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MECHANICAL PROPERTIES OF SEVERAL LOCAL AND INTRODUCED GRAPE VARIETIES: RESEARCH AND EVALUATION OF THEIR TECHNOLOGICAL SUITABILITY

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Abstract. The article presents the findings from a study evaluating the morphological, biological and technological characteristics of various table and technical grape varieties cultivated in the Republic of Azerbaijan. The research adhered to the descriptors of the International Organization of Vine and Wine (OIV). The study reveals a wide range in the size of grape bunches, with medium, large and small bunches being predominant. Notably, the local and introduced varieties Arna-grna, Khindogny, Hamashara, Shirvanshahy and Moldova exhibited superior morphological traits such as mass, volume and size of bunches. Juice yield, a key indicator of technological suitability, ranged from 45.5% to 80.0%. The Shiraz variety had the lowest juice yield (45.8%), whereas the Moldova (76.8%) and Uni Blanc (80.0%) varieties had the highest. Most varieties had small berries, but Arna-grna (481 g), Gyanjavi (341 g) and Moldova (317 g) were considered medium. The sugar content in the berries was categorized as average, high or very high, with Shirvanshahy having the highest sugar content (25.0 g/100 cm^3). The titratable acidity of the varieties was low to average, while the active acidity was mainly low.

Keywords: *Grape variety, local variety, bunch, berry, ampelodescriptor.*

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1. Introduction

Grapes are a food product with significant medicinal and dietary properties. To assess their taste, nutritional qualities and technological suitability, the most critical factors are sugar content, organic acids and mechanical (enocarpological) indicators. The levels of sugar and acidity in grape berries, as well as the dynamics of their changes during ripening, are influenced by the mechanical properties of the bunch, the biological characteristics of the variety, soil and climatic conditions and the agricultural practices employed.

Consumers evaluate table grape varieties based on the presentation, density and size of the bunches, as well as the color, uniformity of berry size and a pleasant, harmonious taste. In contrast, technical varieties are primarily judged by the quality of the wines produced from them.

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Research in viticulture indicates that grape groups of different taxonomic origins exhibit varying indicators of mechanical berry stability and wine tasting evaluations. To enhance the assortment of native grape varieties used in winemaking, it is essential to assess the potential of collectible varieties. Researchers have identified that the first factor in polymorphism differentiation is berry size, followed by yield and the ripening period. Additionally, grape varieties vary in their intended use, further highlighting the need for comprehensive evaluation in viticultural research. The study of the mechanical composition of grape bunches and berries during uvological research enables the determination of the ratio of berries to stalks in a bunch, as well as the ratio of skin, pulp, juice and seeds within a berry.

Bunches primarily consist of two uvological components: the stalk and the berry. Long-term uvological studies have shown that if the proportion of berries in a bunch ranges from 91.5% to 99.0%, the technological suitability of the grapes is considered high. Relative to the total mass of the bunch, the proportion of berry skins typically varies between 0.9% and 38.6%, seeds between 0.9% and 10.8% and pulp between 71.1% and 95.5%. Viticulture research has determined that grapes meet technological standards optimally when the berries constitute 96.5% of the bunch, with stalks making up the remaining 3.5%. While the formation of mechanical elements and the structure of grape bunches and berries adhere to inherent natural patterns, their development is substantially impacted by the biological characteristics of the grape variety, as well as environmental and anthropogenic factors. Given their adaptability, the mechanical properties of grapes are influenced by a wide range of factors. Annual weather variations play a crucial role, as different weather conditions each year can significantly impact grape development. Topographic factors such as the gradient and exposure of slopes, as well as the altitude at which the grapes are grown, also affect their growth and quality. The health of the grapevine is another important factor, with healthier vines typically producing better-quality grapes. The positioning of bunches on the vine influences their exposure to sunlight and air circulation, which can affect both their mechanical properties and their overall development. Morphometric characteristics, including the size and shape of bunches and berries, are critical indicators of grape quality and suitability for various uses.

