.A. Comparative study of the quality indicators of grape varieties used in the production of Tokai wines // Beer and beverages. 2023. №1. pp. 30-34

3. Bagirzadeh, A.S., Kasumova, A.A., Mehdiyev, U.D. Development of technology for the production of Tokai-type wines. // Proceedings of the XII International Scientific and Technical Conference. Mogilev – 2018. April 19-20. Volume 1. pp. 101-102.

4. Bagirzadeh, A.S, Omarov Y.A, Hacıyeva A., Gurbanova S., Gasimova A., İsmayilov M., Nabiyev A. Improvement of the production technology of tokay wines on the basis of revealing the effect of enzyme activity on the quality of grape // Eastern-European Journal of Enterprise Technologies, 2023. Vol. 2(11 (122)), -pp.49-62

5. Bagirzadeh, A.S., Omarov, Y.A., Kasumova, A.A., Nabiyev, A.A. Study of the enzyme activity of grape varieties used for the production of Tokai-type wines // Machinery and technology of food production: Proceedings of the XV Anniversary International Scientific and Technical Conference. Mogilev BSU. April 19 – 20, 2023. In two volumes Vol. 1. pp. 64-65.

6. Bagirzadeh, A.S., Omarov, Y.A., Gasimova, A.A., Nabiyev A.A Study of pectinesterase enzyme activity in grape varieties used for the production of Tokay wines. III International Scientific and Practical Conference «Scientific advances and innovative approaches». -Tokyo. Japan: February 23-24, -2023, -pp. 5-7.

7. Bagirzadeh, A.S., Nabiev, A.A. Improving the technology of production of Tokai-type wines in Azerbaijan // Azerbaijan Technological University. Proceedings of the International Scientific and Practical Conference "Protection of cultural heritage and biodiversity in the context of urban industrialization". Ganja: - 2017.pp-32-33.

8. Bagirzadeh, A.S., Nabiyev, A.A. The study of quality indicators of grape varieties used in the production of Tokai-type wine materials // Azerbaijan Technological University. Actual problems of the food and light industry. Materials of the international scientific and practical conference. Ganja: -2019. pp.76-77.

9. Bagirzadeh, A.S., Akhundov, P.F., Nabiyev, A.A. Selection of grape varieties for the production of Tokai-type wines and the study of mechanical composition indicators // Azerbaijan Technological University. Materials of the scientific and practical conference on "The main problems of university ranking", dedicated to the 98th

anniversary of the birth of the great leader Heydar Aliyev. Ganja:-2021. pp.6-7.

10. Bagirzadeh, A.S., Mehdiyev, U.S., Nabiyev A.A. The study of grape variety breeding for the production of Tokai type wines // Azerbaijan Technological University. Materials of the republican scientific conference on "Technological development – the basis of economic development". Ganja - 2021. pp. 21-22.

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