



QUALITY ASSESSMENT OF ORGANIC WINES PRODUCED FROM DIVERSE GRAPE (*VITIS VINIFERA* L.) CULTIVARS IN AZERBAIJAN

M.A. HUSEYNOV^{1*}, L.R. EYYUBOVA², S.F. RAHIMOVA¹, S.A. MAMMADOVA¹,
 A.A. ADILOV², and M.H. MAHARRAMOVA¹

¹Azerbaijan State University of Economics, UNEC, Baku, Azerbaijan

²Scientific Research Institute of Viticulture and Wine-making, Baku, Azerbaijan

*Corresponding author's email: movlud.huseynov@unec.edu.az

Email addresses of co-authors: leyla.eyyubova@vitis.agro.gov.az, samaya.rahimova@unec.edu.az,
mammadova.saida.alim.2025@unec.edu.az, adilovafiq987@gmail.com, mehriban.maharramova@unec.edu.az

SUMMARY

Investigating the current state of organic wine produced from autochthonous and introduced grape (*Vitis vinifera* L.) cultivars on the increasing demand of organic products worldwide was the focus of this study. Organic wines underwent comparative assessment with conventional winemaking practices, with the variations in its quality traits also analyzed. Particular attention centered on certification issues and the significance of developing organic wine production in Azerbaijan. The analytical study proceeded on organic wine samples produced from different grape cultivars in the Mountainous Shirvan Region. The results revealed organic wines were relatively less complex in terms of aroma and bouquet compared with conventional wines. However, organic wines appeared considerably easier to assimilate by consumers, although both types of wines showed similar drinking comfort characteristics. The concentration of sulfur dioxide (SO₂), being a vital quality parameter, ranged between 19.3 and 33.8 mg/L and was within the limits established by regulatory standards. The analysis enunciated that organic wines produced from different grape cultivars possess the highest physicochemical quality indicators. Alcohol content, acidity, phenolic profile, and SO₂ levels complied with technological and international standards.

Keywords: Organic wine, grape (*V. vinifera* L.) cultivars, environmentally friendly production, viticulture, Ecovin certification, physicochemical analysis, sensory evaluation

Key findings: The analysis of organic biowine samples produced from different grape (*V. vinifera* L.) cultivars showed the highest quality indicators for physicochemical parameters. Alcohol content, acidity, phenolic profile, and SO₂ levels complied with technological and international standards.

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INTRODUCTION

Viticulture and winemaking represent important sectors of the agricultural economy in Azerbaijan. Considering the country's considerable potential in this field, several vital policy measures have successfully employed support for the development of this industry. In 2001, the law 'On Viticulture and Winemaking' received approval from the great leader Heydar Aliyev. Later, the 'State Program on the Development of Winemaking in the Republic of Azerbaijan for 2012–2020' and the 'State Program on the Development of Winemaking in the Republic of Azerbaijan for 2018–2025' also gained approval by presidential decrees. In past years, the vineyard areas and the grape (*Vitis vinifera* L.) production have notably increased in the republic. By comparing with previous years, the grape productivity has shown considerable improvement in the country. Many studies have been progressive to ensure the sustainable development of viticulture based on scientific strategies and to preserve valuable local grape cultivars that served as raw material for wines recognized internationally. However, the research related to organic grape production and organic winemaking remains limited, highlighting the need for further scientific investigations in Azerbaijan (Mustafayev *et al.*, 2025; Salimov *et al.*, 2025).

Currently, the concept of 'organic products' is widely evident in food retail markets. The conventional agricultural system mainly focuses on maximizing the yield and productivity per unit area, while organic production prioritizes environmental sustainability, product safety, and quality. For organic food products, the organically grown raw materials are often sufficient. However, in organic winemaking, it is not enough for the grapes alone to undergo production organically; the entire technological process must also comply with specific restrictions. One of the most important limitations concerns the use of sulfur dioxide (SO₂), which is a widely utilized element at different stages of conventional winemaking as an antioxidant and antimicrobial agent. However, in organic wine production, the SO₂ application either entails significant restrictions or total avoidance (Uygun *et al.*,

2018; Nabiye *et al.*, 2025; Bagirzade *et al.*, 2024b).