The degree of berry ripeness at the time of harvest is essential for determining the final product's taste and suitability for winemaking or table consumption. Agricultural practices are equally significant in shaping the mechanical properties of grapes. Effective irrigation ensures that grapes receive adequate water throughout their growth cycle, while proper fertilization provides the necessary nutrients. Green operations, such as canopy management, help optimize sunlight exposure and air flow. Managing the vine's load by controlling the number of buds and shoots can influence the size and quality of the grape bunches. Additionally, techniques such as supplementary pollination can enhance grape yield and quality. These factors collectively determine the mechanical properties and overall quality of the grapes (Nabiyev, 2008; Salimov, 2019; Sharifov, 2013; Zarmayev & Borisenko, 2018; Kulidzhanov & Bogatyrsky, 2008). The evaluation of uvological traits in indigenous grape cultivars originating from the Don region offers insights into their distinctive attributes and potential implications for viticulture (Naumova *et al.*, 2020). Similarly, the analysis of phenological and enocarpological aspects in locally grown grapevine varieties within Georgia's Kartli province presents valuable observations regarding their growth dynamics and fruit attributes (Ujmajuridze & Mamasakhlisashvili, 2017).

The advancement and broadening of fruit varieties are crucial aspects of fruit cultivation, playing pivotal roles in boosting agricultural productivity and safeguarding genetic diversity. Throughout time, scholars have utilized diverse approaches to delve into the genetic underpinnings of fruit characteristics, striving to create cultivars that suit particular environmental settings and meet consumer demands. This introduction presents an overview of three notable contributions in the realm of fruit breeding and genetic studies, emphasizing methodologies, diversity evaluation and the assessment of agrobiological parameters. These endeavors underscore the multifaceted nature of research aimed at refining fruit varieties, underscoring the significance of methodological innovation, comprehensive diversity scrutiny and meticulous analysis of agrobiological metrics in advancing the field.

2. Literature Review

Masyukova's research (1973) on fruit breeding and genetic studies provides a fundamental insight into the methodologies integral to fruit breeding programs. This extensive text delineates a range of breeding techniques and genetic principles necessary for the advancement of new fruit varieties with enhanced traits. The methodologies elucidated in this publication continue to be a valuable resource for fruit breeders and geneticists, offering guidance in the selection and hybridization of parent varieties to attain desired characteristics. Naumova & Novikova's (2020) investigation delves into the extensive array of grape cultivars within the Don Ampelographic collection, with a particular emphasis on their morphological attributes. This scholarly inquiry enriches our comprehension of grape diversity by illuminating discrepancies in crucial morphological features across various grape cultivars. Through the meticulous examination of morphological traits, the study furnishes discernment into the genetic heterogeneity inherent in the collection, thereby furnishing pertinent data for both grape breeders and conservationists. Studennikova (2019) examines the uvological and agrobiological performance of Kokur white grape on different rootstocks for clone breeding, evaluating factors like yield and berry quality. These findings, along with other studies in fruit breeding and genetics, highlight the significance of advancing methodologies and understanding rootstock-scion interactions to develop superior fruit varieties, crucial for sustainable agriculture amidst changing environmental conditions. Makarov et al. (2018) investigate the changes in the phenolic complex of grape varieties from the Magarach Institute as they transition from grapes to sparkling wine, analyzing how phenolic compounds evolve through the winemaking stages. Their findings highlight significant modifications in the phenolic profile due to both grape variety properties and winemaking practices, offering crucial insights for optimizing sparkling wine quality.

