UDC 663.3
DOI: 10.15587/1729-4061.2025.326471

IDENTIFYING THE FACTORS AFFECTING THE PREPARATION OF WINE MATERIAL FROM CHERRY FRUITS

Hasil Fataliyev
Doctor of Technical Sciences, Professor*
Muhammad Mammadzade
PhD Student**
Mehman Ismayılov
Doctor of Philosophy in Engineering, Associate Professor**
Natavan Gadimova
Corresponding author
Candidate of Technical Sciences, Associate Professor
Department of Engineering and Applied Sciences
Department of Food Engineering
Azerbaijan State University of Economics (UNEC)
Istiqlaliyyat ave., 6, Baku, Azerbaijan, AZ 1001
E-mail: natavan.qadimova@mail.ru
Naila Mammadova
Assistant*
Teymur Musayev
PhD, Associate Professor
Scientific Research Institute of Viticulture and Winemaking
Ministry of Agriculture of the Republic of Azerbaijan
20 January str., 16, Absheron, Azerbaijan, AZ 0118
*Department of Food Engineering and Expertise
Azerbaijan State Agricultural University (ASAU)
Ataturk str., 450, Ganja, Azerbaijan, AZ 2000
**Department of Food Engineering and Expertise
Azerbaijan Technological University (ATU)
Shach Ismail Khatai ave., 103, Ganja, Azerbaijan, AZ 2011

The object of the study is wine material obtained from cherry fruit grown in the Goranboy, Goygol and Ganja regions of Azerbaijan. Although several studies have been conducted regarding the production of juice and wine from cherries, the variation in the mechanical composition of the fruit and the juice and wine produced from it, depending on the conditions in which the plant is cultivated, has not been studied.

The Brix value of the juice obtained from the fruits was the lowest in Goygol (16.0), the highest in Goranboy (18.5), and the intermediate value was 16.9 in Ganja. The antioxidant content was highest in the Ganja sample (37.4 TEAC mmol/l), followed by Goranboy (28.3 TEAC mmol/l), and Goygol (20.0 TEAC mmol/l). When looking at the monomer anthocyanins, the lowest value was in Ganja (350 mg/l), followed by Goygol (366 mg/l), and Goranboy had the highest value (548 mg/l).

The physical-chemical composition of the wine samples, as well as the quality and quantity of volatile compounds, were studied. The highest of dry matter content was in Goranboy (76.7 g/dm^3), the lowest in Goygol (38 g/dm^3), and the intermediate value in Ganja (51.3 g/dm^3). This can be attributed to the soil and climatic conditions of these regions. Goranboy is located in a hotter arid region, which results in higher dry matter content in the fruits compared to the other two regions. Ganja, located in a semi-mountainous area, has a more moderate climate compared to Goranboy, while Goygol, primarily situated in a mountainous region, is known for its cold winters and cool summers. All these differences are reflected in the products obtained from the fruit plants grown in these areas.

The results obtained can be used by family farms and winemaking enterprises

Keywords: juice, wine material, cherry, cultivated conditions, seed, aroma profile, skin

Received 21.01.2025
Received in revised form 17.03.2025
Accepted date 02.04.2025
Published date 29.04.2025

How to Cite: *Fataliyev, H., Mammadzade, M., Ismayılov, M., Gadimova, N., Mammadova, N., Musayev, T. (2025). Identifying the factors affecting the preparation of wine material from cherry fruits. Eastern-European Journal of Enterprise Technologies, 2 (11 (134)), 77–88. https://doi.org/10.15587/1729-4061.2025.326471*

1. Introduction

Considering that the produced grapes are mainly used fresh, as well as for the production of juice, wine, and brandy wine material, it becomes clear that the production of various drinks, including wine and brandy, is of great importance. Another factor contributing to this is the significant decrease in grape production compared to the 1980s. All of this highlights the importance of utilizing other raw material resources. From the perspective of wine tourism, it is also evident that producing drinks with different taste characteristics from various raw materials suitable for each region is of significant value.

Globally, and especially in our country, fruit winemaking has not yet developed sufficiently. However, considering the role of fruit plants in agriculture, the variety of varieties, and the growth in production, it is expected that there will be substantial development in this direction in the near future. The ecological conditions provide significant advantages for producers in fruit cultivation, resulting in an annual increase in production volume. In some years, the high productivity observed in fruit production is accompanied by the accumulation of excess products after consumption and realization. Some of the produced fruits, which cannot be consumed fresh, gain importance for their use in wine and other drinks.

Cherry is one of the fruit plants grown in private households, farms and large gardens. The fact that it can grow in any conditions is one of the conditions that create the basis for its widespread distribution. Growing this fruit plant in lowland, foothill and mountainous areas allows for the production of products with different varieties and organoleptic properties. Jams, juices, liqueurs, etc. are mostly prepared from it in everyday life.

Based on the above, it is possible to note that these studies dedicated to the study of the mechanical composition indicators of this fruit, which has found wide application in everyday life and in the processing industry, and the study of the changes in the physicochemical composition of wines made from it depending on the conditions of cultivation, are relevant.

2. Literature review and problem statement

The article [1] presents the results of a study on the influence of filtration speed and processing operations on the quality of cherry juice. Some quality control analyses were conducted on simply pressed, depectinized and depectinized cherry juices that were clarified. Some losses in the chemical composition of cherry juice during processing were found. However, it was determined that the best product in terms of light transmission, taste, and transparency was cherry juice that was depectinized and clarified. However, such issues as the study of the mechanical composition of fruits and juices prepared from them depending on the growing conditions of the plant have not been studied.

An organoleptic analysis [2, 3] of vinegars obtained from cherries in two different ways was carried out, with the aim to identify the best product. It was shown that the fruit taste, aroma and smell were better perceived in the cherry vinegar prepared in the traditional way, the color showed a turbidity due to the fermentation time. But such an important issue as determining the indicators of the physical and mechanical composition of cherry fruits remained unresolved.

The articles [4, 5] examined the effects of cherries, cherries, and cranberries on human health using clinical studies. For this purpose, a literature review was conducted and 27 international clinical studies on the topic were included. The results showed that red fruits of the cherry group may have antioxidant, antidiabetic, hypolipidemic, hypertensive and cardioprotective effects, as well as significant effects on sleep and mood.

The article [6, 7] studies the effect of production and storage periods of cherry juice on antioxidant substances. During production and storage, there is a significant decrease in antioxidant substances that determine the functional properties of this product. It was found that the losses of the sum of anthocyanins and phenolic compounds during the production and storage of cherry juice amount to 35–61 % and 0.8–16 %, respectively. But such an important question as determining the mechanical composition of cherries remained unresolved.

The article [8, 9] presents the results of a study on neutralizing the acidity of cherry juice. It is shown that neutralization using calcium hydroxide and potassium carbonate leads to a change in the chemical composition and organoleptic properties of the juice. However, when using calcium carbonate, the above-mentioned disadvantages are not observed.

In the works [10, 11] cherry juice was treated with ultrasound at different temperatures (20 °C, 30 °C, 40 °C), different genetic values (50 %, 75 %, 100 %), and different times (2 min, 6 min, 10 min). The antioxidant values of cherry juice were determined and modeling was performed. However, the physical and mechanical compositional parameters of cherry fruit, as well as other compositional parameters of juice and wine samples obtained from it, have not been studied.

The article [12] shows the effect of heating, boiling and microwave treatment on some properties of cherry juice. It is shown that all types of treatment did not have a statistical effect on the total monomeric anthocyanin content and the polymeric color ratio. It was found that the use of microwaves can be an alternative heating method to conventional heating for the preparation of homemade cherry juice.

The article [13] presents the results of treating cherry fruits with salicylic acid and chitosan. It was found that the mass loss in cherry fruit treated with salicylic acid solution was 3.5–3.4 %; with the combined effect of salicylic acid and chitosan, it was reduced by 2.7–3 %.

Cherry is one of the most important stone fruit crops in Lebanon [14]. Some varieties suffer greatly from the influence of altitude in terms of maturity index. The development period of the fruit increases with altitude, and in many cases higher fresh weight and size are observed. However, the firmness of the fruits decreases. The total amount of phenolic compounds and the reduction of iron complexes are interestingly dependent on geographical conditions. The total amount of anthocyanins and the radical scavenging activity remain unchanged, unlike the previous ones.

