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CHANGE IN THE ORGANOLEPTIC PROPERTIES OF GRAPE VARIETIES OF DIFFERENT RIPENING PERIODS

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Abstract. In the process of ripening, due to the chemical processes occurring in the composition of the berry, its taste becomes more balanced. Our research investigated the change in the organoleptic properties of grape varieties of medium (Gara Shany) and late (Agadai and Moldova) ripening periods. There were two tastings with a gap of two weeks. On the results obtained, it was determined that the evaluation mark of the Gara Shany variety slightly decreased, that of the Agadai variety remained unchanged and that of the Moldova variety - increased considerably. The difference in ripening periods of the studied varieties can explain such a situation. Also, these results are to some extent consistent with the results of studies on changes in the chemical composition of the berries of these varieties: minimal changes were noted in the chemical composition of the Gara Shany variety, much more significant in the Agadai variety and the biggest changes are indicated in the Moldova variety.

Keywords: *Grapes, chemical composition, maturity, Absheron peninsula.*

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1. Introduction

The degree of ripeness has the greatest influence on the quality of grapes. The most decisive factor influencing the commercial processing, transportation and storage of table varieties is the determination of ripeness and harvesting dates. The choice of optimal harvesting time depends on the main indicators that determine the taste characteristics of the grapes - sugar content and acidity, as well as their ratio. The issues of correctly determining the ripeness of grapes, determining the timing and organization of harvesting and compliance with the requirements for harvesting, sorting, packaging and transportation have a significant impact on the economy of farms growing grapes. For example, with premature harvesting, the properties inherent in the variety are lost and a significant amount of sugar is not collected, which ultimately leads to significant financial losses. In viticulture and winemaking farms, when the first signs of ripening of grapes appear, regular monitoring of changes in its composition - the accumulation of sugar and a drop in acidity - is established. Acidity is a factor that determines the stability of wine

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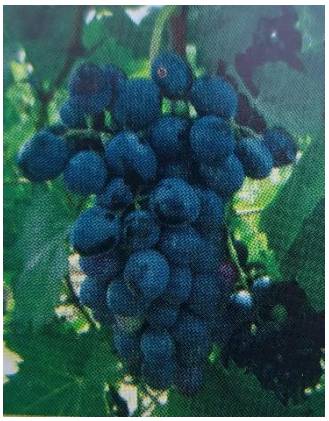
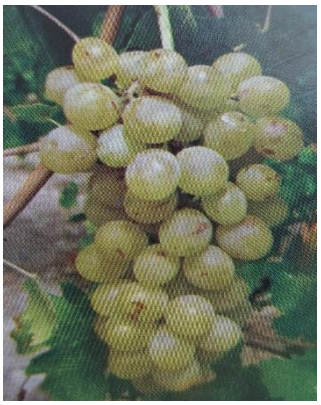
and its organoleptic and gastronomic features. The acidity level of wine depends on the grape variety, agricultural technology and processing technology. During the ripening process, the acidity of grapes decreases. The degree of ripeness of grapes depends on the amount of solar radiation received and the average air temperature, therefore there is usually a close relationship between climate and acidity level. Earlier ripening of grapes due to global warming can lead to a slowdown in enzymatic processes during the transformation of substances responsible for the accumulation of organic acids and the production of a yield with a high content of sugars and acids. The percentage of sugar and titratable acidity are indicators based on which the suitability of grapes for production purposes is determined (Kushnereva *et al*., 2012; Makuyev *et al*., 2018; Rolle *et al*., 2021; Plantevin *et al*., 2024). The requirements for the composition of grapes for fresh consumption and the production of light table, strong or dessert wine are different. Therefore, the degree of ripeness of grapes is a decisive indicator in determining the timing of harvesting grapes intended for fresh consumption and the production of a certain type of wine (Kushnereva *et al*., 2012).

2. Materials and methods

The studies were carried out in the Institute's Ampelographic Collection located on the Absheron Peninsula. The climate is subtropical. High temperatures in dry and hot summers are moderated by strong northerly winds. Winter is relatively mild, mostly cloudy, with frequent rains and sometimes snow. The average annual temperature is 13.5-14.4°C, the sum of active temperatures is 4192-4461°C and the total amount of solar radiation is 130-135 kcal/cm^2 (most of them - 80-90 kcal/cm^2 occur in summer), annual rainfall - 200-250 mm. The coldest month is January (3.0-3.8°C), while the hottest months are July and August (up to 42°C). The number of frost-free days is 308, sunny - 220-230. The territory of the peninsula is subject to strong winds. In addition to improving plant transpiration, an increase in wind speed increases evaporation, resulting in dry soil. The highest level of evaporation is observed in July-August and the lowest - is in February. The soils of the peninsula are predominantly sulphurous-sandy and clayey; saline brown soils are the most common. It should also be noted that due to global warming, the annual amount of precipitation on the peninsula has increased from the usual 200-250 mm in recent years to 250-300 mm. Thus, the type of climate could gradually change from continental to temperate.

