The object of this study is the production technology of Tokaj-type wine materials. The material used was white and red grape varieties, withered by twisting on the vine for 4–5 days. Wine materials were prepared from these grape varieties using new technology, i.e., by adding the wort to the alcohol along with the pulp. The technology for the production of environmentally friendly Tokaj-type sweet dessert wines using technical grape varieties cultivated in the foothills of the Goy-Gol and flat zone of the Samukh region has been improved. Providing the population with environmentally friendly food products, as well as wines, is one of the most important tasks of our time. Poor quality food creates conditions for the development of various diseases. For this purpose, a technological scheme for the production of Tokaj-type wine materials has been devised. The quality indicators of Tokaj wine material prepared by fermenting in alcohol must from grapes withered by twisting on the vine for 4–5 days with pulp for 3–4 days were studied. The rates of alcohol loss were calculated based on the contraction coefficient (0.08 %) during co-fermentation with wort. For wine materials prepared from grape varieties grown under the conditions of the Samukh region, alcohol consumption is reduced. This is due to the high sugar content in the wine material. In the prepared wine material, the amount of alcohol and sugar corresponded to the norm – the alcohol content reached 14–15 % and residual sugar 16 %. As a result of the tasting, wine material prepared from the Rkatsiteli grape variety in the Samukh region was rated 9.5 points, and wine material prepared from the red Madras grape variety 9.3 points. The results make it possible to regulate the desired quality of wine material and use it in the production of Tokaj wine

Keywords: Tokaji wine material, contraction coefficient, extract content, phenolic compounds, acidity

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IMPROVEMENT OF TECHNOLOGY FOR PRODUCING WINE MATERIAL FOR TOKAJ WINE

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1. Introduction

Tokaji-type wines belong to the category of sweet dessert wines. To produce wine, it is necessary to pay attention to grape varieties, soil and climatic conditions of cultivation, degree of ripeness, richness of nutritional components, and other factors. Raw materials should be more resistant to microbiological diseases [1].

The grape varieties used in the production of Tokaj wine must have a high content of natural sugars. It is known that the sugar contained in grapes is a representative of simple carbohydrates, consisting mainly of glucose and fructose. In wine production, grape varieties that contain more fructose than glucose should be used. This is mainly due to the fact that fructose is twice as sweet as glucose.

To produce high-quality wine, it is important to have high-quality raw materials, that is, the grapes must contain the required amount of sugar, total acidity, phenolic compounds, and a small amount of pectin. Total sugar is used both for fermentation and for storing residual sugar in wine materials. General acidity is involved in the formation of the unique taste and aroma of wine [2].

Phenolic compounds, creating conditions for the formation of the fullness of wine, simultaneously protect wine from oxidation and pathogens [3]. The low content of pectin, a representative of heteropolysaccharides, in wine also has a positive effect on its quality. Since pectin substances are colloidal particles, they affect the turbidity of wine. In addition, the formation of highly toxic methyl alcohol in wine occurs due to the hydrolysis of pectin substances [4].

According to Hungarian law, Tokaji-type wines are environmentally friendly and produced in a natural way. It is prohibited to add alcohol or other ingredients to wine materials during its production. In its homeland, this wine is also called royal wine. To prepare Tokaj dessert wine naturally, the sugar content of the grapes should be between 40–42 %. Since in the Hungarian Republic there are no technical grape varieties capable of harvesting up to 40 % sugar, the percentage of sugar is increased by rolling the grape bunches on the vine [5].

When the bunches are rolled on the vine, the berries wilt, and the sugar percentage increases due to water evaporation. For such grape varieties, the must yield is significantly less than for fully ripe ones. As a result of research, it has been established that the process of gradual softening of grape berries occurs in pre-withered grape varieties. This is due to the activation of oxidative enzymes. Thus, compared to fully ripened grape varieties, the enzyme activity in dried grapes is significantly higher. An increase in enzyme activity creates conditions for the consumption of its constituent nutrients for the respiration process. This means that, compared to withered grapes, the amount of nutrients in ripened grapes is significantly higher [6].

Therefore, the issue of improving the technology for the production of Tokaj-type wine materials using local raw materials is very relevant. It is important to take into account the change in the composition of nutrients during the preparation of wine and the improvement in the organoleptic characteristics of the finished product.

2. Literature review and problem statement

In [7], the authors argue that for the production of Tokaj-type wine materials it is important to use fully ripened technical grape varieties. Compared to unripe and overripe grape varieties, fully ripened grapes are rich in organic and inorganic substances. These substances have a positive effect on the taste and aroma of the prepared wines, and also enrich it with extractive substances. It is impossible to make high-quality wine from unripe and overripe grape varieties. In unripe grapes, the sugar content necessary for making wine is low, and the acidity is higher than normal. However, the authors did not indicate a specific period of grape harvest, during which the maximum amount of nutrients necessary for the preparation of high-quality wine material accumulates in the grapes.

From work [8] it became known that in comparison with ripened grapes, in unripe grapes the amount of malic acid is higher than tartaric acid. Excessive amounts of malic acid in wine are undesirable. If the content of malic acid in wine exceeds 2 g/dm^3, then an unpleasant sharp taste is felt, which is called green acidity. In the same work, the volume of organic acids such as oxalic, citric, tartaric, and succinic is determined.

According to work [9], as grapes ripen, the amount of malic acid decreases and turns mainly into tartaric acid, the content of which is very desirable in wine. Natural acids, including tartaric acid, play a special role in the formation and maturation of wine. In ripe grapes, the amount of tartaric acid is 80–90 % of the total acidity. The acidity of wine is one of the main indicators of the chemical composition and tasting assessment. The active acidity of the must and wine plays an important role in the process of formation and maturation of wine, determines the ratio of fermentation products, the tendency to oxidation, biological and colloidal cloudiness. However, the influence of active and titratable acidity on the quality of wine material is not considered.

The authors of [10] indicate that the quantitative determination of the total acidity of grapes and wine is determined by tartaric acid. It is difficult to make quality wine from overripe grapes. This is due to the fact that grapes that have gone through the ripening period soften, and the nutrients they contain are used for the respiration process. That is why the nutritional components of overripe grape varieties are significantly lower compared to ripe grapes. The authors did not pay attention to the influence of volatile acidity on the process of making wine. Volatile acidity is caused by the presence of volatile acids in wine, for example, acetic acid, which is formed as a result of the oxidation of ethyl alcohol by acetic acid bacteria. Acetic acid, further reacting with ethanol, forms an ester called ethyl acetate, which is the source of unpleasant odors in wine.