In Azerbaijan, Salimov (2016) underscores the wealth of indigenous grape varieties in Azerbaijan, noting the documentation of over 400 local variants, yet highlighting that only half have been collected and cataloged. The article primarily delves into detailing the ampelographic traits of specific local grape varieties from diverse Azerbaijani regions, emphasizing significant differences in morphology, biology and technology among them. This underscores the potential for further exploration and utilization of these varieties in breeding programs. Additional literature has been produced addressing analogous subjects (Salimov *et al*., 2017; 2015). In the field of ampelography, grape berries hold significance due to their role in conveying varietal characteristics and durability, while within table viticulture and the processing industry, their value lies in their size and mechanical attributes, which ultimately dictate the technological suitability of grapes (Jabaroglu, 2013; Huseynov & Ahmadli, 2017; Mikailov & Farzaliyev, 2018). During the research on the uvological organs and biological characteristics of selected grape varieties and clones, we measured indicators such as the proportions of juice, skin, stalk and seeds relative to the total bunch mass. Additionally, we recorded the weight of 100 berries, the weight of 100 seeds, the number of berries per bunch, the percentage of berries in bunches, solid residue, the skeleton (skin and stalk) and the ratio of pulp or juice to the skeleton, among other factors.

3. Methodology

The material for this research included both local and introduced grape varieties grown in the Absheron ampelographic collection and at the Shamakhy Experimental Station of the Research Institute of Viticulture and Winemaking. The study was conducted over a three-year period from 2019 to 2021. The vineyards were irrigated and followed a planting scheme of 3.0 x 1.5 meters, employing a multi-arm fan formation for the grapevines to ensure optimal growth and management. This methodological approach allowed for a comprehensive assessment of the grape varieties under controlled conditions, providing valuable data on their performance and adaptability.

Morphological signs and uvological indicators of bunches and berries of the grape varieties were studied according to generally accepted methods. The digital description according to international ampelodescriptors was carried out in accordance with the OIV (2018) protocols. The proportions of the stalk and berries in the bunch, as well as the proportions of the skin (along with the remaining pulp), seeds and juice in the berry, were determined through mechanical analysis. The size and volume of berries, along with their resistance strength during crushing and separation from the peduncle, were also assessed using appropriate mechanical analysis methods.

4. Results and Discussion

In the course of our research, we examined the morphological features and indicators of bunches, berries and seeds in both local and foreign grape varieties intended for table and technical uses. When determining the length of the bunch at the studied grape varieties, it was found that this indicator varies between 13.6-28.7 cm. According to the ampelodescriptor OIV 202, with a length of 8 cm or less, a bunch is considered very small, with a length of 8-12 cm – small, with a length of 12-16 cm – medium, with a length of 16-20 cm – large, with a length of 20-24 cm or more – very large. Based on this, the bunches of the varieties Traminer pink, Chardonnay, Senso and Madrasa were rated as average (13.6-15.6 cm) and the bunches of the varieties Arna-grna (28.7 cm), Shirvanshahy (24.5 cm), Hamashara (24.0 cm), Mtsvane (21.6 cm), Marselan (21.4 cm) were estimated as very large ones.

In addition to the length, the indicator of the bunch width was also studied by us during the research work. This indicator varied between 6.7-11.4 cm. The minimum width of a bunch was noted on eight varieties. The lowest indicator in width was in the Shiraz variety (6.7 cm). On other varieties, the width of the bunches was estimated as average. In the varieties Arna-grna (11.4 cm) and Hamachara (11.2 cm), the width of the bunches was more than average. Very narrow, wide and very wide bunches were not found in the studied varieties.

During the research, we also studied the bunch mass index. The mass of the bunches is one of the indicators that affect the yield. The higher the mass of the bunches, the greater the grape harvest. In the varieties studied by us, the mass of the bunch varied within 96.2±13.8 - 597.0±32.6 g. According to the descriptor OIV 502, if the mass of one bunch is 100 g and below, the bunch is considered very small, if 150-250 g – small, if 350-450 g – medium, if 650-950 g – large, if 1200 g and above – very large. Among the varieties we studied, only the Chardonnay variety had very small bunches (96.2± 13.8 g). Small bunches were observed in eleven varieties: Bayanshira (236.4±27.4 g), Grenage black (223.2±11.4 g), Madrasa (249.0±12.8 g), Sauvignon blanc (218.6±18.4 g), Aleatico (192.8±8.4 g), Alicante Boucher (188.6±7.5 g), Marsanne (246.2±14.6 g), Montepulciano (218.6±11.8 g), Senso (168.4-7.6 g), Carignan (159.1±26.5 g). Medium-sized bunches were observed only at the Hamashara variety (380.8±24.4 g). There were no large and very large bunches of the studied varieties. But in the varieties Moldova (335.0±26.4 g), Khindogny (346±16.4 g), Hamashara (380.8±24.4 g) and Arna-grna (482.0±28.4 g), the mass of the bunches was higher than in other varieties.