There are studies [15] where differences in the types of volatiles substances were found in different extracts of Portuguese cherry. It is shown that they have great potential for use as nutriseptics in pharmaceutical, cosmetic and food industries.

In the work [16] conducted in the cherry orchard, without the use of chemicals showed that the weight of the fruit was 10.41 g, the weight of the seeds was 0.50 g, the weight of the stem was 0.12 g, and the length of the stem varied from 43.0 to 48.4 mm. While the fruit width was 27.2 mm, the fruit length was determined to be 24.9 mm. However, the ratio of breaking strength to mass and the surface area of the fruit in cherry fruits have not been studied.

In the studies [17] the physical and mechanical properties of the Istanbul cherry variety were determined. The length, width, thickness and average dimensions of the fruit diagram were as follows: 19.02, 17.23, 16.68 and 17.56 mm. The single product weight, roundness, bulk density of the grain, single fruit volume, surface area and porosity were as follows: 3.76 g, 92.41 %, 630 kg/m^3, 963.44 kg/m^3, 3.72 cm^3, 9.72 cm^2, 34.54 %. However, the changes in the physical and mechanical properties of the fruit depending on the conditions in which it is grown have not been studied.

The article [18] examined cherries from 5 different maturity groups depending on color and size. However, fruit weight remained approximately the same after 4 stages. Increasing fruit maturity resulted in a decrease in the fruit separation strength values as follows. This decrease occurred between 4.25 and 1.78 N. The results showed that maturity groups 3 and 5 were critical for harvesting. However, the changes in the characteristics of cherry fruit depending on the conditions in which it is cultivated have not been studied.

From the above, it is clear that the physical and mechanical properties of cherry fruits change depending on the growing conditions. The location of the structural parts of cherry fruits in the total mass of the fruit, as well as the changes in the juice and wine obtained from cherry fruits depending on the growing conditions of the fruit, have not been sufficiently studied. In addition, the quantitative and qualitative composition of volatile components in cherry wine samples depending on the growing conditions of the fruit has not been sufficiently studied.

3. The aim and objectives of the study

The aim of the study is to identifying the influence of growing conditions on physical and mechanical composition of cherry fruits and wine material samples obtained from them. This will allow the results to be used in wine production.

To achieve this aim, the following objectives are achieved:

– to determine the physical and mechanical composition of cherry fruit depending on the growing conditions;

– to determine the physical and chemical composition of the obtained juice and wine samples;

– to determine the qualitative composition and quantity of volatile compounds in wine samples.

4. Materials and methods

The object of the study is wine material obtained from cherry fruit. The main idea of the study is to determine the physical and mechanical properties of cherry fruits grown in different regions, to study the changes in the physical and chemical composition, volatile compounds, and the amount of aromatic substances of juices and wines obtained from the fruits depending on the region of cultivation. The application of modern analysis methods serves to greatly simplify the issues in the study.

A SHİNKO Instruments hand-held dynamometer with a capacity of 2 kg and an accuracy of 0.01 kg is used to determine the breaking strength of the fruit.

The length (L), width (W), thickness (T), stem length, and stem width of the fruit are measured with a Mitutoyo digital compass with an accuracy of 0.01 mm.

The mass of the fruit is measured with a Denver Instrument digital analytical balance with a capacity of 120 g and an accuracy of 0.001 g.

The hardness of the fruit pulp is determined using a hand-held penetrometer. It has a maximum capacity of 196 N and an accuracy of 0.05 N. A 4 mm tip is used in the hand-held penetrometer.

A cylindrical container with a volume of 0.00124 m^3 with an open top and bottom is used to measure the volumetric weight of the fruit.

The real volumetric weight of the fruits is carried out using a cylindrical measuring container with a volume of 100 ml.

The hydrodynamic properties of the fruits (sharp speed in water, gravity, friction in water and lifting force) are measured using a 600 mm high container with a surface of 250×250 mm, a water tank and a camera with a resolution of 1792×828.

The experiments are carried out with samples collected from 5 randomly selected cherry trees. To determine the strength of the fruit to be broken off from the branch, a total of 200 cherry samples, ten each from the north, south, west and east sides of each tree, are torn off from the branches using a hand dynamometer. The indicator reflected on the dynamometer at the moment of breaking off is recorded. First, the fruits are torn off from the branch of the tree with a hand dynamometer and the strength of the stem to be broken off from the branch is determined. Then, cherry samples with the same stem are torn off by holding them by the stem with a hand dynamometer and the strength of the fruit to be broken off from the stem is determined. Fruits that break off without a stem (fruit-stem) and fruits that break off with a stem (stem-branch) are numbered and labeled. The fruit breaking strength (q) of each cherry tree in the experiment is divided by the fruit mass (g) and its ratio is found. Fruits collected with stems and without stems are transported in special boxes to avoid mechanical loss during transportation. The boxes are fitted with shock-absorbing box spacers. The fruit samples are kept in a refrigerator at 4 °C during the tests.

In order to determine the moisture content of cherry fruit, 30 fruits are divided into two without separating them and without removing the seeds and kept in a drying cabinet at a temperature of 72 °C until they reach a constant mass. The following formula is used to determine the moisture content:

$$\text{Humidity},\% = \frac{W_0}{W} \times 100, \tag{1}$$

where W_0 – mass of wet product, g; W – mass of dry product, g.

In the cherry samples taken for the experiment, the length, width, thickness, stem length and stem width of a total of 120 cherries, including physical damage such as rot, are measured with a digital compass that can measure with a precision of 0.01 mm. The average diagram, roundness (%) and surface area value for cherry fruits are determined using a special formula.

In order to determine the shadow area of a total of 40 fruits, 20 with stems and 20 without stems, photographs are taken of each fruit without stems on 2 main axes and each fruit with stems on a single axis with 1 cm^2 calibration surfaces and analyses are performed using the Image Tool 3.0 imaging program.

The average shadow area for fruits without stems is determined by the following formula:

$$A_{\text{sh.a.a.v.}} = \frac{A_{k_1} + A_{k_2}}{2}, \tag{2}$$

where $A_{\text{sh.a.a.v.}}$ – the average value of the shadow area, m^2; A_{k1} and A_{k2} – the areas of the fruit on the two main axes.

To determine the ratio of the fruit pulp to the amount of seeds, the fruit and seed masses of 150 randomly selected fruits are weighed one by one on a digital analytical balance with an accuracy of 0.001 g. Then, the fruit mass is divided by the seed mass and the fruit pulp/seed ratio is calculated.

To determine the firmness of the fruit pulp, a total of 30 fruits are measured using a 4 mm cylindrical tip on a hand-held penetrometer, 30 fruits are measured along the x-x axis (abscissa axis) and 30 fruits along the z-z (diagram length) axis.

Digital precision scales with a sensitivity of 0.001 g are used to determine the volume mass of the harvest. The cylindrical container with the determined volume is filled and its mass is determined. Measurements of fruits with and without stems are performed separately in 3 repetitions.

To determine the real volumetric mass, measurements are carried out using a cylindrical vessel with a volume of 100 ml. Distilled water is poured into a cylindrical container up to the level of 50 ml, and with the help of a thin wire, the fruits are placed in the water one by one. Thus, the volume of the fruit and its real volume mass are calculated according to the formula based on the mass of water displaced by each fruit.

When determining porosity, it is important to know that this property is related to the volume mass of the collection and the real volume mass of the material, and reflects the amount of voids when collecting the material:

$$\varepsilon = \left(1 - \frac{P_b}{P_f}\right) \cdot 100, \quad (3)$$

where ε – porosity, %; P_b – weight of volume, kg/m^3; P_f – real mass volume, kg/m^3.