Paper [11] presents data related to the Tokaj Selection wine (the Hungarian equivalent of "Asu"), which are typical sweet wines produced in the Tokaj wine region, which is part of two countries: Slovakia and Hungary. Taking into account the economic importance and uniqueness of these wines, this work developed a new, rapid, and inexpensive method combining infrared spectroscopy and multivariate models for the characterization of Slovak Tokaj Selection wines. The developed new, fast, and inexpensive method, as well as multivariate models, will contribute to the characterization of not only Slovak Tokaj-type wines but also Tokaj-type wines produced in other regions of the world. The quality of a wine consists of a set of properties that make it acceptable or desirable to the consumer, who is impressed by the wine's pleasurable features. Therefore, the quality problem must be solved with the help of wine production technology, which is aimed primarily at preserving and developing these features. Quality is a combination of pleasant taste sensations directly related to the chemical composition of the wine. But it is well known how inaccurate and subjective the determination and assessment of the taste properties of wine are, on the one hand, and the difficulty of relating them to the chemical composition of the wine, on the other. Essentially, it is impossible to completely solve this problem. However, it is well known that wine quality is a relative concept, that consumer taste changes dramatically over time and now varies depending on the region. The main difficulty is to define and translate into precise and clear language the advantages and disadvantages of a particular wine. The difficulty is considerable since in order to know the effect on the quality of wine of one or another method of preparation, one or another processing, one or another material, or to judge accurately enough the factors that ensure better quality, one must first of all have a reliable and convenient method to define and express types, norms, limits, comparative values.

Work [12] reports a study of red grape varieties, which are rich in phenolic compounds, and thanks to them, juices prepared from them have antioxidant and antimicrobial properties. However, their suitability for producing different types of wines is not explored here.

Study [13] compares Tokaj varietal wines produced from different grape varieties. Identified volatile organic compounds were analyzed using one-way analysis of variance. Wines made from white grape varieties were characterized by the presence of a high concentration of terpenoids. Enantioselective analysis of the dominant terpenoids (limonene, linalool, hotrienol and α-terpineol) was performed using Heartcut-2D-GC: the R-form was dominant for limonene and linalool, and the S-enantiomer for hotrienol and α-terpineol. Statistical analysis (ANOVA) confirmed that R-linalool was the most significant compound responsible for the main differences between the studied varietal wines. It is known that phenols also belong to volatile organic compounds, and their content dominates in wine materials prepared using the red method from white and red grape varieties. The identification of these compounds would make it possible to identify the representative responsible for the differences between wines made from grapes grown in different climatic conditions.

In [14], a simple UV spectrum was studied to distinguish original Tokaj wines from fakes, and to distinguish wines depending on their country of origin. This issue was resolved using one approach to classifying classes. To this end, two different approaches were tested and evaluated: simple independent data-driven analogy class modeling – DD-SIMCA and single-class partial least squares – OC-PLS. In both cases, the models were built and optimized in a rigorous manner using only samples of the target class. A set of exter-

nal samples was used to test the model's ability to recognize original samples and reject counterfeits. This method could also be used for Tokaji wines prepared locally to prevent low-quality products from entering the market, and thereby protect people from counterfeits.

Work [15] reports a study on the influence of technologies used in winemaking on the content of phenols and their antioxidant activity. Three methods for determining antioxidant activity were compared: DPPH, beta-carotene bleaching test, and ABTS. The enological parameters and composition of the phenolic fraction of annual wines were also determined. The authors of the work claim that the addition of tannins made it possible to increase the content of phenols in musts and wines much more than in other technologies. The results regarding antioxidant activity depended on the method used. For the wort, DPPH analysis showed no major differences between technologies, while tannin addition produced the highest antioxidant activity in beta-carotene and ABTS analyses. Wine aging determined an increase in antioxidant activity regardless of the method used. Wine produced using traditional technology and the addition of tannins showed the greatest antioxidant activity in terms of DPPG and beta-carotene. The highest correlation coefficients (0.961 and 0.932) were calculated between phenolic content and must ABTS values, while the lowest values (0.413 and 0.517) were calculated between phenolic content and ABTS values of wines. The addition of tannins produced high levels of monomeric anthocyanins, flavonoids, vanillin-responsive flavones, and coumaroyl malvidin and low levels of acetylated malvidin. The research could be a useful tool for wineries seeking to increase the antioxidant content of their wines, thereby turning them into functional drinks and extending their shelf life. In this regard, the most suitable and cost-effective technology for the production of wine materials is the fermentation of wort on pulp, during which the wort is enriched with natural phenolic compounds.

Work [16] presents materials on the antioxidant and antiradical effects of red table wines. It has been studied that the antioxidant and antiradical properties of red table wines are determined by the varietal characteristics of the grapes and the technology of its processing. A correlation has been established between the antioxidant property and the concentration of the components of the phenolic complex, as well as the antioxidant and antiradical properties of red wines. The variants with the highest concentration of representatives of phenolic compounds – catechins and tannins – had high antioxidant and antiradical value. It has been proven that in red grape varieties and with the technology of wine preparation using fermentation of must on pulp, the antioxidant and antiradical properties of wines also increase. Depending on the grape variety and preparation technology, antioxidant activity varied by more than 30 %. The data obtained indicate that wine preparation technology allows increasing intravarietal antioxidant activity from 10 to 20 %. It has been proven that in red grape varieties and with the technology of wine preparation using fermentation of must on pulp, the antioxidant and antiradical properties of wines also increase. However, the authors did not determine the influence of varietal characteristics and zoning of grapes on the activity of enzymes that break down phenolic compounds and the quantitative change in these compounds.

The authors of [17] used electron paramagnetic resonance (EPR) spectroscopy to study red, white, and Tokaji wines. The radical scavenging ability was tested in 30 wine samples from the Slovak region. They compared 10 samples of red and 10 samples of white wines made from different grape varieties grown in different regions. Research has shown that Tokaji wines demonstrate very good cleansing properties, occupying a position between white and red table wines. Cleaning capacity was expressed in Trolox equivalent antioxidant capacity (TEAC): 14.8±1.5 for red, 8.1±3.4 for Tokaji and 3.3±1.6 for white wines. However, the work does not present data from lowland and foothill areas.

Work [18] analyzed the influence of climatic elements on the quantity and quality of wine in the Tokaj wine region in Hungary. Using the Makra test, significant deviations were found in both the wine quantity and quality data sets. The studies analyze the relationship between climatic variables and the quantity and quality of wine using various statistical methods. The study confirmed that the most important factors in wine quantity are sunshine in May, June, July, and August, and precipitation in September. Average temperature, precipitation, and sunshine in May and September, as well as precipitation in July and sunshine in August play a key role in wine quality. The role of climate in September is most important since the formation of ace (Botrytis), an important component of wine quality, largely depends on the conditions of that month. The results show that the significant variables obtained by factor analysis better explain the linear relationships between climate and wine quantity and quality than those obtained by the x2 test. The researchers argue that climate type classifications are more effective at explaining differences in wine quantity than differences in wine quality. Overall, the study identifies the characteristics and importance of climate variables that have a significant relationship with the quantity and quality of wine in a region. The authors did not focus on the influence of climatic conditions in lowland and foothill areas where grapes grow and on the method of their withering.