The origin of organic winemaking has its common association with France. Following World War II, a small group of French farmers returned to natural cultivation practices with less dependency on chemical fertilizers and pesticides. With the rise of ecological awareness during the 1960s, the organic viticulture gradually expanded throughout Europe and later reached the United States. In Azerbaijan, organic viticulture has been developing in the Shamakhi Region, where organic vineyards have successful establishments and organic wine production has gained initiatives. Organic grape cultivation basically relies on the biological plant protection measures using plant-based and mineral preparations instead of synthetic pesticides. Fertilization practices typically involve composted plant material, decomposed leaves, and organic residues derived from vineyard wastes (Capp, 2002; Kose and Odabash, 2005; Bagirzadeh *et al.*, 2023). For organic viticulture, the vital requirement was that vineyards must either reached establishment on land never receiving treatment with synthetic chemicals or must undergo a conversion period of at least three years before obtaining an organic certification (Maykish *et al.*, 2021; Kazimova *et al.*, 2025).

Organic certification plays a crucial role in distinguishing organic products from conventional ones. Certification procedures ensure transparency and prevent false labeling while protecting consumers. In several countries, including European states and the United States, both organic grape production and organic wine production are subject to certification. Organizations, such as Ecovin, initially provided certification in Germany. Organic certification criteria typically include the use of healthy grapes, with careful processing, restrictions on synthetic agents, and reduced reliance on sulfur dioxide (Parpinello *et al.*, 2019; Kazimova *et al.*, 2024; Bagirzade *et al.*, 2024a).

In organic agriculture, the community interest has gained gradual enhancement in previous years in Azerbaijan (Uygun *et al.*, 2018; Gumbatov *et al.*, 2024). In the Mountainous Shirvan Region, the conduct of

certified organic wine production was successful. Vineyards on larger areas have achieved establishment without using chemical fertilizers and pesticides, with modern wineries succeeding in construction to support the organic wine production. In this region, vineyards include both local and introduced grape cultivars, such as Madrasa, Shirvanshahi, Khindogni, Saperavi, Carignan, Mourvedre, Cinsault, Grenache Noir, Marselan, Bayanshira, Rkatsiteli, Roussanne, Marsanne, and Kakhuri Mtsvane. In these vineyards, the design of viticultural practices ensured moderate yields (around seven tons per hectare) and also maintained high-quality grapes. Several vineyards' cultivation continued under rainfed conditions, ensuring no use of mineral fertilizers, and the vine root systems developed deeper within the soil profile, allowing plants to absorb greater quantities of mineral nutrients from the soil. As a result, grapes produced under these conditions often possess a rich mineral composition, contributing to the production of wines with fresh and balanced sensory characteristics (Huseynov *et al.*, 2025; Teymurov *et al.*, 2026).

MATERIALS AND METHODS

The wine samples produced from local and introduced technical grape (*V. vinifera* L.) cultivars during 2024–2025 were the selected research material. The technological processing conditions and regimes, as well as the physicochemical and organoleptic quality parameters of the wines, were the main objects of these investigations (Fataliyev, 2011; Mammadov *et al.*, 2025). Laboratory analyses of organic wine samples produced in the Mountainous Shirvan Region proceeded using a modern FOSS Winescan FT 120 laser analyzer, while determination of sulfur dioxide (SO_2) content continued using the classical analytical method (GOST, 2014; Shukurova *et al.*, 2026), in accordance with the requirements of GOST 32115-2013. Each analysis took place at least three times to ensure the reliability and reproducibility of results.

The research methodology relied on a comprehensive approach to the tasks set in the study. This included the evaluation of various technological factors, starting from agrotechnical practices used in grape cultivation, as well as the production processes and quality variables of white, rosé, and red wines (Fataliyev, 2011; Huseynov *et al.*, 2026a). In determining the optimal technological conditions during production stages, complex physicochemical analyses ensued to examine the principal compositional components of wine materials (Fataliyev, 2011; Salimov and Huseynov, 2025).