A water tank consisting of a container with a size of 250×250 ml and a height of 600 mm was used to determine the hydrodynamic properties of cherry fruits. The tank was filled with ordinary water at a temperature of 20 °C to a height of 550 mm. A total of 40 fruits, 20 with stems and 20 without stems, were dropped into the water one by one and the movement of the fruit in the water was recorded using a camera. The recorded images were analyzed on a computer and the sharp velocity value was calculated by finding the time of the fruit's sinking. The forces effective in the movements of the cherry fruit in the water were obtained from the following equations:

$$F_W = mg,$$

$$F_d = C \cdot A_{\text{sh.a.a.v.}} \frac{P_W V_t^2}{2},$$

$$F_b = P_W \cdot V \cdot g, \quad (4)$$

where F_W – gravitational force, N; F_d – friction force in water, N; F_b – lifting force, N; g – gravitational acceleration, m/sec^2; C – friction coefficient, $A_{sh.a.a.v.}$ – average shadow area, m^2; V_t – sharp speed, m/sec:

$$C = \frac{2 \cdot mg \cdot \left(P_f - P_w\right)}{V_t^2 \cdot A_{\text{sh.a.a.v.}} \cdot P_f \cdot P_W}. \quad (5)$$

During the production of cherry wine, after separation from the stem and washing, the cherries are crushed. 100 mg/dm^3 of SO_2 and 2–3 % yeast are added to it and allowed to ferment. Fermentation lasts for 3–5 days, during which the pith collected on top should be mixed with the fermenting juice several times a day or the juice should be taken from the bottom and poured onto the pith. In order to ensure that the coloring substances in the peel pass into the juice, the pulp can be heated in enameled pots. Then the pulp is cooled to 20 °C and pressed. After the pulp is pressed, when the fermentation is complete, it is left to rest and the containers are completely filled and 100–150 mg/dm^3 of SO_2 is added. It is delivered to the consumer within 3–6 months or boiled and sent for distillation.

The physicochemical and organoleptic characteristics of raw materials, semi-finished products and finished products are determined by the general analysis methods available in enochemistry [19, 20].

However, modern analysis methods, including High Performance Liquid Chromatography (HPLC), computer technology for statistical data processing and statistical analyses were performed using the SPSS18 package [21, 22].

The mass concentration of phenolic compounds in wine was determined by the Folin-Chocolate method. The Folin-Chocolate reagent, when added to the wine, oxidizes the phenolic groups and reduces them to a blue compound. At this time, the intensity of the color is proportional to the concentration of phenolic compounds.

Hunterlab (Model D-9000 Color Difference Meter) analyzer was used to measure the color of wine samples. In Hunter, a-value measures redness and greenery, and b-value measures yellowness and blueness. The L-value measures the degree of light or brightness. The price varies between 100 – full white, 0 – black.

As a result of the research, the changes in the physical and mechanical properties of cherry fruits depending on their cultivation in different regions will be studied, the role of the amount and proportions of the components that make up the fruit (peel, seeds, pulpy juice) in the juice yield will be determined; the changes in the physical and chemical composition of the wines obtained depending on the region of cultivation, the amount of volatile and aromatic compounds will be determined.

5. Results of the study of factors affecting the preparation of wine material from cherry fruit

5. 1. Determination of physical and mechanical composition indicators of cherry fruit

During the study of the values of the breaking strength of the fruit, it was found that the average fruit mass, breaking strength (fruit-stem) and the ratio of breaking strength to mass of cherry fruits plucked without a stem were characterized by different values, depending on the growing conditions (Fig. 1).

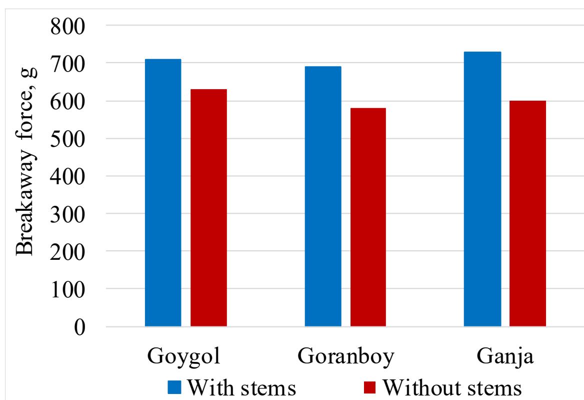

Fig. 1. Breakaway force of cherry fruits with and without stems, g, n=6, p<0.05

When looking at the breaking strength with stems, Ganja was the first with 725 g, followed by Goygol with 705 g and Goranboy with 697 g. In terms of breaking strength without stems, the sample from Goygol region was in first place with 630 g, followed by cherry samples collected from Ganja with 605 g and Goranboy with 585 g.

As can be seen, the highest value of the mass with stems was observed in the cherry sample collected from Goranboy with 5.30 g, the lowest with 4.70 g in Goygol, and the average with 4.76 g in Ganja (Fig. 2).

The Goranboy sample with the largest mass value of fruits in stemless rupture –5.14 g was the first, followed by Ganja with 4.65 g and Goygol with 4.61 g.

The ratio of the strength of the stem rupture of cherries to the mass of the fruit with stems varied between 150.0–157.6. At the same time, the highest was 157.6 in Ganja, the lowest was 139.4 in Goranboy, and the average position was – 150 in Goygol (Fig. 3).

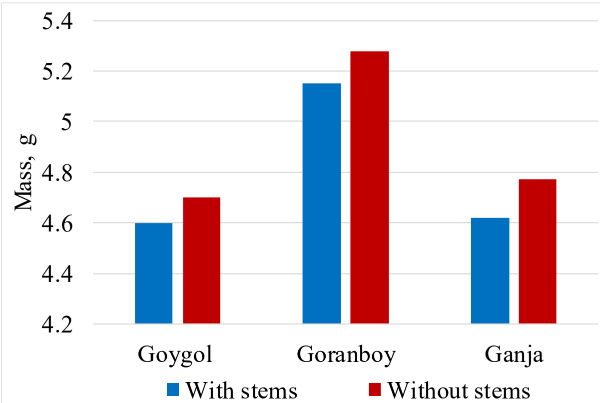

Fig. 2. Mass of cherry fruits with and without stems, g, n=6, p<0.05

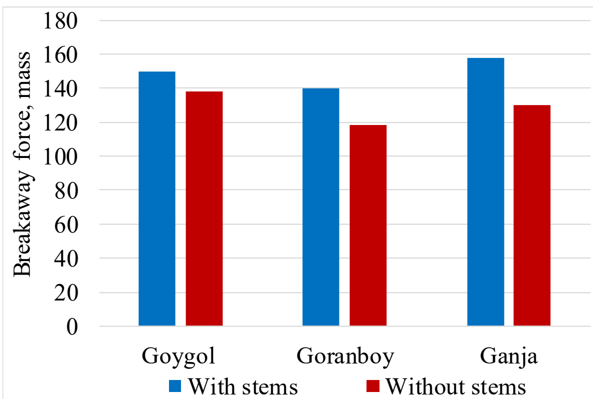

Fig. 3. The ratio of the strength of the rupture of cherries to the mass, n=6, p<0.05

According to the ratio of stemless breaking strength to stemless mass of the fruit, Goygol region was the first with 136.9, Ganja was the second with 130.1, and Goranboy was the last with 116.3.

Studies show that there are quite a few factors that affect the change in breaking strength values. The difference between the breaking strength values of cherries and sour cherries is related to indicators such as the ripening period of the fruits, the type of fruit, the location on the tree, harvesting times, cultivation conditions, and climatic factors. The breaking strength values of fruits also differ within the variety according to the harvesting periods. It is reported that the breaking strength of cherry fruits is lower than that of cherries.

Studies show that as apple fruits ripen, the breaking strength values decrease. The results obtained regarding the size of cherry fruits with stems in the studies conducted to determine the sizes of the fruits are given below (Table 1).

As can be seen, the length of the fruit varied between 20.96–22.1 mm in different regions. The lowest indicator (20.96 mm) was the cherry fruit collected from Goygol region, followed by (21.36 mm) Ganja and finally (22.1 mm) Goranboy region. Goranboy region was the first with 21.01 mm in terms of fruit diameter, followed by Ganja (20.45 mm) and Goygol (19.70 mm).

The stem length of cherry fruits collected from different regions differed slightly from each other. This indicator was 25.06 mm in Goranboy region, 25.30 mm in Ganja and 25.61 mm in Goygol.