The bunches of the grape varieties we studied also differed in volume. The volume of the bunches varied within 96.7-560.6 ml. The minimum indicator was noted on the Chardonnay variety (96.7 ml). Arna-grna (560.6 ml), Shirvanshahy (502.8 ml) and Hamashara (480.4 ml) varieties significantly surpassed other varieties in terms of bunch volume. The bunches of the other varieties turned out to be about the same volume.

In the course of research, we determined the height of vines of the studied grape varieties. It turned out that the height of the vines varies in the range of 87.7-308.4 cm. The highest vines were noted at the Arna-grna variety (308.4 cm), medium ones were noted at the Shirvanshahy (240.6 cm) and the Marselan (210.3 cm) varieties. The remaining varieties were rated as low on this indicator. Very low vines were found only at the Shiraz variety (87.7 cm).

We also studied the indicators of the size of berries (length and width). As you know, the size of the berries affects the mass of the bunches. The more the number of berries in a bunch and the larger their size, the higher the average mass of the bunches. And this, in turn, has a positive effect on grapevine productivity. As a result of the study, it turned out that the width of the berries of the studied grape varieties changes within 11.1-19.2 mm and the length – within 11.4-24.4 mm. According to the descriptor OIV 220, with a length of up to 8 mm, the berry is considered very short, with a length of 8-13 mm – short, with a length of 13-18 mm – medium, with a length of 18-23 mm – long, with a length of 23-28 mm and more – very long. There were no very short berries among the varieties we studied. Short berries were noted at the Chardonnay variety (11.4 mm), long berries – at the Montepulciano variety (19.0 mm), very long ones – at the Moldova variety (24.4 mm). The other varieties had medium-length berries.

In accordance with the descriptor OIV 221, a berry is considered very narrow if its width is 8 mm or less, narrow – if the width is 8-13 mm, medium – if the width is 13-18 mm, wide – if the width is 18-23 mm, very wide – if the width is 23-28 mm or more. In the grape varieties studied by us, the width of the berry varied between 11.1-19.2 mm. Very narrow and very wide berries were not found. The Chardonnay (11.1 mm) and Shiraz (12.0 mm) varieties had narrow berries and the Arna-grna (19.2 mm) variety had wide berries. The berries of the remaining varieties were rated as average. The smallest in size (both in length and width) were the berries of the Chardonnay variety.

According to the descriptor OIV 503, if the mass of one berry is less than 1 g, it is considered very small, if 1.13-3 g – small, if 3.1-5 g – medium, if 5.1-7 g – large, if 7.1-9 g and more – very large. In the grape varieties studied by us, the mass index of one berry varied within 1.83-4.92 g. The Arna-grna variety (4.92 g) significantly surpassed other varieties in this indicator. According to the descriptor OIV 503, this variety was rated as average. The remaining varieties were classified as small. Very small, large and very large berries were not noted.

Depending on the species and variety, grape seeds vary both in shape, size and color and in weight. When evaluating seeds according to the descriptor OIV 243, they are classified as very small if their mass is 4-10 mg, as small if the mass is 10.1-25 mg, as medium if the mass is 25.1-40 mg, as large if the mass is 40.1-55 mg and as very large if the mass is greater than 65 mg. Based on this, the varieties Moldova (38.8 mg), Shiraz (32.2 mg), Chardonnay (30.0 mg), Semillon (36.1 mg) and Carignan (36.1 mg) by seed weight were evaluated as average, the varieties Bayanshira (44.1 mg), Marselan (46.4 mg), Marsanne (45.5 mg), Mtsvane (43.4 mg), Montepulciano (46.6 mg), Sauvignon blanc (48.6 mg), Roussanne (48.4 mg) – as large and varieties of Khindogny (92.0 mg), Shirvanshahy (114.6 mg), Madrasa (86.6 mg), Aleatico (68.8 mg), Alicante Boucher (68.8 mg), Traminer pink (83.6 mg), Grenage black (76.6 mg), Ugni blanc (84.5 mg) – as very large. There were no varieties with very small and small seeds.