The main differences between organic and conventional wine production can have this summarization, as follows:

- Grapes intended for organic wine production underwent manual harvests under cool environmental conditions. This method allows the removal of damaged and undesirable berries because preferred organically grown grapes may be more sensitive. In conventional production, mechanical harvesting may also be applicable (Capp, 2002; Huseynov and Aghayev, 2024).
- After transporting to the winery under appropriate conditions, grapes required immediate processing. Delays between technological stages were unacceptable (Capp, 2002).
- If immediate processing is not possible, applying cold treatment is essential to separate sediment from the must (Capp, 2002; Asadullayev *et al.*, 2024).
- Particular attention must be in minimizing the use of sulfur dioxide (SO_2), which serves a common application as an antioxidant and antimicrobial agent. The permitted total SO_2 content in bottled organic wines varies by country regulations. In Australia and New Zealand, it should not exceed half of the amount permitted in conventional wines; in some European countries, the limit is approximately 60 mg/L for white wines and 40 mg/L for red wines, while according to USDA regulations, the maximum permitted level is 100 mg/L (Capp, 2002; Amanova *et al.*, 2026).
- Organic wine production generally favors spontaneous fermentation using naturally

occurring yeasts found on the grape surface. It is typical that pesticides and insecticides negatively affect the development of natural yeasts. Additionally, some pure yeast strains may produce hydrogen sulfide, which must also be considered (Capp, 2002; Huseynov *et al.*, 2026c).

- After fermentation, wines usually require rapid completion and stabilization because the protective effect of sulfur dioxide is beneficial only to a limited extent (Capp, 2002; Najafov *et al.*, 2026).

- In large-scale production, using nitrogen or carbon dioxide gases serves to prevent contact with atmospheric oxygen (Capp, 2002; Kulihev *et al.*, 2026).

- Physical operations, such as filtration and clarification, are applicable at the minimum level necessary.

- Small amounts of oxygen may be essential to accelerate the maturation process of wines.

- The use of sorbic acid and potassium sorbate, which are sometimes applied in conventional wine production to increase stability, is nonpermissible in organic winemaking (Capp, 2002; Mammadov *et al.*, 2026).

- Chlorination of cork materials used in bottle stoppers is unallowable because chlorine residues may migrate into the wine (Capp, 2002; Musayeva *et al.*, 2026).

- Hot filling methods should not be applicable in organic wine production because of their potential negative impact on mineral components and vitamins (Capp, 2002; Sadigov *et al.*, 2026a).

- Cleaning must require using water suitable for hygienic purposes, often under pressure. High-pressure hot steam may be desirable for cleaning hard-to-reach areas. In some countries, the use of 1% caustic soda solution, sulfur dioxide in tartaric solution, and citric acid is allowable for removing the difficult contaminants (Capp, 2002; Sadigov *et al.*, 2026b).

Statistical analysis

The studied properties of the wine sustained evaluation using one-way analysis of variance (factorial ANOVA). The Tukey's b post-hoc test ($p < 0.05$) proceeded using IBM SPSS software

version 27. A Pearson correlation matrix also entailed calculations for all parameters at a significance level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

In the comparison of organic and conventional wines produced from local and introduced technical grapes (*V. vinifera* L.), the organoleptic characteristics appear in Table 1. Overall, the organic wines showed a weaker aroma and bouquet than conventional wines for the said traits. In color stability, conventional wines—especially the white wines—were notably better than organic wines; however, organic wines are much easier to assimilate compared with conventional wines. In terms of drinking comfort, both wines demonstrated similar indicators (Table 1). The analysis of organic wine samples produced in the Mountainous Shirvan Region using the modern FOSS Winescan FT 120 laser analyzer, as well as the total SO_2 determined by the classical method (GOST, 2014) following the requirements of GOST 32115-2013, occurs in Tables 2, 3, and 4.