Table 1

Dimension characteristics of cherry fruits with stems, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Length, mm	20.96	22.1	21.36
Width, mm	18.95	20.31	20.47
Thickness, mm	18.45	19.30	18.80
Diameter, mm	19.70	21.01	20.45
Roundness, %	88.97	89.5	90.1
Surface area, mm^2	1230	1280	1220
Shaft length, mm	25.61	25.06	25.30
Shaft width, mm	1.66	1.72	1.75
Mass, g	4.76	5.11	4.91
Shadow area, mm^2	390.12	406.25	395.46

The surface area of the fruit varied between 1,220–1,280 mm^2. At this time, the lowest indicator was in Ganja (1,220 mm^2), followed by Goygol (1,230 mm^2) and Goranboy (1,280 mm^2) in increasing order.

The dimensions of cherry fruits without stems were determined (Table 2).

Table 2

Dimension characteristics of cherry fruits without stems, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Length, mm	21.00	21.31	21.07
Width, mm	18.65	20.18	20.22
Thickness, mm	18.40	19.20	18.85
Diameter, mm	19.75	20.55	20.12
Roundness, %	89.00	89.6	90.0
Surface area, mm^2	1210	1270	1212
Mass, g	4.68	5.02	4.85
Shadow area, mm^2	361.17	380.05	375.12

As can be seen, the length of the cherry fruits without stems varied between 21.00–21.31 mm, the width between 18.65–20.22 mm and the thickness between 18.40–19.20 mm, and the diameter of the fruits varied between 19.75–20.55 mm.

It should be noted that not only the conditions under which the fruit ripens, but also different branches on a fruit tree affect the size and mass of the fruit.

The mass of the cherry fruit pulp and the mass of the seed were determined, and the ratio of pulp to seed, as well as the hardness of the pulp, were also determined (Table 3).

Table 3

Ratio of fruit pulp to seed and hardness, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Mass of fruit pulp, g	4.12	4.32	4.23
Mass of seeds, g	0.31	0.33	0.27
Fruit pulp/seed mass	13.29	13.09	15.66
Fruit pulp hardness, N	12.92	12.58	12.77

As can be seen, depending on the ripening conditions, the mass of the fruit pulp in the cherry fruit varied between 4.12–4.32 g. The mass of the stone fluctuated between 0.27–0.33 g depending on the variants. The ratio of fruit pulp to stone was observed to be at least 131.09 in Goranboy and at most 15.66 in Ganja. It is known that cherry fruit is not resistant to long-term storage. One of the important indicators in the transportation and storage of this fruit is the hardness of the fruit pulp. The hardness of the fruit pulp was 12.92 N in Goygol, 12.77 N in Ganja and 12.58 N in Goranboy. Therefore, the transport resistance of the fruit is higher in the foothills and mountainous areas compared to the lowland regions.

The volumetric mass of the crop, the real volumetric mass and the porosity indicators of the fruits of cherries with and without peduncles are determined.

The bulk density of stemmed cherry fruits was highest in the Goranboy sample (401.05 kg/m^3), followed by the Ganja (397.31 kg/m^3) and Goygol samples (396.71 kg/m^3) in decreasing order (Fig. 4).

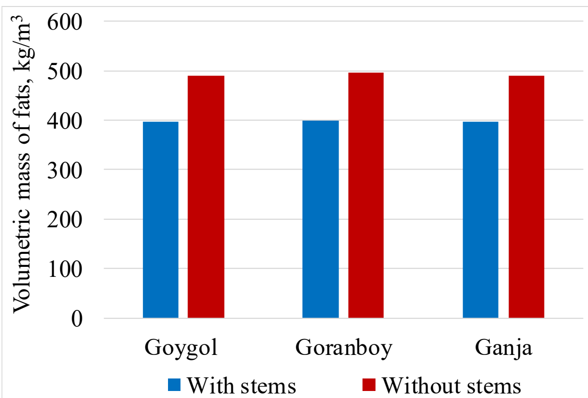

Fig. 4. Volumetric mass of fats in cherry fruits with and without stems, kg/m^3, n=6, p<0.05

It was noted that the bulk density of cherry fruits without stems was higher than that of those with stems. Although a similar sequence was observed in this case, the indicators were higher and fluctuated between 485.33–496.18 kg/m^3. If to compare it with cherries with stems, a slight increase in this indicator is noticeable. This also indicates that cherry fruits without stems have a greater possibility of being filled in a cylindrical form.

The real volumetric mass of cherry fruits with and without stalks was determined (Fig. 5).

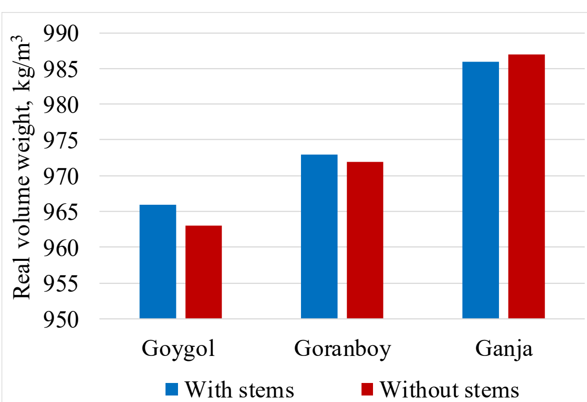

Fig. 5. Real volume weight of cherry fruits with and without stems, kg/m^3, n=6, p<0.05

It was found that the largest real volume weight of cherry fruits with stems was in the Ganja sample (986.22 kg/m^3), followed by Goranboy (973.45 kg/m^3) and Goygol (965.30 kg/m^3) samples in decreasing order. The real volume weight of cherry fruits without stems varied between 963.13–986.43 kg/m^3, a similar situation was observed for the samples.

When determining the porosity indicators of cherry fruits with and without stems, it was found that they were distinguished by their different values (Fig. 6).

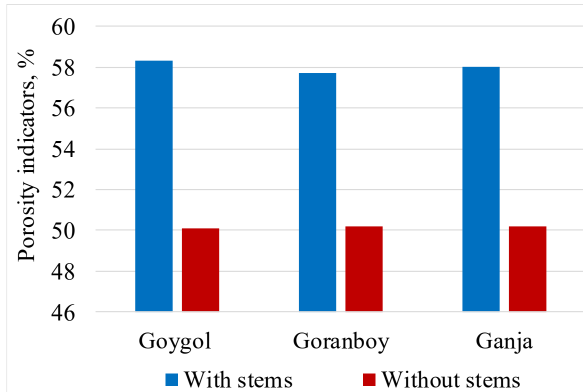

Fig. 6. Porosity indicators of cherry fruits, collected with and without stems, %, n=6, p<0.05

The porosity index in fruits with stems was higher in Goygol, 58.40 %, in Ganja – 58.01 % and in Goranboy – 57.73 %. It is noticeable that in fruits without stems it is slightly lower than the previous one. At the same time, in the Goranboy sample it was more – 50.38 %, in Goygol – 50.35 % and in the Ganja sample – 50.33 %.

The hydrodynamic properties of cherry fruits were studied. Since fruits with stems are larger than those without stems, the value of the gravitational force of stems was higher. The value of the friction force in water of fruits with stems was higher (Tables 4, 5).

Table 4

Hydrodynamic properties of cherries with stems, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Earth's gravity, N	0.044	0.052	0.049
Friction force in water, N	0.0031	0.0030	0.0032
Buoyancy, N	0.046	0.042	0.043
Acute velocity, m/sec	0.054	0.050	0.053
Friction coefficient, C	6.95	6.98	6.91

It is clear from the Table 4 that in cherry fruits with stems, the gravitational force of the earth varied between 0.044–0.052 N, the friction force in water between 0.0030–0.0032 N, the lifting force between 0.042–0.046 N, the abrupt velocity between 0.050–0.054 m/sec and finally, the friction coefficient between 6.91–6.98 C.