Table 1. Morphological features of bunches, berries and seeds of the studied technical grape varieties

Grape variety	Bunch length (cm)	Bunch width (cm)	Bunch weight (g)	Bunch volume (ml)	Vine height (cm)	Berry width (mm)	Berry length (mm)	Weight of one berry (g)	Weight of one seed (mg)	Number of seeds in a berry (pcs.)
Arna-grna	28,7	11,4	482,0±28,4	560,6	308,4	19,2	22,4	4,92	130,0	2,08
Bayanshira	17,2	8,9	236,4±27,0	240,7	156,7	16.1	17.2	2,32	44.1	1.97
Khindogny	18,6	9,8	346±16,4	332,8	162,4	17,8	18,8	2,36	92,0	1,46
Hamashara	24,0	11,2	380,8±24,4	480,4	117,7	14.2	14.9	2.84	56.3	1.34
Shirvanshahy	24,5	10,6	597,0±32,6	502,8	240,6	15,4	16,2	1,97	114,6	1,53
Madrasa	15,6	7,8	249,0±12,8	270,5	112,4	18,2	18,8	2,45	86,6	1,36
Aleatico	17,4	8,6	192,8±8,4	246,5	153,5	14,6	14,8	1,96	68,8	2,12
Alicante Boucher	18,4	8,8	188,6±7,5	224,8	144,4	16,4	16,8	2,08	95,4	2,14
Traminer pink	13,6	7,6	146,6±6,8	330,0	104,4	18,2	18,8	2,52	83,6	1,93
Grenage black	17,8	8,3	223,2±11,4	210,4	144,6	17,4	17,6	2,08	76,6	1,77
Marselan	21,4	9,4	254,4±12,8	224,6	210,3	16,6	16,8	2,28	46,4	1,63
Marsanne	19,8	9,2	246,2±14,6	242,4	171,4	16,4	16,8	193	45,5	1,78
Mtsvane	21,6	8,6	258,8±14,2	235,4	176,3	17,6	17,8	1,88	43,4	1,36
Montepulciano	22,4	8,8	218,6±11,8	208,5	198,6	18,2	19,0	1,93	46,6	1,88
Moldova	16,8	10,6	335,0±26,4	321,5	170,2	16,4	24,4	1,96	38,8	1,65
Senso	15,4	7,8	168,4±7,6	158,4	120,5	16,5	17,2	1,98	56,0	2,14
Semillon	16,1	8,6	140,1±11,3	126,5	106,7	13.9	13.8	2,18	36.1	2.17
Sauvignon blanc	17,4	8,0	218,6±18,4	200,8	136,0	14,2	15,4	2,25	48,6	2,33
Ugni blanc	16,6	7,4	254,6±32,5	246,4	136	16,5	17,2	2,52	84,5	1,67
Shiraz	18,0	6,7	113,6±16,5	100,8	87,7	12.0	13.2	2,25	32.2	2.27

Carignan	18,3	7,4	159,1±26,5	136,5	92,3	14.4	14.9	1,83	36.1	1.63
Chardonnay	14,7	7,0	96,2±13,8	96,7	96,6	11.1	11.4	1,86	30.0	2.20
Roussanne	18,6	7,8	146±8,72	142,4	152,6	14,4	14,8	1,92	48,4	1,21

Table 2. Some morphometric and morphological indicators of the studied grape varieties and forms (on average for 2019-2021)