We conducted studies on the chemical characteristics and organoleptic properties of three grape varieties (Moldova, Agadai and Gara shany) widely cultivated in Azerbaijan and grown in the Ampelographic Collection of the Research Institute of Viticulture and Winemaking. Below is a brief description of these grape varieties (Panahov & Salimov, 2012; Salimov *et al*., 2015) (Table 1).

Table 1. Description of the wine grape varieties studied

Variety	Botanical description	Agrobiological description	Technological description
Moldova 	The leaves are of large and very large size (18 x 23 cm), roundish, plain, 5-bladed. The flowers are hermaphroditic. Clusters are medium and large (12-18 x 12-14 cm), conical or cylinder-conical shaped, medium-thick or loose. The berries are large (15 x 24 mm), round, black and covered with a thick wax layer.	The duration of the growing season is 160 days. The plant`s growth vigor of is high. The shoots ripen almost completely (97%). Productivity – 89.6-204.4 c/ha.	A universal grape variety. The mass concentration of sugar in the juice is 16.6-18.6 g/100cm^3, titratable acidity – 6.2-7.8 g/dm^3.
Agadai 	The leaves are of large size (17 x 23 cm), oval, plain, 5-bladed. The flowers are hermaphroditic. Clusters are medium and large (25-27 x 20-23 cm), cylinder-conical shaped, medium-thick or loose. The berries are large (13 x 26 mm), round, white.	The duration of the growing season is 164-173 days. The plant`s growth vigor of is high. The shoots ripen for 88.6%. Productivity – 133.8 c/ha.	A table grape variety. The mass concentration of sugar in the juice is 16.0-18.0 g/100 cm^3, titratable acidity is 4.0-5.6 g/dm^3.
Gara shany 	Annual shoots are light brownish. Leaves (15-20 cm) are light green. The flower type is hermaphroditic. The clusters are medium and large (12-22 x 8-12 cm). The berries are medium or large (17-21 x 15-19 mm), dark blue.	The duration of the growing season is 146 days. The shoots ripen for 90.7%. The plant's growth vigor is high. Productivity – 76-96 c/ha.	A table grape variety. The mass concentration of sugar in the juice is 17.6-19.2 g/100 cm^3, titratable acidity is 4.4-5.5 g/dm^3.

More detailed description of these varieties can be found in the VIVC (https://www.vivc.de/) database.

The sugar content of the berries was determined with a refractometer and the acidity was determined by titration.

The organoleptic characteristics of grapes were evaluated at tastings.

Technological, biochemical, physiological and organoleptic studies were carried out within the framework of research work in the vineyards and the laboratories of the Azerbaijan Research Institute of Viticulture and Winemaking. Classical and modern research methods were used (Dospekhov, 1985; Troshin & Maghradze, 2013; Salimov, 2019). The juice's sugar content and acidity were also evaluated using descriptors of the International Organisation of Vine and Wine (OIV, 2018). For sugar content (OIV 505) mark 1 is for very low level (less than 12 g/100 cm^3), 3 - is for low (12-15 g/100 cm^3), 5 - medium (15-18 g/100 cm^3), 7 - high (18-21 g/100 cm^3) and 9 - very high (21-24 g/100 cm^3 and higher). For acidity, mark 1 is for very low (less than 3 g/dm^3), 3 - low (3,1-6 g/100 cm^3), 5 - medium (6,1-9 g/100 cm^3), 7 - high (9,1-12 g/100 cm^3) and 9 - very high (12,1-15 g/100 cm^3 and higher).

3. Results and discussions

The sugar content of juice is the main feature that determines the organoleptic value and direction of the use of grapes. Our studies have shown that in the process of ripening, the sugar content of all studied variants increased by 2.7-15.4%, depending on the variety.

In addition to the sugar content, the taste characteristics and quality of processed products are greatly influenced by another important indicator - the acidity of the juice. In our studies, the acidity of different varieties gradually decreased by 2.8-6.7% (Table 2).