As can be seen, the gravity of the stemless cherry fruit varied between 0.043–0.048 N. The friction force in water was slightly lower than that of the stemmed cherry fruit, ranging between 0.0027–0.0029 N. The buoyancy force varied between 0.042–0.046 N, the abrupt velocity varied between 0.051–0.053 m/sec, and the friction coefficient varied between 7.30–7.51 C.

Table 5

Hydrodynamic properties of cherry without stems, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Earth's gravity, N	0.043	0.047	0.048
Friction force in water, N	0.0028	0.0027	0.0029
Buoyancy, N	0.046	0.042	0.043
Acute velocity, m/sec	0.053	0.051	0.053
Friction coefficient, C	7.30	7.42	7.51

5. 2. Determination of the physicochemical composition of juice and wine samples obtained from cherry fruit

Some physicochemical properties of juice samples obtained from cherry fruit grown in different regions were studied (Table 6). It was found that the lowest Brix value was in the Goygol region, 16.0, and the highest was in the juice obtained from the fruit grown in Goranboy, 18.5, while Ganja showed an intermediate position and stood out with its 16.9.

Table 6

Physical-chemical indicators of cherry juice samples, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Brix number	16.0	18.5	16.9
pH	2.92	2.98	2.99
Titratable acidity, %	2.24	1.77	2.50
Color Values: L	19.73	19.37	19.77
a	+3.07	+1.72	+3.33
b	–0.47	–0.92	–0.29
Antioxidant capacity, TEAC mmol/l	20.0	28.3	37.4
Degradation index, %	9.5	19.1	12.4

The antioxidant capacity was highest in the Ganja sample (37.4 TEAC mmol/l), followed by Goranboy (28.3 TEAC mmol/l) and Goygol sample (20.0 TEAC mmol/l) in decreasing order. The amount of total phenolic compounds and monomeric anthocyanins in the juice samples was as follows (Fig. 7).

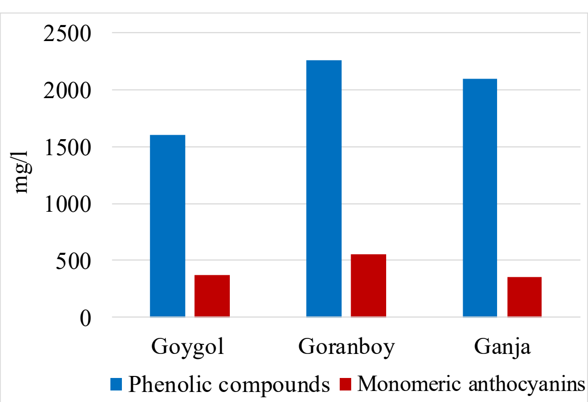

Fig. 7. Phenolic compounds and monomeric anthocyanins in cherry juice samples, mg/l, n=6, p<0.05

The amount of phenolic compounds varied between 1,625–2,295 mg/l across the samples, with the highest indicator in the Goranboy sample (2,295 mg/l), the lowest in Goygol (1,625 mg/l), and the Ganja sample (2,095 mg/l) occupying an intermediate position. When looking at monomeric anthocyanins, it can be seen that the comparatively low indicator was in Ganja (350 mg/l), followed by Goygol (366 mg/l) and Goranboy (548 mg/l).

Wines were prepared and studied from cherry fruits cultivated in different regions (Table 7).

Table 7

Physical and chemical composition indicators of cherry wines prepared in different regions, n=6, p<0.05

Indicators	Prices for samples		
	Goygol	Goranboy	Ganja
Titratable acidity, g/dm^3	6.7	5.9	6.4
Volatile acidity, g/dm^3	0.29	0.44	0.36
Alcohol, h %	7.3	10.9	10.1
Total sulfite acid, mg/dm^3	48.4	55.7	84.6
Free sulfuric acid, mg/dm^3	8.5	20.2	24.3
Sugar content, g/dm^3	9.8	15.7	13.1
Total phenolic compounds, mg/dm^3	151.46	157.63	155.24
Methyl alcohol, mg/dm^3	36.51	76.42	116.14

The alcohol content in the samples ranged between 7.3–10.9 % by volume, sugar content between 9.8–15.7 g/dm^3 and titratable acidity between 5.9–6.7 g/dm^3.

One of the main indicators of the quality of wine is the amount of titratable acids in its composition. This indicator plays a key role in the taste quality of wine and its resistance to diseases. The amount of titratable acids varied between 5.9–6.7 g/dm^3 in different variants. The amount of titratable acids was lower in the Goranboy sample than in others, average in the Ganja sample, and higher in the Goygol sample. This factor varied depending on the location of the region (zonality), as well as soil and climatic conditions.

The main representative of volatile acids found in wine is acetic acid. Since this acid accounts for about 90 % of volatile acids, volatile acids are expressed by converting them into acetic acid. The amount of volatile acids in the samples varied between 0.29–0.44 g/dm^3. This indicator was observed to be the least in the Goygol sample and the most in the Goranboy sample. As can be seen, the amount of volatile acids in the samples varied within the norm typical for wines that are not stored and matured.

The alcohol content mainly expresses the amount of ethyl alcohol in the wine. This indicator can vary depending on the initial sugar content of the raw material and the course of fermentation. In the studied samples, the amount of alcohol in the samples was the least in the Goygol sample with 7.3 h%, and the most in the Goranboy sample with 10.9 h%.

Sulfur dioxide is one of the most important substances used and preferred to maintain the stability of wines and increase their shelf life. Sulfur dioxide is considered an important means of preventing oxidation of wine and infection with microorganisms. The amount of sulfur dioxide injected can vary depending on the type and composition of the wine. Although sulfur dioxide in wine is present in both free and total forms, it is mainly free sulfur dioxide that has a protective effect.

The amount of total sulfite acid in cherry wine samples fluctuated between 48.4–84.6 mg/dm^3 and was higher in the Ganja sample (84.6 mg/dm^3) and lower in the Goygol sample (48.4 mg/dm^3). The Goranboy sample (55.7 mg/dm^3) was in the middle position.

The amount of free sulfur dioxide was 24.3 mg/dm^3 in the Ganja sample, 20.2 mg/dm^3 in the Goranboy region, and 8.5 mg/dm^3 in the Goygol region.

The sugar content in the samples varied between 9.8–15.7 g/dm^3.

In wine samples, methyl alcohol is not formed by fermentation, but by the enzymatic decomposition of methoxyl groups of pectin in the medium during fermentation. It is reported that the lower the amount of pectin in the raw material, the lower the amount of methyl alcohol in the wine. The amount of methyl alcohol in the samples varied between 36.51–116.14 mg/dm^3. As can be seen, these samples have a higher amount of methyl alcohol than grape wine. The main reason for this is that grapes have less pectin. The application of pectolytic enzymes during initial processing is one of the factors that increases the amount of methyl alcohol in wine. In our studies, the higher amount of methyl alcohol was in the Ganja sample (116.4 mg/dm^3), the lower amount was in the Goygol sample (36.51 mg/dm^3), and the Goranboy sample (76.42 mg/dm^3) was in the middle position.

Phenolic compounds are considered to be the main indicators of the composition of wines obtained from other fruits, as well as in grapes. Phenolic compounds determine the quality indicators of the product, such as its appearance, taste and aroma. Phenolic compounds play an important role in the maturation of wines, giving them physiological and colloidal properties. The amount of total phenolic compounds in the samples varied between 151.46–157.63 mg/dm^3.

Dry matter in wine is formed from carbohydrates, glycerin, non-volatile acids and salts, nitrogenous compounds, tannins and coloring substances, ash, sugars, and essential oils (Fig. 8).