The results exhibited that the compositional parameters of wine samples were at a satisfactory level for the typical organic product characteristics. This revealed the proper conduct of technological procedures both during grape cultivation and wine production. The sulfur dioxide, being one of the important indicators, ranged between 19.3 and 33.8 mg/L in wine samples, which falls within the limits established by the relevant international standards. Therefore, one can conclude that following precisely the technological measures in the application of SO_2 for antioxidant and antibacterial purposes succeeded (Capp, 2002; GOST, 2014; Uygun *et al.*, 2018).

In studying the physicochemical parameters of the studied white organic wine samples (obtained from the grape cultivars Bayan Shira, Arna Grna, Rkatsiteli, Kisi, and Kakhuri Mtsvane), certain differences were evident (Table 2). The ethanol content varied between 12.70% and 14.73%, which may be in association with the sugar accumulation potential and ripening level of grape cultivars.

Table 1. Main differences in the organoleptic characteristics of conventional and organic wines.

Characteristics	Conventional wine	Organic wine
Aroma	Strong	Weak
Bouquet	Strong	Weak
Color stability	Very good	Good
Digestibility	Easy	Easier assimilation
Drinking comfort	Positive	Positive

Table 2. Physicochemical parameters of organic white bio-wines obtained from different technical grape cultivars using the modern FOSS Winescan FT 120 laser analyzer and determination of total SO₂ by the classical method (in accordance with the requirements of GOST 32115-2013).

No.	Indicators	Grape cultivars' wine samples				
		Bayanshira	Arna Grna	Rkatsiteli	Kisi	Kakhuri Mtsvane
1	Density (g/L)	0.98904	0.98922	0.98790	0.98794	0.98820
2	Ethyl alcohol (%)	13.11	12.70	14.73	14.73	14.02
3	Residual sugar (g/L)	0.55	1.02	1.54	1.40	1.25
4	Glucose+Fructose (g/L)	1.30	1.00	1.72	1.57	1.18
5	Extract (g/L)	17.25	17.32	19.53	19.34	17.65
6	PH	3.46	3.32	3.43	3.42	3.53
7	Total acidity (g/L)	4.2	4.82	5.04	5.01	4.38
8	Volatile acidity (g/L)	0.6	0.34	0.44	0.40	0.46
9	Malic acid (g/L)	0.13	0.16	0.75	0.73	0.19
10	Lactic acid (g/L)	1.22	1.08	-0.16	0.15	2.74
11	Tartaric acid (g/L)	2.91	3.72	3.47	3.39	3.05
12	Citric acid (g/L)	-0.35	-0.25	-0.34	-0.34	-0.35
13	Glycerol (g/L)	7.78	6.35	8.53	8.42	7.63
14	Methanol (mg/L)	0.06	0.06	0.08	0.08	0.06
15	Potassium ion	0.54	0.53	0.58	0.64	0.73
16	SO ₄	0.23	0.26	0.16	0.20	0.24
17	Ash (g/L)	0.96	1.05	1.12	1.15	1.41
18	Total polyphenols (g/L)	306	282	408	465	478
19	Anthocyanins (/L)	-104	-155	-180	-160	-127
20	Tannins (g/L)	0.87	0.59	0.7	0.73	0.78
21	Total SO ₂ (mg/L)	32.7	33.8	31.2	33.1	31.9

According to the influence of phenolic and sugar balance on fermentation outcomes in organic viticulture systems, the recent studies considerably supported the present results (Parpinello *et al.*, 2019; Costafreda-Aumedes *et al.*, 2025).

The residual sugar content ranging from 0.55 to 1.54 g/L revealed that the samples belong to the dry wine category. The pH values ranged between 3.32 and 3.53, which provides favorability for microbiological stability and sensory balance. Total acidity ranged from 4.2 to 5.04 g/L, which corresponds to a harmonious acidity profile for white wines. In the concentrations of malic and lactic acids, the

considerable differences exhibited that partial malolactic fermentation occurred in some wine samples. Recent studies also reported that malolactic fermentation softens the texture of wine and improves overall sensory quality (Geffroy *et al.*, 2021; Candar, 2024; Huseynov *et al.*, 2026b).