Grape variety	Mechanical parts of the bunch, %			Juice output from 100 berries, %	Weight of 100 berries, g	Sugar content, g/100 cm^3	Titratable acidity, g/dm^3	pH
	stalk	solid residue	juice					
Arna-grna	6,2	20,6	73,2	86,4	481	14,5	6,4	3.60
Bayanshira	4,3	21,8	73,9	80,4	228	17,0	7,4	3.18
Shirvanshahy	4,0	22,7	73,3	86,8	187	25,0	4,4	3.49
Madrasa	5,1	22,6	72,3	83,6	121	23,0	5,5	3,22
Khindogny	4,8	20,2	75,0	86,5	162	21,6	6,2	3,46
Hamashara	4,0	22,0	74,0	81,6	212	21,8	5,2	3,44
Gyanjavi	7,1	27,7	65,2	71,6	341	24,0	4,3	3,72
Saperavi	4,2	28,3	67,5	80,2	112	21,0	7,9	3.29
Rkatsiteli	5,6	23,4	71,0	78,8	192	22,3	5,4	3.44
Roussanne	6,8	24.2	69,0	82,4	192	22,8	6,3	3.36
Chardonnay	4,8	27,2	68,0	82,6	154	18,5	6,8	3,34
Moldova	3,1	20,1	76,8	76,3	317	18,0	7,2	3,15
Aleatico	6,0	22,5	71,5	75,4	206	19,0	6,3	2,98
Alicante Boucher	3,9	22,3	73,8	82,6	206	19,0	5,5	3,54
Traminer pink	3,6	25,4	71,0	78,4	246	22,6	3,2	3,40
Grenage black	4,4	20,4	75,2	76,8	208	20,0	6,4	3,21
Marselan	3.8	22,2	74,0	86,2	228	22,6	5,8	3,48
Marsanne	3,3	25,1	71,6	79,6	193	19,7	7,0	3,92
Mtsvane	2,0	29,5	68,5	78,8	198	18,0	7,1	3,96
Montepulciano	7,0	29,5	63,5	80,3	193	23,2	6,5	3,86
Senso	4,0	26,0	70,0	78,4	196	18,2	8,2	3,75
Semillon	3,8	21,4	74,8	86,4	198	21,6	7,6	2,98
Sauvignon blanc	5,5	21,5	72,5	79,4	208	22,6	4,2	2,92
Ugni blanc	4,0	16,0	80,0	85,6	246	19,6	6,4	3,52
Shiraz	4,9	49,9	45,8	87,2	220	22,8	5,0	3,48
Carignan	3,7	39,9	57,0	87,8	225	23,0	5,0	3,56

When digitally evaluating the seeds of the varieties we studied, the number of seeds in the berry was also determined by the descriptor OIV 623. It turned out that in most of the studied varieties, the number of seeds in the berry is 1 or 1-2. There were no seedless varieties, as well as varieties with 2-3, 3-4, 4 or more seeds.

During the research work, we studied the uvological indicators of local and introduced technical grape varieties. The percentage of the most significant mechanical parts of the bunch, such as stalk, solid residue and juice, was determined. It turned out that the proportion of stalk in a bunch varies in the range of 2.0-7.1%. The Gyanjavi (7.1%) and Montepulciano (7.0%) varieties had a higher percentage of stalk and the Mtsvane variety (2%) had a low one. The solid residue content of the studied grape varieties ranged from 16.0-49.9%. The highest content of solid residue relative to other varieties was observed at the Shiraz variety (49.9%) and the minimum – at the Ugni blanc variety (16.0%).

In the field of grape processing, juice yield plays a crucial role. For technical varieties, this indicator is of decisive importance; the higher the juice yield, the greater the technological suitability. In the local and introduced technical grape varieties we studied, the juice yield ranged from 45.8% to 80.0%. The Ugni blanc variety (80.0%) significantly surpassed other varieties, reaching the maximum yield, while the minimum yield was noted in the Shiraz variety (45.8%).