The authors of [19] studied the mineral composition of wines depending on many environmental and technological factors. They argue that the variables studied influence human health. The paper provides data on possible changes in the mineral composition and pH of wines due to 4-hour maceration of the skins and fermentation under a layer of sulfur. The experiments were carried out on acidic sandy soil in the Middle East of Hungary. The mineral composition of the wines was determined using a ThermoFischer Scientific iCAP 6300 ICP-OES, pH was measured using a pH10pen (VWR International) in the field and using a SevenEasyTM pH meter (Mettler Toledo) in the laboratory. The results of the first version of the study demonstrated the effect of skin maceration, which is widely used to enhance aroma. In the second option, red grape varieties were used, which were used for double maceration in the technology of rose and red wine. Data from the first study showed that when skins are macerated, the contents of K, Cu, Mn, and P increase, and Fe decreases significantly. Data from the second study show that with longer skin contact and higher fermentation temperatures, K, Mg, Mn, P, Sr, and B increased, while Fe and Ba decreased. In terms of pH, data shows that skin maceration and fermentation increase K content by approximately 30–70 % and pH by 0.4–0.5. However, it is important to note that for the production of environmentally friendly products it is not allowed to use additional ingredients; the authors used the method of maceration of the skins and fermentation under a layer of sulfur. The development of innovative methods for producing environmentally friendly products is an urgent

problem, the solution of which requires special approaches to improving existing technologies.

In [20], the authors studied the role of various yeast strains in the production of volatile flavor components of Tokaj-Asu wine. The effects of *Saccharomyces cerevisiae* starter and a typical endogenous strain of *Candida stellata*, as well as spontaneous fermentation, were studied and compared. Solid-phase microextraction (SPME) sampling and GC-MS separation and identification were used to quickly compare the aroma profile. Significant differences were found between wines fermented with different yeast strains. Using *Saccharomyces cerevisiae* starter alone speeded up fermentation but caused only minor changes in flavor and aroma content. *Candida stellata* contributes little to aroma, especially the longer carbon chain ethyl esters. Characteristic compounds were found in aged wine Tokaj Asu.

The use of selected yeasts was not widespread because the improvement in quality that could be expected from them was not always sufficiently obvious. It is now known that the use of pure cultures and yeast generally has only an indirect effect on the quality of wine. For example, the use of alcohol-resistant yeast helps complete fermentation, and therefore there is no risk of it stopping. Another example is the use of acid-reducing yeast (*Schizosaccharomyces*), which produces wines with low acidity. It is important to note that the *Candida stellata* strain, which is usually isolated from grape must, is competitive and stable in fermentation of both white and red wine in various wine regions of the world and can withstand ethanol concentrations of at least 9 % (by volume). Because this yeast can cause spoilage, the authors did not conduct studies to characterize *C. stellata* for its ability to produce desirable metabolites for wine flavor, such as acetate esters, or for the presence of enzymatic activity that enhances the aroma of wine.

In [21], the authors studied volatile organic compounds in healthy and botrytized grapes, as well as in botrytized wines (Tokaj selection), using solid-phase microextraction followed by gas chromatography in combination with mass spectrometric analysis. Research has shown that more than 95 compounds were found in uninfected grapes. And botrytizing significantly increased the volume of volatile compounds. Compounds such as higher alcohols, carbonyls, furans, terpenoids, and esters of carboxylic acids, as well as alcohol in botrytized wines, have been identified in grapes. The authors selected seven chiral compounds (α-terpineol, hotrienol, limonene, diethyl malate, 2,3-butanediol, and whiskey lactones) for further chiral separation. The results of the study showed that botrytizing affected the enantiomeric ratio of the studied terpenes of grapes of all varieties. The distribution of α-terpineol enantiomers was influenced by the wine processing technology used. The authors did not study the volatile organic compounds of dried grapes because it is Tokaj wine material, prepared using the technology of infusing the must on pulp from grapes withered on the vine for 4–5 days, that gives high organoleptic indicators.

Thus, dessert wines, in particular Tokaji-type wines, should be included in the human diet. Analysis of the literature confirms that methods for characterizing wines, identifying volatile organic compounds, differences in wines depending on the country of origin, the influence of technological methods on the content of phenols and their antioxidant activity have been sufficiently studied. However, there is no data on the impact of grape zoning on the quality of wine materials and changes in the quality indicators of finished products. In addition, no research has been conducted on the preparation of Tokaj wine material using dried grapes; there is data regarding healthy and botrytised grapes.

Therefore, to further substantiate the development of technology for the production of Tokaj wine materials, expanding the range of sweet dessert wines and satisfying various consumer preferences, a comprehensive analysis of the nutritional value of raw materials is necessary, i.e., grape varieties and wine materials prepared using innovative technology for the production of Tokaji-type wine.

3. The aim and objectives of the study

The purpose of our study is to improve the technology for the production of wine materials for Tokaj wine based on local raw materials. This will make it possible to prepare an environmentally friendly product with high organoleptic and quality indicators.

To achieve this goal, the following tasks are solved:

– to develop a technological scheme for preparing wine materials;

– to determine the quality indicators of Tokaj wine material prepared by fermenting in alcohol the must obtained from grapes withered by twisting on the vine for 4–5 days with pulp for 3–4 days.

4. The study materials and methods

4. 1. The object and hypothesis of the study

The object of our study is the production technology of Tokaj-type wine materials. As research material, we used white grape varieties widespread in the territory of the Republic of Azerbaijan – Bayan-Shirey, Rkatsiteli, as well as red grape varieties – Cabernet Sauvignon and Madras, grown in the Samukh and Goygol regions.

According to assumptions, wine material prepared using improved technology is enriched with nutritional components, especially extract content and phenolic compounds. This is achieved by fermenting the wort on pulp for 3–4 days. When choosing raw materials, it is important to take into account the cultivation area and the withering period. Grapes harvested from the lowlands have a higher sugar content than grapes harvested from the foothills. In addition, the percentage of sugar in wine material made from grapes that have been dried by twisting on the vine for 4–5 days is higher. Typically, Tokaji-type wines are produced using grapes that have been dried for 10–12 days. During this time, the sugar content artificially increases but the amount of important nutritional components decreases due to consumption in metabolic processes. It is important that in Tokaj-type wine material the residual sugar content is 16 % and the volume fraction of alcohol is 15 %. To achieve this condition, alcohol is added to the wort using traditional technology. In this case, the taste and smell of ethyl alcohol persists for a long time. According to the proposed technology, fermentation is carried out not by adding alcohol to the wort but by adding fermenting wort to alcohol, the amount of which is calculated according to the contraction coefficient. Vigorous fermentation accelerates the assimilation of alcohol. In addition, when adding must to alcohol, further fermentation is stopped, which is undesirable in wine production. This is due to the fact that acetic acid fermentation

occurs and the volume of volatile acids, including acetic acid, increases and negatively affects the organoleptic characteristics of the wine material.