The variations in total polyphenols (282 to 478 mg/L) reflect the influence of varietal characteristics and technological processing conditions. In particular, the high polyphenol content observed in the Kisi and Kakhuri Mtsvane samples revealed an increase in antioxidant potential. The total SO₂ level ranged between 31.2 and 33.8 mg/L,

Table 3. Physicochemical parameters of organic rosé bio-wines produced from different technical grape cultivars were determined using the modern FOSS Winescan FT 120 laser analyzer, with the total SO₂ content analyzed by the classical method, in accordance with the requirements of GOST 32115-2013.

No.	Indicators	Grape cultivars wine samples		
		Madrasa	Khindogni	Shirvanshahi
1	Density (g/L)	0.99218	0.99158	0.99345
2	Ethyl alcohol (%)	11.42	11.29	11.17
3	Residual sugar (g/L)	1.34	1.26	1.50
4	Glucose+Fructose (g/L)	1.10	1.15	1.14
5	Extract (g/L)	19.38	17.90	20.11
6	PH	3.24	3.45	3.35
7	Total acidity (g/L)	5.85	5.16	6.04
8	Volatile acidity (g/L)	0.46	0.55	0.46
9	Malic acid (g/L)	0.13	0.19	0.15
10	Lactic acid (g/L)	2.85	2.69	2.91
11	Tartaric acid (g/L)	3.54	3.80	3.93
12	Citric acid (g/L)	-0.16	-0.23	-0.12
13	Glycerol (g/L)	7.15	6.43	7.20
14	Methanol (mg/L)	0.17	0.15	0.15
15	Potassium ion	0.54	0.64	0.66
16	SO ₄	0.23	0.16	0.21
17	Ash (g/L)	1.29	1.35	1.48
18	Total polyphenols (g/L)	822	750	892
19	Anthocyanins (g/L)	-2	-62	-6
20	Tannins (g/L)	0.64	0.75	0.40
21	Total SO ₂ (mg/L)	32.2	19.3	30.9

confirming the relatively low levels accepted for organic winemaking (OIV, 2025). The rosé organic wines produced from grape cultivars Madrasa, Khindogni, and Shirvanshahi were characteristic of moderate alcohol content (11.17%–11.42%) and relatively high total acidity (5.16–6.04 g/L) (Table 3). These indicators correspond to the fresh and fruity sensory profile typical of rosé wines.

The polyphenol content, ranging between 750 and 892 mg/L, detailed the highest level of phenolic extraction compared with white wines, which can be because of the short-term skin contact stage. Past studies reported that in rosé wines, the phenolic compounds play an important role in color stability and resistance to oxidation (Ribereau-Gayon *et al.*, 2021). The presence of lactic acid (2.69–2.91 g/L) revealed the activity of malolactic fermentation and showed that a more balanced taste profile emerged due to softening of the acidity (Mirade-Orduña, 2021).

According to the results presented in Table 4, the ethanol content in red organic wines ranged at 12.41%–14.66%. The higher alcohol content in grape cultivars Marselan, Carignan, and Mourvedre indicated the superior level of phenolic maturity. The extract content ranging between 23.40 and 27.74 g/L stated that red wines have a robust structural potential. The total acidity variations, ranging from 5.64 to 7.40 g/L, together with the pH values, demonstrated the presence of optimal conditions ensuring microbiological stability.

The concentration of phenolic compounds ranged from 1775 to 3741 mg/L, with the maximum value observed in the Carignan grape sample. Anthocyanin content, ranging between 216 and 982 mg/L, revealed the highest color intensity and aging potential. In present studies, the constant increase in phenolic synthesis under organic viticulture conditions was also consistent with previous findings (Cravero, 2019; Bora *et al.*, 2022).

Table 4. Physicochemical parameters of organic red bio-wines produced from different technical grape cultivars using the modern FOSS Winescan FT 120 laser analyzer, as well as the determination of the total SO₂ content by the classical method, in accordance with the requirements of GOST 32115-2013.