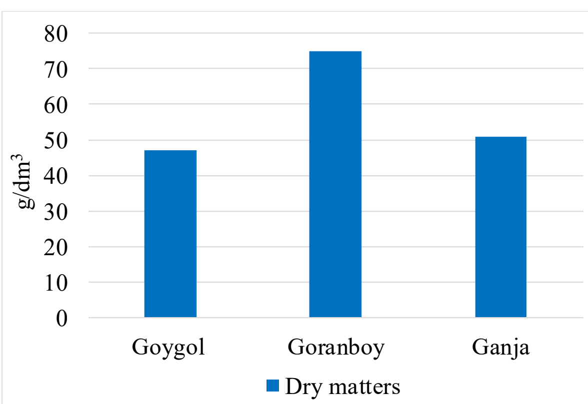

Fig. 8. Amount of dry matter in wine samples, g/dm^3, n=6, p<0.05

The amount of dry matter in the samples was the highest in Goranboy district (76.7 g/dm^3), the lowest in Goygol district (38.5 g/dm^3), and Ganja (51.3 g/dm^3) demonstrated an average position. This can be attributed to the soil and climatic conditions of these regions. Thus, the location of Goranboy district in an arid region with a warmer climate creates the basis for the accumulation of more dry matter in the fruits cultivated here compared to the other two regions. While Ganja district, located in the foothills, has a more moderate climate compared to Goranboy, Goygol district, located mainly in mountainous areas, is known for its cold winters and cool summers. All these differences are reflected in the products obtained from fruit plants cultivated here.

5. 3. Determination of the amount of volatile compounds in cherry wine samples

The amount of volatile compounds was determined in wine samples. The determined amount of higher alcohols was as follows (Table 8).

Table 8

Amount of higher alcohols in cherry wine samples, n=6, p<0.05

Higher alcohols, μg/dm^3	Prices for samples		
	Goygol	Goranboy	Ganja
2,3-butanediol	1,101.2	1,023.2	2,135.9
Benzyl alcohol	1,677.34	127.5	6,943.4
2-phenylethyl alcohol	4,847.3	25,846.7	33,022.1
4-hydroxybenzeneethyl	361.3	–	455.3
Total	7,987.14	26,997.4	72,556.7

As can be seen, 4 higher alcohol representatives were detected in the wine samples, namely 2,3-butanediol, benzyl alcohol, 2-phenylethyl alcohol and 4-hydroxybenzeneethyl. Among them, it is especially mention 2-phenylethyl alcohol and benzyl alcohol, which are important in terms of aromatic properties. The amount of 2-phenylethyl alcohol is noticeably higher in the Ganja wine sample (33,022.1).

One of the most important compounds that form the aroma of wine is esters. Esters are formed during alcoholic fermentation. They are classified as secondary products formed by yeasts. Esters are divided into 2 groups: the first group includes acetates of higher alcohols, in particular, ethyl acetate, isoamyl acetate, hexyl acetate and 2-phenylethyl acetate; the second group includes ethyl esters of fatty acids. This mainly includes C4, C6, C7, C8 and C10-carbons.

Below are the esters and their amounts in the wine samples (Table 9).

Table 9

Amount of esters detected in cherry wine samples, n=6, p<0.05

Esters, μg/dm^3	Prices for samples		
	Goygol	Goranboy	Ganja
Isoamyl acetate	22.1	23.6	18.4
Ethyl lactate	23,965.4	7,796.8	44,022.9
Ethyl sorbate	492.7	341.9	365.5
Diethyl succinate	1,096.7	2,395.8	3,401.3
Ethyl-4-hydroxybutanoate	165.3	596.4	407.8
Ethylhydrogensuccinate	4,394.5	14,322.3	16,796.3
Ethyl vanillate	73.5	84.2	321.3
Ethyl-3-hydroxyhexanoate	165.7	134.3	675.7
Ethyl hexanoate	22.1	29.6	33.1
Ethyl octanoate	47.1	36.8	61.3
Total	30,445.1	25,761.7	66,103.6

As can be seen from the table, the total amount of esters in cherry wine samples was the highest in the Ganja sample, the lowest in the Goranboy sample, and the Goygol sample was in the middle position between the two samples.

The qualitative composition of volatile acids was studied in the experimental samples. These types of acids, which play a major role in the aroma, are mainly fatty acids. It is reported that fatty acids are synthesized by yeast and bacteria during fermentation. The volatile acids detected in cherry wine samples and their amounts are given below (Table 10).

Table 10

The amount of volatile acids detected in wine samples, n=6, p<0.05

Volatile acids, μg/dm³	Prices for samples		
	Goygol	Goygol	Goygol
Acetic acid	346.8	277.4	846.3
Butanoic acid	51.3	46.5	57.8
Octanoic acid	505.8	340.4	595.7
Butyric acid	106.3	85.4	120.7
3-methyl butanoic acid	165.1	122.3	501.3
Hexanoic acid	296.4	47.3	496.5
Decanoic acid	77.6	96.4	65.3
Benzoic acid	382.1	2,97.9	405.5
Total	1,931.4	1,313.6	3,089.1

The lowest amount of volatile acids was observed in the Goranboy sample (1,313.6 μg/dm^3), the average in Goygol (1,931.4 μg/dm^3), and the highest amount in the Ganja sample (3,089.1 μg/dm^3).

During the research, it was found that in addition to those mentioned in the wine samples, other volatile compounds are found. They are 6-carbon compounds, lactones, aldehydes and ketones, etc. (Table 11).

Table 11

The amount of other compounds detected in cherry wine samples, n=6, p<0.05

Other compounds	Prices for samples, μg/dm³		
	Goygol	Goranboy	Ganja
Hexanol	265.3	394.2	480.5
Sis-hexanol	13.7	12.5	14.9
Acetoin	720.5	1,540.4	167.9
Ethyl vanillate	161.3	207.6	301.5
4-ethyl-2-methoxyphenol	185.3	177.2	201.4
2, 6-dimethoxyphenol	545.3	320.1	451.5
Coumarin	38.2	5.4	44.3
γ- butylolactone	4,125.3	1,740.7	5,323.8
Pantolactone	44.3	46.2	51.5
Acetaldehyde	44.1	31.3	37.7
Furfurole	122.3	105.2	161.4
Hydroxymethyl furfurole	–	9.7	–
3 methyl thio-1-propnol	405.7	451.3	502.4
Total	6,671.1	5,041.8	7,738.8

Other compounds found in cherry wine samples include 6-carbon compounds, carbonyl compounds, lactones, aldehydes and ketones, and others. It was found that the total amount of these compounds in wine samples ranged from 5,041.8 to 7,738.8 μg/dm^3. At this time, the Ganja sample was in the lead with 7,738.8 μg/dm^3, followed by the Goygol sample with 6,671.1 μg/dm^3 and the Goranboy sample with 5,041.8 μg/dm^3.

Among the volatile phenols that can affect the aroma of wine, 4-vinyl phenol, 4-vinyl guaiacol, 4-ethyl phenol, 4-ethyl guaiacol, and eugenol can be noted. The most notable of these is the volatile phenol compound coumarin found in cherry seeds. It should be noted that volatile phenols are products obtained from the decomposition of phenolic acids in grapes in grape wines by the action of the yeast decarboxylase enzyme during the fermentation process.

Lactones are reported to be formed mainly as a result of the activity of yeasts. γ-butylolactones are the most important lactones for wine and are found in all wines. This can also be seen in cherry wine samples. The results of the analysis of the aroma profile of wine samples are given (Table 12).

Table 12

Results of the aroma profile analysis of wine samples, n=6, p<0.05

Indicators	Value in samples, by weight		
	Goygol	Goranboy	Ganja
Color	5.45	5.75	6.20
On the nose – fresh fruit	4.52	3.80	4.36
On the nose – artificial fruit	4.4	3.36	3.05
In the mouth – fresh fruit	3.10	2.65	3.01
In the mouth – artificial fruit	5.22	3.51	4.96
Boiled	4.66	5.32	4.15
Sweetness	1.35	1.12	0.96
Acidity	2.45	2.15	1.86
Bitterness	1.22	1.37	1.01
Astringency	2.85	2.16	2.35
Fullness	3.35	2.86	3.94
Overview	5.45	4.96	5.25

During the analysis of the aroma profile of the wine samples, it was found that the color of the samples was evaluated between 5.45–6.20 points. At this time, Ganja was the highest with 6.20 points, Goranboy was average with 5.75 points, and Goygol was the last with 5.45 points. During the analysis of the aroma profile, an assessment was made according to the characteristics of fresh fruit and artificial fruit (imitation of fruits) in the nose and mouth. In the nose, the characteristics of fresh fruit were slightly higher than artificial fruit, and in the mouth, on the contrary, artificial fruit was rated higher than fresh fruit. The Goranboy sample was rated higher for bitterness, the Goygol sample for astringency, the Ganja sample for fullness, and finally, the Goygol sample for overall appearance.