The research was carried out in 2018–2023 at the Department of Food Engineering and Expertise of the Azerbaijan Technological University, as well as in the laboratory at the Georgian State Agrarian University.

4. 2. Methods for studying quality indicators of Tokaj wine materials

The technology for the production of environmentally friendly sweet dessert wines of the Tokaj type has been improved using technical grape varieties cultivated in the foothills of the Goy-Gol region and the lowland zone of the Samukh region. The quality indicators of Tokaj wine materials prepared by adding wort to alcohol were studied. To prepare the wine material, we used varieties of white and red grapes, dried for 4–5 days, along with pulp. The harvested grapes are cleaned, washed, dried, squeezed, and added to alcohol. The wort ferments together with the pulp for 3–4 days, cultural yeast is introduced, the pulp is separated from the wort and fermentation continues. Then the wort is cooled, separated from the yeast mass, filtered, and stored at a temperature of 0...+ 2 °C, and transferred to a tank. The wine material is separated from the yeast sediment, treated with bentonite, and stored.

The following indicators were studied in the prepared wine material:

– total sugar using the hydrometric method [22];

– titratable acidity using direct titration method [22];

– volatile acidity using the potentiometric method [22];

– active acidity using the electrometric method [22];

– extractivity using a pycnometer based on the relative density of wine [22];

– methyl alcohol by photocolorimetry method [23];

– phenolic compounds by chromatography-mass spectrometry [23];

– tasting of finished wine material [24].

It was assumed that in the production of wine materials it is advisable to use grapes that are ripened or dried by twisting on the vine for 4–5 days since it is impossible to obtain high-quality finished products from unripe and overripe grapes. According to the traditional technology for the production of Tokaj wine, grapes dried for 10–12 days are used, but in this case the amount of such important components as extractives, phenolic compounds and must yield is reduced. This is due to the fact that when grapes wither, they are spent on metabolic processes. Raw materials grown in low-lying areas are rich in exactly the same components that are required to obtain high-quality wine materials. Adding wort to alcohol will make it possible to achieve the required sugar and alcohol standards for the production of Tokaj wine material with high organoleptic characteristics.

5. Results of a scientific and experimental study of the possibility of using grape varieties for the production of Tokaj-type wine materials

5. 1. Technological scheme for preparing Tokaj-type wine material by adding mash with pulp to alcohol

White and red grape varieties delivered to the plant are separately cleaned of infected and damaged berries (in a special apparatus), the bunches are washed (in warm water – 20–25 °C), dried, and subjected to subsequent processing. The main purpose of washing grapes is to remove medications and dust particles from the surface of the berries. This is done in order to produce environmentally friendly Tokaj wine. At the next stage, the grape bunches are separated from the ridge, the berries are pressed, and the resulting pomace is fermented for 3–4 days. Then the pulp is separated from the wort and the fermentation process continues. According to the developed method, Tokaj-type wine material is produced according to the scheme shown in Fig. 1.

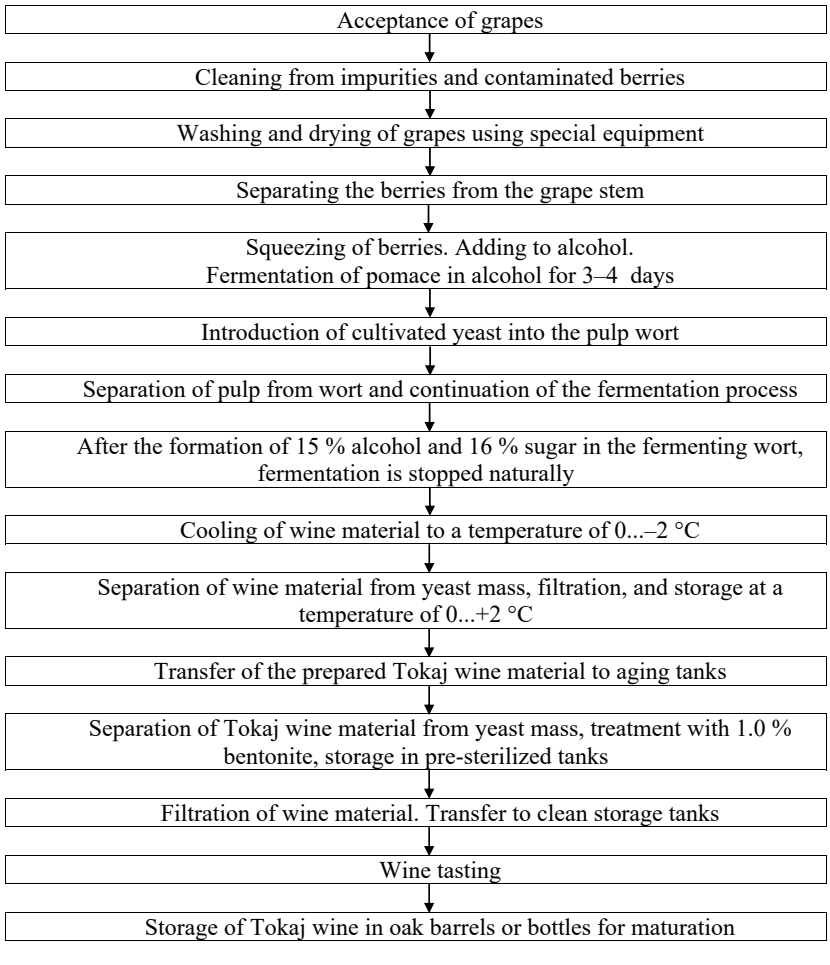

Fig. 1. Technological scheme for the production of wine material of the Tokaj type

The grapes are transported to the plant in boxes with a capacity of 10–15 kg. First, with the participation of laboratory workers, an average sample is taken, the sugar content

and acidity of the grapes are determined, and microbiological control is carried out. Then, on a conveyor belt, the grape bunches are cleaned of various impurities, diseased berries, washed with warm water (25–30 °C), and dried with air at a temperature of 35–40 °C.

It is known that currently, due to pollution of the ecosystem, various dust and impurities accumulated in the atmosphere under the influence of wind and rain settle on the surface of grapes. Even as a result of technogenic impact on the soil, toxic substances and heavy metals in the air enter the grapes. In addition, during the period from the formation of a bunch to the ripening of grapes, various chemical preparations are used against various diseases and pests that accumulate on the surface of the grape skin. This, of course, negatively affects the quality of, first, the must, and then the wine. The grapes are first washed with clean running water, dried with warm air, and then transferred for processing. When producing different types of wines, grapes are not washed. The main goal of this process is to produce environmentally friendly, high-quality wine that is beneficial for the human body by cleaning the grapes from impurities and chemicals.