Table 2. Change of biochemical composition during maturation

Variety	Sugar, g/100 cm^3					Titrated acidity, g/dm^3				
	19.08	OIV (505)	03.09	OIV (505)	change %	19.08	OIV (506)	03.09	OIV (506)	change %
Moldova	22,1	7	25,5	9	+15,4	7,5	5	7,0	3	-6,7
Agadai	17,1	5	18,2	5	+6,4	3,2	1	3,0	1	-6,2
Gara shany	14,8	3	15,2	3	+2,7	3,7	1	3,6	1	-2,8

Although regular processes occurred in all variants of the experiment - an increase in sugar content and a decrease in acidity, it should be noted that the intensity of these processes in the 2021 season was significantly lower than in 2020. This can be explained by extremely hot weather at the end of summer, due to which the grapes reached full maturity much earlier than usual. These results are consistent with data reported by some authors (Faralli *et al.*, 2024; Rogiers *et al.*, 2022).

As it ripens, thanks to ongoing processes, the taste of the grapes gradually changes and becomes more harmonious. In the course of our research, organoleptic evaluations of grapes of different degrees of maturity were carried out. The results are shown in Table 3.

Table 3. Results of organoleptic evaluation

Variety	Variants	19.08.2021				03.09.2021			
		Appearance	**Flavor of berries**	**Thickness of skin and character of pulp**	**Overall mark**	**appearance**	**Flavor of berries**	**Thickness of skin and character of pulp**	**Overall mark**
Gara shany	1	2	3	2	7	1	2	2	5
	2	2	4	2	8	1,5	4	1,5	7
	3	2	5	2	9	2	4	1,5	7,5
	4	2	5	2	9	1	3	2	6
	5	2	4	2	8	1,5	4	2	7,5
	mean	2	4,2	2	**8,2**	1,6	3,4	1,8	**6,6**
Moldova	1	1	2	1,5	4,5	2	2	2	6
	2	1	2	2	5	2	4	2	8
	3	2	2	2	6	2	4	2	8
	4	1	2	1	4	2	5	2	9
	5	1	2	1,5	4,5	2	4	1	7
	mean	1,2	2	1,6	**4,8**	2	3,8	1,8	**7,6**
Agadai	1	2	4	2	8	1,5	5	1,5	8
	2	2	5	1	8	2	3	2	7
	3	2	4	0,1	7	2	5	2	9
	4	2	5	1	8	2	3	1,5	6,5
	5	2	4	2	8	1,5	3	1	5,5
	mean	2	4,4	1,2	**7,2**	1,8	3,8	1,6	**7,2**

As we can see, compared with the results of the first tasting, the final assessment of the Gara shany variety has slightly decreased, the Moldova variety has increased significantly and the Agadai variety has remained at the same level. This state can be explained by the difference in the maturation of varieties. Also, the results obtained for these indicators indirectly correspond to the results of experiments on changing the chemical composition: for example, during the indicated ripening period, slight changes were observed in the chemical composition of the Gara shany variety, in the Agadai variety - at an average level, in the berries of the Moldova variety there were large changes. The foregoing suggests that as a result of extreme summer heat, as a manifestation of climate change, the grapes reached full maturity much earlier than usual. The process of changing the sugar/acidity ratio in early ripening varieties slowed down, while in late-ripening varieties, the processes of sugar accumulation and acidity reduction continued and the taste of these varieties became more harmonious. The results of grape tasting agree with the literature sources available (Kushnereva *et al*., 2012; Akram *et al*., 2024).

4. Conclusion

Summarizing the obtained results, we can come to some conclusions:

- Changes in the chemical composition of berries during ripening (an increase in sugar content and a decrease in acidity) began to occur much earlier than usual; this can be explained by the abnormal heat observed during the season. This state was also manifested in a change in taste; thus, in late-ripening varieties, the taste remained stable or improved during ripening, while in early-ripening varieties, the tasting assessment at the time of full ripening lagged far behind the results of the previous tasting;

- To determine the optimal harvesting time, it is important not to miss the moment of reaching the conditions inherent in the varieties, regularly monitoring the chemical composition and taste of the berries during the ripening period.

Here it would be appropriate to mention the impact of climate change on viticulture; an increase in the average annual temperature even by 1-2°C leads to significant instability of the vineyards. According to the scenario built using the PRECIS model, in the period up to 2050, the average annual temperature in Azerbaijan is expected to increase by 1.5-1.6°C and precipitation - by 0-20%, depending on the region. In the longer term, up to 2100, the temperature is expected to rise to 5°C, precipitation - by 20-80%. As a result of these changes, the sugar content of berries is expected to increase by 2-3% and acidity by 1%, which will contribute to producing high-quality table and dessert wines rather than light ones.

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