One of the main uvological indicators of grape varieties is the juice yield from 100 berries. According to the OIV descriptor 233, the juice yield from 100 berries is considered very low if it is 50% or less, low if it is 51-65%, medium if it is 66-75%, high if it is 76-90% and very high if it is 91% or more. In the grape varieties we studied, the juice yield from 100 berries varied from 71.6% to 87.8%. The Gyanjavi (71.6%) and Aleatico (75.4%) varieties had an average juice yield, while the rest had a high yield. There were no varieties with very low, low, or very high juice yields. According to the OIV descriptor 503, berries are classified as very small if the mass of 100 berries is 100 g or less, small if the mass is 110-300 g, medium if the mass is 300-500 g, large if the mass is 510-700 g and very large if the mass is 710-900 g or more. In the grape varieties we studied, the mass of 100 berries varied from 112 g (Saperavi) to 481 g (Arna-grna). Most varieties had berries rated as small. The Gyanjavi (341 g), Moldova (317 g) and Arna-grna (481 g) varieties, compared to other varieties, had a higher mass index for 100 berries and were classified as medium.

During the research, we also determined the sugar content in the berries of the studied grape varieties. The sugar content index varied between 14.5-25.0 g/100 cm^3. According to the OIV descriptor 505, the sugar content of berry juice is considered very low if it is 12 g/100 cm^3 or less, low if it is 12-15 g/100 cm^3, medium if it is 15-18 g/100 cm^3 high if it is 18-21 g/100 cm^3 and very high if it is 21-24 g/100 cm^3 or more. Based on this classification, the sugar content of the studied varieties was evaluated as follows: Arna-grna (14.5 g/100 cm^3) – low; Bayanshira (17.0 g/100 cm^3), Moldova (18.0 g/100 cm^3) and Mtsvane (18.0 g/100 cm^3) – medium; Chardonnay (18.5 g/100 cm^3), Aleatico (19.0 g/100 cm^3), Alicante Boucher (19.0 g/100 cm^3), Marsanne (19.7 g/100 cm^3), Senso (18.2 g/100 cm^3), Ugni blanc (19.6 g/100 cm^3) and Saperavi (21.0 g/100 cm^3) – high and other varieties – very high. The maximum sugar content was observed in the Shirvanshahy variety (25.0 g/100 cm^3). According to the OIV descriptor 506, the titratable acidity of grape juice is considered very low if it is 3 g/dm^3 or lower, low if it is 3.1-6 g/dm^3, medium if it is 6.1-9 g/dm^3, high if it is 9.1-12 g/dm^3 and very high if it is 12.1-15 g/dm^3 or more. In the studied grape varieties, the titratable acidity index ranged from 3.2-8.2 g/dm^3. Based on this, the titratable acidity of the varieties was assessed as low and medium. There were no varieties with very low, high or very high titratable acidity.

During the research, we also determined the pH level as an indicator of active acidity. According to the OIV descriptor 508, the pH value in the juice of the studied grape varieties was assessed as low. There were no varieties with medium or high pH levels.

5. Conclusion

Conducted over a three-year period spanning from 2019 to 2021, the study investigated morphological features and indicators pertaining to bunches, berries and seeds in both local and foreign grape varieties intended for table and technical purposes, uncovering noteworthy disparities among the examined parameters. Bunch attributes such as length, width and mass exhibited notable variations across varieties, with Arna-grna, Shirvanshahy and Hamashara displaying particularly remarkable values. Berry dimensions exhibited considerable diversity, characterized by Arna-grna boasting the broadest berries and Moldova featuring the longest, while seed weight demonstrated significant variability, with Khindogny, Shirvanshahy and Madrasa showcasing the heaviest seeds.

Furthermore, there was a wide-ranging variability in juice yield and sugar content among the varieties, with Ugni blanc recording the highest yield and Shiraz the lowest, whereas Shirvanshahy exhibited the highest sugar content. Additionally, the study noted variations in titratable acidity, predominantly classified as low across the majority of the varieties. Collectively, these findings provide valuable insights into the morphological and uvological characteristics of grape varieties in Azerbaijan, facilitating informed decisions in grapevine selection and management practices to optimize yield and quality.