At the next stage, the berries are separated from the ridge, squeezed out, freed from pulp, and the wort is sent to a tank for infusion. The grape must is cooled to a temperature of 0...–2 °C and stored for 12–15 hours.

The main purpose of cold treatment is to prevent the darkening of the wort and the settling of suspended particles. In this case, the activity of oxidative enzymes is slowed down or inhibited under the influence of low temperature. The main reason for the darkening of the wort is an increase in the activity of oxidative enzymes (ascorbate oxidase, polyphenol oxidase, peroxidase, etc.) [25].

An increase in enzyme activity in the wort creates conditions for more intensive decomposition of the beneficial substances contained in it. Therefore, it is considered more appropriate to store the wort cold. At this time, the wort becomes transparent, and suspended substances settle to the bottom of the tank. The partially clarified wort is separated from the yeast sediment and fed into fermentation tanks. Before fermentation, the wort is added to a predetermined amount of alcohol and subjected to the fermentation process.

In the fermentation process at wine industry enterprises, for white grape varieties, cultural yeast of the GVS-804 brand, manufactured in Germany, is used, and for red grape must, cultural yeast of the NT-50 brand, produced in France, is used [26]. Before fermentation, the specified cultural yeast is added to the wort in an amount of 1–1.5 %. The fermentation process is carried out in fermentation tanks under the control of a special operator at a temperature of 14–16 °C. During the fermentation period, the temperature is constantly adjusted. It is not practical to carry out the fermentation process at a relatively high temperature.

This is due to the fact that when the fermentation process is carried out at high temperatures (18–24 °C), the unique varietal aromatic substances and some useful components formed during the fermentation process evaporate. This negatively affects the aroma and taste of the wine produced. The process of natural fermentation stops when up to 15 % alcohol is formed in the fermenting wine material. The reason for this is that the wine material has a conservation coefficient of more than 80. Thus, up to 15 % natural alcohol and 16 % sugar remain in the wine material.

After fermentation stops, the upper part of the reservoir (container) is completely filled with the same wine. After some time, the young wine material is separated from the yeast sediment, filtered, and stored in other sterile, clean containers. At the next stage, Tokaj wine material, if necessary, is brought to a special condition by blending and stored in oak barrels or oak bottles for 1.5–3 years. During storage, care for Tokaji wine is carried out according to the instructions.

5. 2. Studying the quality indicators of Tokaj wine materials

Chemical and organoleptic indicators of Tokaj wine material using fully ripened grapes grown under the conditions of the Samukh and Goygol regions are given in Table 1.

To prepare Tokaj wine, the grape varieties Bayan-Shirey, Rkatsiteli, Cabernet Sauvignon and Madras, grown in the Samukh region, which is a flat zone of the country, and in the Goy-Gol region, relatively located in the foothills, were used. The data in Table 1 show that the amount of total sugar in grape varieties grown in the Samukh region is significantly higher than in the Goy-Gel region.

While the total sugar content in white and red grape varieties in the Samukh region was 21.6÷28.5 g/100 cm^3, in the same grape varieties grown in the foothills of the Goygol region, this figure was 18.5÷23.8 g/100 cm^3. It is known that for the preparation of sweet dessert wines, including Tokaj wines, the percentage of sugar in grapes must be significantly higher than for the production of table wines.

It is known that in the production of dessert wines, the fermentation process is artificially stopped by adding alcohol to the fermenting wort. When formed in fermenting wort, 14–15 vol. % alcohol, the natural fermentation process slowly stops. This means that Tokaj wine material contains up to 14–15 % alcohol and 16 % residual sugar.

During the research work, fermentation was carried out not by adding alcohol to the wort but by adding fermenting wort to the alcohol.

The Table 1 data clearly show that to prepare Tokaj wine material under the conditions of the Samukh region, wort obtained from individual grape varieties, previously added to alcohol, is added to fermentation tanks.

In addition, loss rates were calculated based on the contraction coefficient (0.08 %) during the co-fermentation of alcohol and wort. It was calculated that during the fermentation of wort obtained from Bayan-Shirey grapes with alcohol, the loss of alcohol amounts to 1 vol %. When fermenting wort obtained from Rkatsiteli grapes with alcohol, alcohol losses amount to up to 0.6 vol %. This figure for the Cabernet Sauvignon and Madras varieties, respectively, is 0.7 vol % and 0.8 vol %.

Thus, taking into account the contraction coefficient, Tokaj wine material retains 15 % alcohol and 16 % natural sugar. These indicators are identical to Tokaj wine material made under the conditions of the Gey-Gol region.

Table 1 shows that the percentage of sugar in grape varieties grown in the Goygol region is significantly lower compared to grape varieties grown in the Samukh region. While in grapes grown under the conditions of the Gey-Gel region the amount of total sugar is 18.5÷23.8 %, in the Samukh region this figure fluctuates between 21.6÷28.5 %.

Table 1

Qualitative indicators of Tokaj wine material prepared by fermenting wort from ripened white and red grapes with pulp in alcohol for 3–4 days

№	Indicator	Made from white grapes		Made from red grapes	
		Bayan-Shirey	Rkatsiteli	Cabernet Sauvignon	Madrasa
Samukh district					
1	Total grape sugar, g/100 cm^3	21.6	28.5	27.8	24.3
2	Alcohol pre-added to the wort, vol %	12.5	7.8	8.3	10.6
3	Accounting for the contraction ratio (k=0.08), %	11.5	7.2	7.6	9.8
4	Alcohol loss during contraction, %	1.0	0.6	0.7	0.8
5	Alcohol yield in wine material, vol %	3.5	7.8	7.4	5.2
6	Alcohol in Tokaj wine material, vol % (total)	15.0	15.0	15.0	15.0
7	Sugar in Tokaj wine material, g/cm^3	16.0	16.0	16.0	16.0
8	Titratable acidity, g/dm^3	6.4	5.8	6.0	6.2
9	Volatile acidity, g/dm^3	0.38	0.40	0.40	0.44
10	Active acidity, g/dm^3	3.1	3.2	3.2	3.3
11	Extractivity, g/dm^3	36.2	36.1	39.4	41.2
12	Phenolic compounds, g/dm^3	0.61	0.64	0.78	0.82
13	Methyl alcohol, g/dm^3	0.21	0.24	0.32	0.27
14	Assessment, in points	8.7	9.5	9.2	9.3
Goy-Gola District					
1	Total grape sugar, g/100 cm^3	18.5	23.4	23.8	21.5
2	Alcohol pre-added to the wort, vol %	14.6	11.3	11.1	12.6
3	Accounting for the contraction ratio (k=0.08), %	13.4	10.4	10.2	11.6
4	Alcohol loss during contraction, %	1.0	0.6	0.7	0.8
5	Alcohol yield in wine material, vol %	1.6	4.6	4.8	3.4
6	Alcohol in Tokaj wine material, vol % (total)	15.0	15.0	15.0	15.0
7	Sugar in Tokaj wine material, g/cm^3	16.0	16.0	16.0	16.0
8	Titratable acidity, g/dm^3	7.1	6.4	6.5	6.8
9	Volatile acidity, g/dm^3	0.38	0.40	0.36	0.34
10	Active acidity, g/dm^3	3.2	3.3	3.2	3.3
11	Extractivity, g/dm^3	37.1	39.2	40.4	42.1
12	Phenolic compounds, g/dm^3	0.62	0.65	0.84	0.90
13	Methyl alcohol, g/dm^3	0.22	0.23	0.34	0.37
14	Assessment, in points	8.2	8.8	9.0	9.2