6. Discussion of the results of the study of the influence of factors on the preparation of wine material from cherry fruit

In contrast to [1] where the influence of cherry juice on the flow rate of the filter was studied, in our research the average weight of the fruit, the breaking strength (fruit-stem), and the ratio of the breaking strength to the mass of cherry fruits, collected without peduncles and with peduncles was studied. It was found that the breaking strength in plucking with stems is higher than in plucking without stems. In plucking with stems, cherries are plucked from branches, and in plucking without stems, from fruits. Therefore, in the first case, that is, plucking from branches, more force is spent on plucking from fruits than on plucking the stem from fruits (Fig. 1).

The ratio of the cherry's stem breaking strength to the mass of the fruit with the stem was 150.0–157.6, while the ratio of the stemless breaking strength to the mass of the fruit without the stem was much lower, i.e., 116.3–136.9 (Fig. 3).

In contrast to studies where the influence of the period of production and storage [6, 7], as well as ultrasonic treatment [10] on the antioxidant properties of cherry juice was studied, in this study the antioxidant capacity of juice samples obtained from cherry fruits grown in different regions was studied. This indicator turned out to be the highest in the Ganja sample (37.4 TEAS mmol/l), followed by the Geranboy (28.3 TEAS mmol/l) and Heigel (20.0 TEAS mmol/l) samples in descending order (Table 6, Fig. 7).

In contrast to [8], which investigated the effects of chemicals used to neutralize the acidity of cherry juice on the chemical composition and organoleptic properties of the juice, this study examined the color indices (Table 6) of cherry juice and aroma profile analyses (Table 12) in cherry wine samples. It was found that the color of the samples was evaluated between 5.45–6.20 points. At this time, Ganja was the highest with 6.20 points, Goranboy was average with 5.75 points, and Goygol was the last with 5.45 points.

In contrast to [13], where the effect of treatment with salicylic acid and chitosan on the mass of cherry fruits was investigated, in this study the mass of cherry fruits with and without petioles was studied. The weight of cherry fruits with a pedicel was 4.70–5.30 g, which is significantly lower than the weight of fruitless specimens (4.61–5.14 g), which is due to the additional weight of the pedicel (Fig. 2).

Unlike the study [16] devoted to the study of the size and mass of cherry fruits and their individual parts, this study investigated the change in the size of cherry fruit and stem and the diameter of the fruit surface depending on the zonation. The stem length of cherry fruits collected from different regions differed slightly from each other. This indicator was 25.06 mm in Goranboy region, 25.30 mm in Ganja and 25.61 mm in Goygol. The surface area of the fruit varied between 1,220–1,280 mm^2. At this time, the lowest indicator was in Ganja (1,220 mm^2), followed by Goygol (1,230 mm^2) and Goranboy (1,280 mm^2) in increasing order. Such a change in indicators can be associated with the conditions of fruit cultivation. Thus, the sequence of decreasing altitude from the mountainous Goygol area is followed by Ganja and then the plain area of Goranboy district. If to pay attention, it is possible to see that the size of the fruits decreases with increasing altitude of cultivation (Table 1).

At the same time, the effect of cultivation conditions on the size and mass of fruits was investigated.

The length of the cherry fruits without stems varied between 21.00–21.31 mm, the width between 18.65–20.22 mm and the thickness between 18.40–19.20 mm, and the diameter of the fruits varied between 19.75–20.55 mm. It should be noted that not only the conditions in which the fruit ripens, but also different branches on a fruit tree affect the size and mass of the fruit (Table 2).

Unlike the study [13] that investigated the effect of salicylic acid and its combination with chitosan on the mass of cherry fruit, this study investigated the effect of cultivation conditions on the porosity index of cherry fruit. It was noticeable that this index was slightly lower in stemless fruits than in stemmed ones, with the Goranboy sample being 50.38 % higher, the Goygol sample being 50.35 % average, and the Ganja sample being 50.33 % lower (Fig. 6).

Unlike this study [14] that considered the effect of the conditions under which stone fruit plants were grown on the harvest season, this study investigated the friction and gravity forces, lifting force, and sharp speed in cherry fruit. The gravitational force and the friction force in water were higher in the stemmed cherry fruits than in the stemless fruits, which is due to their relatively large mass (Tables 4, 5).

Some physical and chemical properties of juice samples obtained from cherry fruits grown in different regions were studied. It was found that the Brix number was the lowest in the Goygol region, 16.0, and the highest in the juice obtained from the fruit grown in Goranboy, 18.5, while Ganja showed an average position and was notable for being 16.9. All this can be explained by the fact that the climatic conditions in the lowland areas of Goranboy are warmer than in others. Ganja and finally Goygol regions are characterized by a slightly colder climate (Table 6).

Unlike this study [15], which studied the mineral and volatile composition of cherry by-products, here the effect of growing conditions on the amount of phenolic compounds was studied. The amount of phenolic compounds was highest in the Goranboy sample (2,295 mg/l), lowest in Goygol (1,625 mg/l), and in this case the Ganja sample (2,095 mg/l) took an intermediate position (Fig. 7).

The amount of titratable acids was lower in the Goranboy sample than in others, average in the Ganja sample, and higher in the Goygol sample. This factor varied depending on the location of the region (zonation), as well as soil and climatic conditions. The amount of total phenolic compounds in the samples varied between 151.46–157.63 mg/dm^3 (Table 7).

The amount of dry matter in the samples was the highest in Goranboy district (76.7 g/dm^3), the lowest in Goygol district (38.5 g/dm^3), and Ganja (51.3 g/dm^3) demonstrated an intermediate position. This can be attributed to the soil and climatic conditions of these districts. Thus, the location of Goranboy district in an arid region with a warmer climate creates the basis for the accumulation of more dry matter in the fruits cultivated here compared to the other two districts. While Ganja district, located in the foothills, has a more moderate climate compared to Goranboy, Goygol district, located mainly in mountainous areas, is known for its cold winters and cool summers. All these differences are reflected in the products obtained from fruit plants cultivated here (Fig. 8).

Among the volatile compounds in the wine samples, 4 representatives of higher alcohols were detected, namely 2,3-butanediol, benzyl alcohol, 2-phenylethyl alcohol and 4-hydroxybenzeneethyl. Among them, 2-phenylethyl alcohol and benzyl alcohol, which are important in terms of aromatic properties, can be especially noted (Table 8).

The total amount of esters in cherry wine samples was highest in the Ganja sample, lowest in the Goranboy sample, and the Goygol sample was in the middle position between the two samples (Table 9).

Unlike the study [17] that investigated the physical and mechanical properties of the Istanbul cherry variety, this study investigated the effect of fruit growing conditions on the amount of volatile acids in wine samples taken from them. The lowest amount of volatile acids was observed in the Goranboy sample (1,313.6 μg/dm^3), the average in the Goygol (1,931.4 μg/dm^3), and the highest amount in the Ganja sample (3,089.1 μg/dm^3) (Table 10).

Unlike the study [18], which was devoted to the correct determination of the fruit harvest time to obtain maximum profit, here, the 6-carbon compounds and aroma profile of cherry wine samples were studied. Other compounds detected in cherry wine samples include 6-carbon compounds, carbonyl compounds, lactones, aldehydes and ketones, and others. It should be noted that volatile phenols are products obtained from the breakdown of phenolic acids in grapes in grape wines by the action of the yeast decarboxylase enzyme during the fermentation process (Table 11).

During the analysis of the aroma profile of the wine samples, it was found that the color of the samples was evaluated between 5.45–6.20 points. At this time, Ganja was the highest with 6.20 points, Goranboy was average with 5.75 points, and Goygol was the last with 5.45 points (Table 12).