References

Huseynov, M.A., Ahmadli, J.Y. (2017). Examination of the quality of food products obtained from grapes. *Collection of Scientific Works of the Research Institute of Viticulture and Winemaking*, 21, 69-73. Baku. (In Azerbaijan).

Jabaroglu, T. (2013). Processing of grape and its evaluation in the food industry. *Tekirdag: The Action Plan for the Vision of Horticulture for 2023*, 44-61.

Kulidzhanov, G.V., Bogatyrsky, A.N. (2008). Uvological assessment of local Bessarabian grape varieties in the conditions of the agricultural firm Shabo, Belgorod-Dniester district of Odessa region. *Viticulture and Winemaking*, *45*(2), 55-58. (In Russian).

Makarov, A.S., Yakimenko, Y.N., Ageyeva, N.M. & Biryukova, S.S. (2018). Peculiarities of changing the phenolic complex of grape varieties of the Magarach Institute selection in the system Grapes-wine material-sparkling wine system. *Magarach Viticulture and Winemaking*, *20*(4), 91-93. (In Russian).

Masyukova, O.V. (1973). *Methods of Breeding and Genetic Studies of Fruit Breeds*. Chisinau: Stiinza, 48. (In Russian).

Mikailov, V., Farzaliyev, E. (2018). *General Food technology*. Baku, Institute of Cooperation, 832. (In Azerbaijan).

Nabiyev, A.A., Moslemzadeh, E. A. (2008). *Biochemistry of Food products*. Baku, Elm, 444. (In Azerbaijan).

Naumova, L.G., Ganich, V.A. & Matveeva, N.V. (2020). Uvological Evaluation of Don Aborigenous grapes varieties at the Don Ampelographic Collection Named after Ya.I. Potapenko. *Pomiculture and Small Fruits Culture in Russia*, 59, 152-161.

Naumova, L.G., Novikova, L.Y. (2020). Diversity of varieties of the Don Ampelographic collection on morphological characteristics. *Viticulture and Winemaking*, 49, 74-77. (In Russian).

OIV. (2018). *Descriptor list for grape varieties and Vitis species*, 2nd edition. http://www.oiv.int/en/technical-standards-and-documents/description-of-grape-varieties/oiv-descriptor-list-for-grape-varieties-and-vitis-species-2nd-edition

Salimov, V., Musayev, M. & Asadullayev, R. (2015). Ampelographic characteristics of Azerbaijani local grape varieties. *VITIS-Journal of Grapevine Research*, 54, 121-123.

Salimov, V., Shukurov, A. & Asadullayev, R. (2017). Study of diversity of Azerbaijan local grape varieties basing on OIV ampelographic descriptors. *Annals of Agrarian Science, 15*(3), 386-395. https://doi.org/10.1016/j.aasci.2017.08.001

Salimov, V.S. (2016). Ampelodescriptor indicators of some local grape varieties of Azerbaijan. *Winemaking and Viticulture*, 6, 30-34. (In Russian).

Salimov, V.S. (2019). *Ampelographic Screening of Grapes*. Muallim, 319. (In Azerbaijan).

Sharifov, F.H. (2013). *Viticulture*. Sharg-Garb, 584. (In Azerbaijan).

Studennikova, N.L. (2019). The study of uvological and agrobiological indicators of the Kokur white grape variety on various rootstocks for clone breeding. *Viticulture and Winemaking, 21*(2), 105-108. (In Russian).

Ujmajuridze, L., Mamasakhlisashvili, L. (2017). Phenological and Enocarpological study of local grapevine varieties from Kartli province of Georgia. *Bulletin of Georgian Academy of Agricultural Sciences, 2*(38), 84-85.

Zarmayev, A.A., Borisenko, M.N. (2018). *Selection, Genetics of Grapes and Ampelography*. Simferopol: Foroma LLC, 406. (In Russian).