In Tokaj wine materials prepared from grape varieties grown under the conditions of the Samukh region, the content of titratable or total acidity was 5.8÷6.4 g/dm^3. In wines made from grape varieties grown under the conditions of the Goy-Gol region, this indicator varied within the range of 6.4÷7.1 g/dm^3. Titratable acidity plays a big role in the formation of wine, its unique taste and aroma. Therefore, it is important that all wines, including Tokaj-type wines, contain natural grape acids in accordance with the norm. The total acidity in the composition of the prepared Tokaji wines corresponded to the norm.

Volatile acidity also affects the quality of the wines produced. Volatile acidity in wine is characterized by the oxidation of predominantly ethyl alcohol formed during the fermentation process. It is known that 80–90 % of volatile acids consist of acetic acid, the content of which in wine is undesirable. The high content of volatile acids in wine negatively affects its quality. This is due to the fact that volatile acids (acetic, propionic, valeric, butyric) are highly toxic.

These acids are formed due to improper fermentation process, pre-oxidation, and other factors. In Tokaj-type wines prepared using this technology, the content of volatile acids is significantly lower than the norm. It should also be noted that the content of volatile acids in table wines is higher than in fortified and dessert wines. Wines with a high alcohol content have very low volatile acid content. While the volatile acidity content of wines prepared under the conditions of the Samukh region was in the range of 0.38÷0.44 g/dm^3, then this indicator in wines prepared under the conditions of the Goy-Gol region decreased comparatively lower and amounted to 0.34÷0.40 g/dm^3. The active acidity (pH) of Tokaj-type wines prepared using the proposed technology in both regions ranged from 3.1÷3.3, which corresponds to the norm.

The prepared wine materials are also rich in extractives and phenolic compounds. The data in Table 1 show that in wine materials prepared from red grape varieties, the volume of extractives and phenolic compounds is significantly higher than in wine materials prepared from white grape varieties [27, 28].

While the volume of extractive substances in the wine material prepared from the Bayan-Shirey and Rkatsiteli grape varieties, including total sugar, was 36.2–38.1 g/dm^3, in the wine material prepared from the Cabernet Sauvignon and Madras grape varieties this figure was respectively 39.4 and 41.2 g/dm^3. The volume of phenolic compounds in

wine materials prepared from white grape varieties was 0.58–0.54 g/100 cm^3, and in wine materials prepared from red grape varieties this figure was relatively high – 0.78–0.82 g/100 cm^3.

These indicators, compared to the Samukh region, were relatively high in the Goygol region. The volume of extract in wine materials prepared from grape varieties grown in the Samukh region was 36.2÷41.2 g/dm^3. And in wines made from grape varieties grown under the conditions of the Goygol region, this figure ranged from 37.1÷42.1 g/dm^3. Differences in these indicators by region depend on the specific characteristics of the variety, soil and climatic conditions and other factors [29].

Phenolic compounds are known to have high antioxidant, antimicrobial and even antiviral properties. Phenolic compounds influence mainly the fullness of wine, the enrichment of aromatic substances, long-term quality storage, as well as the slowing down or cessation of the activity of oxidative enzymes.

As can be seen from the data in Table 1, the volume of methyl alcohol in the prepared Tokaj wine materials is significantly less than the norm (0.22÷0.32 g/dm^3), and this is a positive result of the study. The content of methyl alcohol in wines prepared from white grape varieties was 0.22÷0.23 g/dm^3, and in wines prepared from red grape varieties this figure was relatively higher – 0.34÷0.37 g/dm^3. This means that red grape varieties have higher pectin content than white varieties [30].

As a result of the tasting, wine material prepared from the Bayan-Shirey grape variety in the Samukh region was rated 8.7 points, from the Rkatsiteli variety – 9.5 points, and wine material prepared from red grape varieties – 9.2 and 9.3 points, respectively. These indicators significantly exceeded the assessment of wine materials prepared under the conditions of the Goy-Gol region. Thus, wine material prepared from the Bayan-Shirey grape variety is rated 8.2 points, from Rkatsiteli – 8.8 points, from Cabernet Sauvignon – 9 points, from Madrasa – 9.2 points.

6. Discussion of experimental results from a study on the possibility of using grape varieties for the production of Tokaj-type wine materials

The preparation of high-quality Tokaj wine requires the intelligent development of wine preparation technology using local raw materials rich in nutrients. This is only possible if wine material is produced from raw materials with the required condition and using innovative technology (Fig. 1).

When preparing Tokaj wine materials, the grape clusters are left on the vine for more than 12 days. During this time, the sugar content in the berries artificially reaches 40 %. However, during this time, many bunches dry out and fall to the ground, and the content of the components of the chemical composition of the berries decreases due to their use for metabolic processes. According to the new technology, the grapes used to prepare wine material are withered for 4–5 days. This period is enough to achieve the required volume of sugar and nutrients. Continuing withering is not advisable since enzyme activity increases, and important nutritional components of the berries decompose. According to Fig. 1, using new technology, grapes are washed and dried, then submitted for processing. This is a very important point because environmentally friendly products should not contain any foreign compounds [3]. Vineyards are located along highways, and therefore, car exhaust gases, radioactive compounds from industrial emissions and other elements settle on the berries. The preparation of wine material from such grapes increases the risk of the formation of many diseases and malignant tumors. According to traditional technology, sulfur dioxide is used to clarify the wort but in the new technological scheme this component is eliminated, and bentonite is added in a small volume (1 %). Bentonite is a type of montmorillonite clay widely used as a grinding agent. It is used to clarify juices and wines, remove heat-resistant proteins, and limit copper formation. In addition, cooling the wort to 0...–2 °C promotes the sedimentation of suspended particles, protein components, and clarification of the wort.

When wort is added to alcohol, it is enriched with important nutritional components, mainly phenolic compounds, which are inhibitors of oxidative enzymes. As a result of fermentation, after the formation of 14–15 % alcohol and 16 % sugar, the process stops naturally. This is the necessary condition for making sweet dessert wines. The use of grape varieties that have been withered for 4–5 days and are ripe makes it possible, without adding alcohol to the wort, thanks to the sugar collected to the desired standard, to achieve the alcohol and sugar standards for preparing wine materials. Made from environmentally friendly wine materials, Tokaj wine surpasses other dessert wines in aroma, taste, and typicality. The formation of the honey aroma of Tokaj wines involves the phenyl ester of acetic acid and some terpene compounds [13]. Due to their high antioxidant and antimicrobial properties, prepared dessert wines help remove free radicals from the human body [17].