The effect of growing conditions on the physical and mechanical properties of cherry fruits was studied and it was found that depending on the zonality, these indicators change significantly. The mentioned factor also manifested itself in the compositional indicators of the prepared juices and wines. Thus, the juice samples prepared from cherry fruits procured from the Goranboy region, which differs from other regions with its warmer climate, differed in terms of brix index, extractivity and other indicators compared to the products of the relatively moderate climate of Ganja and the foothills of Goygol with a cold climate. A similar situation was also manifested in the wine samples. The alcohol content and extractivity in the Goranboy sample were significantly higher than in the other two samples. As can be seen, this research work, which reflects the change in the physicochemical and organoleptic indicators of juices and wines prepared from raw materials, as well as the amount of volatile components, is aimed at solving complex issues.

During our research, it was found that the physical and mechanical properties of cherry fruits change depending on the growing conditions. The effect of the growing conditions of the fruit on the composition of the prepared product in the winemaking process was experimentally determined, and the effect of the mentioned factor on the amount of volatile compounds in the samples and the aroma profile was experimentally confirmed.

The research materials can be used in the scientific field of winemaking, especially fruit and berry winemaking. The results obtained can be useful for scientific research work on winemaking, family farms and winemaking enterprises. The research results are intended to be applied in winemaking, especially in enterprises engaged in fruit and berry winemaking.

The research is suitable for the preparation of juice and wine from stone fruits, especially cherries, cherries, peaches.

There are limitations in the production of juice and wine obtained by the white method, especially in the production of delicate, slightly oxidized natural white wines.

The shortcomings of the study are related to the differences in the ripening period of cherry fruits depending on the zonation and the difficulty of controlling simultaneous ripening.

Let’s consider it promising to study a number of issues envisaged in the study, including the change in antioxidant properties during the storage and maturation of wines.

7. Conclusions

1. Depending on the growing conditions, the mass of the fruit pulp in cherry fruit was 4.12–4.32 g, the mass of the seed was 0.27–0.33 g, the ratio of fruit pulp to seed was observed to be the lowest in Goranboy – 13.09, and the highest in Ganja – 15.66. One of the important indicators in the transportation and storage of cherry fruit was the firmness of the fruit pulp, which was 12.92 N in Goygol, 12.77 N in Ganja and 12.58 N in Goranboy. It was found that the fruit’s transport resistance was higher in the foothills and mountainous areas compared to the lowland regions.

2. The amount of dry matter was the highest in the Goranboy region (76.7 g/dm^3), the lowest in Goygol region (38.5 g/dm^3), and Ganja (51.3 g/dm^3) demonstrated an average position. The amount of titratable acids varied between 5.9–6.7 g/dm^3, volatile acids between 0.29–0.44 g/dm^3, and alcohol content between 7.3–10.9 h%. The amount of titratable acids was lower in the Goranboy sample than in the others, average in the Ganja sample, and higher in the Goygol sample. This factor varied depending on the location of the region (zonation), as well as soil and climatic conditions.

3. Four higher alcohols were detected in the wine samples: 2,3-butanediol, benzyl alcohol, 2-phenylethyl alcohol, and 4-hydroxybenzeneethyl. Among them, 2-phenylethyl alcohol and benzyl alcohol are particularly important in terms of their aromatic properties. The amount of 2-phenylethyl alcohol is noticeably higher in the Ganja wine sample. One of the most important compounds that form the aroma of wine is esters.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

Financing

The study was performed without financial support.

Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

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

References

1. Fataliyev, H. K. (2011). Wine technology. Baku: Elm, 596.
2. Budak, N. H. (2024). A functional product in gastronomy: sour cherry vinegar. Journal of Tourism and Research, 13 (1), 120–136. https://doi.org/10.7460/turar.1464192
3. Fataliyev, H., Askerova, A., Askerova, I. (2017). Processing technology for fruits and vegetables. Baku: Ecoprint, 368.
4. Bayram, H. M., Öztürkcan, A. (2020). Investigating the Effects of Anthocyanin Rich Cherry Red Fruits on Human Health in Clinical Studies. İstanbul Gelişim Üniversitesi Sağlık Bilimleri Dergisi, 11, 230–254. https://doi.org/10.38079/igusabder.748640
5. Jafarov, F. N., Fataliyev, H. K. (2014). Technology of functional food products. Baku: Elm, 384.

6. Demirdöven, A., Erceyes, E., Erceyes, Ö. (2016). Changes in sour cherry juice concentrate antioxidants during production and storage. GIDA, 41 (4), 213–220. https://doi.org/10.15237/gida.gd15069
7. Fataliyev, H. K., Musaev, T. M., Aliyeva, G. S. (2018). Technology of fruit and berry wines. Baku: Ecoprint, 312.
8. Yeşilören, G., Ekşi, A. (2015). Neutralization as an alternative to reduce acidity of sour cherry juice. GIDA, 40 (3), 157–162. Available at: https://dergipark.org.tr/en/pub/gida/issue/43745/536819
9. Fataliyev, Kh. K., Aliyeva, Sh. E., Musaev, T. M. (2019). Biotechnology. Baku: Ecoprint, 360.
10. Türken, T., Pala, T. (2016). Modeling and Optimization of Sour Cherry Juice Antioxidant Activity by Using Response Surface Methodology and Genetic Algorithm. El-Cezeri Fen ve Mühendislik Dergisi, 3 (2). https://doi.org/10.31202/ecjse.264187
11. Fataliyev, H., Malikov, A., Lezgiyev, Y., Gadimova, N., Musayev, T., Aliyeva, G. (2024). Identifying of the wine-making potential of the autochthon madrasa grape variety of different colors and quality. Eastern-European Journal of Enterprise Technologies, 2 (11 (128)), 56–63. https://doi.org/10.15587/1729-4061.2024.302971
12. Yıldız, D., Gürel, D. B., Çağındı, Ö., Kayaardı, S. (2022). Heat treatment and microwave applications on homemade sour cherry juice: The effect on anthocyanin content and some physicochemical properties. Current Plant Biology, 29, 100242. https://doi.org/10.1016/j.cpb.2022.100242
13. Vasylyshyna, O. (2021). Change of physical indicators of cherry fruit depending on treatment by polysaccharide compositions during storage. Scientific Reports of NULES of Ukraine, 1 (89). https://doi.org/10.31548/dopovidi2021.01.005
14. Nacouzi, D., Masry, R., El Kayal, W. (2023). Quality and Phytochemical Composition of Sweet Cherry Cultivars Can Be Influenced by Altitude. Plants, 12 (12), 2254. https://doi.org/10.3390/plants12122254
15. Nunes, A. R., Gonçalves, A. C., Pinto, E., Amaro, F., Flores-Félix, J. D., Almeida, A. et al. (2022). Mineral Content and Volatile Profiling of Prunus avium L. (Sweet Cherry) By-Products from Fundão Region (Portugal). Foods, 11 (5), 751. https://doi.org/10.3390/foods11050751
16. Beloved, M. (2018). Effects of some chemical applications on cherries on fruit quality. Iğdır, 51.
17. Tasova, M., Güzel, M. (2017). Determination Physico-Mechanic Properties and Color Values of İstanbul Variety Cherry (Prunus cerasus L.). Gaziosmanpasa Journal of Scientific Research, 6, 73–80. Available at: https://dergipark.org.tr/en/download/article-file/399631
18. Akçin, E., Aslantaş, R., Bilgin, J. (2024). Determination of the Effects of Some Plant Growth Regulators on Harvest Time and Fruit Quality of Cordia Cherry Variety. Bahçe, 53, 249–259. https://doi.org/10.53471/bahce.1509642
19. Fataliyev, H. K. (2013). Winemaking practicum. Baku: Elm, 328.
20. Nabiyev, A. A. (2013). The Chemistry of Wine. Baku: Elm, 472.
21. Sheskin, D. J. (2020). Handbook of Parametric and Nonparametric Statistical Procedures. Chapman and Hall/CRC, 1928. https://doi.org/10.1201/9780429186196
22. Gadimova, N., Fataliyev, H., Heydarov, E., Lezgiyev, Y., Isgandarova, S. (2023). Development of a model and optimization of the interaction of factors in the grain malting process and its application in the production of functional beverages. Eastern-European Journal of Enterprise Technologies, 5 (11 (125)), 43–56. https://doi.org/10.15587/1729-4061.2023.289421