Analysis of studies into the quality indicators of wine material prepared from white grape varieties grown in the Samukh region shows that the total sugar content is 21.6÷28.5 g/100 cm^3, and in wine material prepared from white grape varieties grown in the Goygol region is 18.5÷23.4 g/100 cm^3. In wine material prepared from red grape varieties grown under the conditions of the Samukh region, the total sugar content was 24.3÷27.8 g/100 cm^3, and under the conditions of the Goy-Gel region this figure was equal to 21.5÷23.8 g/100 cm^3. It is known that for the preparation of sweet dessert wines, including Tokaj wines, the percentage of sugar in grapes must be significantly higher than for the production of table wines. When producing sweet dessert wines from the grape varieties used, along with a higher content of extractive substances, the percentage of sugar should be higher. This is mainly due to the fact that dessert wines, including Tokaji, must contain between 16 and 20 % sugar.

In addition, the norms of alcohol loss were calculated based on the contraction coefficient (0.08 %) during the joint fermentation of alcohol and wort. It was calculated that during the fermentation of wort obtained from Bayan-Shirey grapes with alcohol, the loss of alcohol volumes to 1 vol %. The loss of alcohol during fermentation of the must obtained from Rkatsiteli grapes with alcohol volumes to 0.6 vol %. The alcohol loss for the Cabernet Sauvignon and Madrasa varieties, respectively, was 0.7 vol % and 0.8 vol %. Thus, studies have shown that, taking into account the contraction coefficient, Tokaj wine material retains 15 vol % alcohol and 16 % natural sugar. These indicators were identical to Tokaj wine material prepared from grape varieties grown under the conditions of the Gey-Gol region.

From the analysis of Table 1 it was revealed that in Tokaj wine materials prepared from grape varieties grown under

the conditions of the Samukh region, the content of titratable or total acidity was 5.8÷6.4 g/dm^3. In wine materials prepared from grape varieties grown under the conditions of the Goy-Gol region, this indicator varied within the range of 6.4÷7.1 g/dm^3. Titratable acidity plays a big role in the formation of wine, its unique taste and aroma. Therefore, it is important that all wines, including Tokaj-type wines, contain natural acids in accordance with the norm. The results made it possible to conclude that in wine materials prepared using the proposed technology, the total acidity corresponds to the norm.

Volatile acidity is also one of the important indicators of dessert wines. Volatile acidity in wine is characterized by the oxidation of predominantly ethyl alcohol formed during the fermentation process. It is known that 80–90 % of volatile acids are represented by acetic acid, the content of which in wine leads to negative consequences. The high content of volatile acids in wine negatively affects its quality. This is due to the fact that volatile acids (acetic, propionic, valeric, butyric) are highly toxic. These acids are formed due to improper fermentation process, pre-oxidation, and other factors. In Tokaj-type wines prepared using the proposed technology, the content of volatile acids is significantly lower than the norm. It should also be noted that the content of volatile acids in table wines is higher than in fortified and dessert wines. Wines with a high alcohol content have very low volatile acid content. From the results of the study, the volatile acidity of wine materials prepared under the conditions of the Samukh region was in the range of 0.38÷0.44 g/dm^3, and under the conditions of the Gey-Gol region it decreased and amounted to 0.34÷0.40 g/dm^3. The active acidity (pH) of Tokaj-type wine materials prepared using the proposed technology from white grape varieties grown under the conditions of the Samukh region varied within 3.1÷3.2. In wine materials of red grape varieties, active acidity varied within the range of 3.2÷3.3. Under the conditions of the Goygol region, the indicators coincided, and no sharp changes were found.

From the results of studying the extractivity of prepared wine materials (Table 1), it became clear that they are rich in extractives and phenolic compounds. In wine materials prepared from red grape varieties, the volume of extractives and phenolic compounds is significantly higher than in wine materials prepared from white grape varieties. The volume of extractives in wine material prepared from the Bayan-Shirey and Rkatsiteli grape varieties was 36.1–39.2 g/dm^3. In wine material prepared from Cabernet Sauvignon and Madrasa grape varieties, this figure was 39.4 and 42.1 g/dm^3, respectively. The volume of phenolic compounds in wine materials prepared from white grape varieties was 0.61÷0.65 g/100 cm^3, and in wine materials prepared from red grape varieties this figure was relatively high – 0.78–0.90 g/100 cm^3.

The content of phenolic compounds in wine materials prepared from grape varieties grown in the Samukh region was relatively higher than in the Goygol region. Differences in these indicators by region depend on the specific characteristics of the variety, soil and climatic conditions and other factors [18].

It is known that phenolic compounds have high antioxidant, antimicrobial and even antiviral properties [15]. Phenolic compounds influence mainly the fullness of wine, the enrichment of aromatic substances, long-term quality storage, as well as the slowing down or cessation of the activity of oxidative enzymes. Fermentation of the wort with pulp in alcohol contributes to the enrichment of the wort with extractive substances, especially phenolic compounds. Removal of grape skins and seeds during processing removes most of the procyanidins and anthocyanins, and subsequent clarification and filtration treatments further reduce the anthocyanin content. Therefore, in the technological process, the clarification of wort with fining substances was replaced by cold treatment [3].

Analysis of the quantitative determination of methyl alcohol in prepared Tokaj wine materials showed that its content is significantly less than the norm (0.22÷0.32 g/dm^3), which shows the correct choice of technology and mode of preparation of wine materials. The content of methyl alcohol in wines prepared from white grape varieties grown in both regions was 0.21÷0.24 g/dm^3, and in wines prepared from red grape varieties this figure was slightly higher and amounted to 0.27÷0.37 g/dm^3. This is due to the fact that red grape varieties contain more pectin than white varieties. When the enzyme pectin esterase is activated, pectin is broken down into polygalacturonic acid and methyl alcohol.

As a result of the tasting, wine material prepared from the Bayan-Shirey grape variety in the Samukh region was rated 8.7 points, from the Rkatsiteli variety – 9.5 points, and wine material prepared from red grape varieties – 9.2 and 9.3 points, respectively. These indicators significantly exceeded the assessment of wine materials prepared under the conditions of the Goy-Gol region. Thus, wine material prepared from the Bayan-Shirey grape variety is rated 8.2 points, from Rkatsiteli – 7.8 points, from Cabernet Sauvignon – 9.0 points, from Madrasa – 9.2 points.

Thus, to prepare high-quality wine materials, it is recommended to use Rkatsiteli and Cabernet Sauvignon grape varieties grown in low-lying areas.

According to Hungarian technology, to produce Tokaji-type wines, bunches of white and red grape varieties are rolled on the vine. They wither for a certain period of time and then are sent for processing. At the same time, the percentage of sugar in grapes artificially increases due to the evaporation of moisture. The percentage of sugar in pre-dried grapes should be in the range of 40–45 %. To produce Tokaji-type wines, grape must is fermented naturally without the addition of alcohol or other ingredients. After formation in the wort 14–16 vol % alcohol, the fermentation process stops naturally. According to the proposed technology, for the production of high-quality wine materials, it is advisable to use only ripe or slightly wilted grapes.

It should be noted that the correct selection and successful practical use of raw materials will in the future be an incentive to improve the relevant technological parameters for the production of Tokaj wine to achieve greater preservation of nutritional components.

An environmentally friendly, high-quality product is an indispensable indicator. Process parameters must be improved to accommodate the use of high nutritional value raw materials to limit added foreign components. This variety will further expand the range of sweet dessert wines.

The development of new technological methods using local grape varieties rich in nutrients, especially sugars, extractives, and phenolic compounds, will allow us to modernize existing technologies for providing the population with environmentally friendly products.

To prepare environmentally friendly Tokaj-type wine material using the proposed technology, special equipment is required for cleaning, washing, and drying grapes, which

large wineries are equipped with. However, it should be noted that at medium and small enterprises, providing such equipment requires additional labor and costs, which ultimately affects the price of the finished product. Compared to other products, organic products are expensive on the market. Such shortcomings are also inherent in this study. However, as statistics show, in the near future the population's demand for environmentally friendly products will increase, and products of unknown origin will be replaced on the market with new organically pure products.

7. Conclusions

1. A technological scheme for the production of Tokaj wine materials has been developed. According to this technology, on a conveyor belt, bunches of grapes are cleaned of various impurities and contaminated berries, washed with warm water (25–30 °C) and dried with air at a temperature of 35–40 °C. Then the berries are separated from the ridge, squeezed, separated from the pulp, and the wort is sent to a tank for infusion. The grape must is cooled to a temperature of 0...–2 °C and stored for 12–15 hours. The partially clarified wort is separated from the yeast sediment and fed into fermentation tanks. Before fermentation, the wort is added to alcohol and subjected to the fermentation process. For fermentation, cultivated yeast of the GVS-804 brand for white grape varieties and NT-50 brand for red grape varieties were used. Before fermentation, the specified cultural yeast is added to the wort in a volume of 1–1.5 %. The fermentation process is carried out in controlled fermentation tanks at a temperature of 14–16 °C. During the fermentation period, the temperature is constantly adjusted. After the formation of 15 % alcohol in the wine material, fermentation stops. Up to 15 % natural alcohol and 16 % sugar remain in the wine material. After fermentation stops, the upper part of the reservoir (container) is completely filled with the same wine. After some time, the young wine material is separated from the yeast sediment, filtered, and stored in other sterile, clean containers. At the next stage, Tokaj wine material, if necessary, is brought to a special condition by blending and stored in oak barrels or oak bottles for 1.5–3 years. During storage, care for Tokaji wine is carried out according to the instructions.

2. It has been established that when choosing raw materials, it is important to take into account the cultivation area. The total sugar content in white and red grape varieties in the Samukh region was 21.6÷28.5 g/100 cm^3, and in the same grape varieties grown in the foothills of the Goygol region, this figure was 18.5÷23.8 g/100 cm^3. During the study, the alcohol content in Tokaj wine material reached 14–15 % and residual sugar 16 %. According to the proposed technology, fermentation was carried out not by adding alcohol to the wort but by adding fermenting wort to alcohol, the volume of which was calculated in advance according to the contraction coefficient. In grape varieties grown in the Samukh region, the sugar content was much higher than in the Goygol region. Therefore, the consumption of alcohol for the fermentation of must from grapes grown in the Samukh region was less than in the Goygol region. In addition, loss rates were calculated based on the contraction coefficient (0.08 %) during the co-fermentation of alcohol and wort. It was calculated that when fermenting wort obtained from Bayan-Shirey grapes with alcohol, alcohol losses volume to up to 1 vol %, while fermenting wort obtained from Rkatsiteli grapes with alcohol, alcohol losses volume to 0.6 vol %. This figure for the Cabernet Sauvignon and Madrasa varieties was 0.7 vol % and 0.8 vol %, respectively. Taking into account the contraction coefficient, Tokaj wine material retained 15 % alcohol and 16 % natural sugar. In Tokaj wine materials prepared from grape varieties grown under the conditions of the Samukh region, the content of titratable or total acidity was 5.8÷6.4 g/dm^3. In wines made from grape varieties grown under the conditions of the Goy-Gol region, this indicator varied within the range of 6.4÷7.1 g/dm^3. Titratable acidity is an important indicator of raw materials and wine as it plays a huge role in the formation of the bouquet and taste of wine.

Volatile acidity in wine material prepared from the Bayan-Shirey grape variety was 0.38 g/dm^3, from the Rkatsiteli grape variety – 0.40 g/dm^3, from the Cabernet Sauvignon variety – 0.40, and from the Madrasa variety – 0.44 g/dm^3.

The active acidity (pH) of Tokaj-type wines prepared using the proposed technology in both regions ranged from 3.1÷3.3, which corresponds to the norm. The volume of extractive substances in wine materials prepared from Bayan-Shirey and Rkatsiteli grape varieties was 36.2–38.1 g/dm^3, in wine materials prepared from Cabernet Sauvignon and Madrasa grape varieties this figure was 39.4 and 41.2 g/dm^3, respectively. The volume of phenolic compounds in wine materials prepared from white grape varieties was 0.58–0.54 g/100 cm^3, and in wine materials prepared from red grape varieties this figure was relatively high – 0.78–0.82 g/100 cm^3. The data obtained in comparison with the Samukh region were relatively high in the Goygol region. The volume of extractives in wine materials prepared from grape varieties grown in the Samukh region was 36.2÷41.2 g/dm^3, and in wines prepared from grape varieties grown in the Goygol region, this figure varied within 37.1÷42.1 g/dm^3. It has been established that differences in these indicators by region depend on the specific characteristics of the variety, soil and climatic conditions and other factors. The results of the tasting showed that wine material prepared from the Bayan-Shirey grape variety in the Samukh region is rated 8.7 points, from the Rkatsiteli variety – 9.5 points, and wine material prepared from red grape varieties – 9.2 and 9.3 points, respectively. These indicators significantly exceeded the estimates of wine materials prepared under the conditions of the Gey-Gol region. Thus, wine material prepared from the Bayan-Shirey grape variety is rated 8.2 points, from Rkatsiteli – 7.8 points, from Cabernet Sauvignon – 9.0 points, from Madrasa – 9.2 points.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

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Data availability

All data are available in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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