No.	Indicators	Grape cultivars' wine samples								
		Marselan	Cinsault	Carignan	Grenaj noir	Mourvedre	Saperavi	Madrasa	Khindogni	Shirvanshahi
1	Density (g/L)	0.99115	0.99060	0.99158	0.99155	0.98995	0.99190	0.99185	0.99341	0.99298
2	Ethyl alcohol (%)	14.60	14.47	14.60	13.76	14.66	13.93	14.10	12.52	12.41
3	Residual sugar (g/L)	1.44	1.19	0.49	1.14	1.47	1.05	1.54	2.11	2.27
4	Glucose+Fructose (g/L)	2.22	2.12	1.72	1.77	2.30	1.85	1.53	1.69	2.21
5	Extract (g/L)	23.71	24.93	27.49	27.74	23.40	25.64	27.01	25.23	23.63
6	PH	3.45	3.43	3.45	3.32	3.44	3.46	3.26	3.21	3.30
7	Total acidity (g/L)	5.64	6.16	6.64	7.40	5.64	6.74	7.20	7.40	6.53
8	Volatile acidity (g/L)	0.55	0.60	0.44	0.58	0.60	0.59	0.50	0.48	0.50
9	Malic acid (g/L)	0.13	0.14	-0.03	0.14	0.22	-0.01	0.17	0.14	0.11
10	Lactic acid (g/L)	1.57	1.51	2.32	1.88	1.89	3.24	1.50	2.44	2.13
11	Tartaric acid (g/L)	3.16	3.72	3.65	4.42	3.15	3.64	4.59	4.75	3.97
12	Citric acid (g/L)	-0.33	-0.36	-0.24	-0.16	-0.40	-0.22	-0.16	-0.05	-0.05
13	Glycerol (g/L)	9.13	9.35	10.27	9.22	8.87	9.61	9.42	7.54	7.86
14	Methanol (mg/L)	0.14	0.15	0.15	0.24	0.18	0.20	0.21	0.22	0.21
15	Potassium ion	0.92	0.84	1.05	0.96	0.91	1.10	0.79	0.81	0.77
16	SO ₄	0.34	0.32	0.42	0.35	0.39	0.25	0.31	0.15	0.20
17	Ash (g/L)	1.55	1.52	1.91	1.95	1.56	1.86	1.71	1.72	1.56
18	Total polyphenols (g/L)	2497	2018	3741	2277	2600	2914	1985	1964	1775
19	Anthocyanins (g/L)	364	293	982	553	404	583	271	275	216
20	Tannins (g/L)	2.60	2.12	3.25	1.72	2.52	2.18	1.40	0.98	0.75
21	Total SO ₂ (mg/L)	30.7	32.2	31.9	32.5	33.6	32.2	33.4	32.5	33.3

The tannin variations were within the range of 0.75–3.25 g/L, reflecting structural differences among the studied grape cultivars and revealing the greater potential for long-term aging. The high glycerol content (7.54–10.27 g/L) suggested the successful completion of the fermentation process and contributed to the sensory softness of the wines. The total SO₂ levels (30.7–33.6 mg/L) were considerably low enough to protect wines from oxidation while still complying with organic wine production standards (OIV, 2025).

The comparative analysis of white, rosé, and red organic wines showed that red wines contained significantly higher levels of phenolic compounds and anthocyanins, while rosé wines enunciated a more vibrant acidity profile. However, the white wines exhibited a more harmonious balance between the acidity and alcohol content. These results were consistent with recent scientific approaches, indicating that organic wine production systems allow an obvious expression of terroir and enrichment of the phenolic profile (Maykish *et al.*, 2021; Van-Leeuwen and Darriet, 2023).

CONCLUSIONS

By examining the main differences between organic and conventional wines produced from local and introduced technical grapes (*V. vinifera* L.) in Azerbaijan, the results confirmed that several factors affect the chemical and organoleptic composition of both wines. In general, considering the characteristics of raw materials used and the production technology applied, organic wines proved cleaner in terms of the chemical substances used during grape cultivation and production and, therefore, were considerably safer from a health viewpoint. However, for some positive characteristics provided by the addition of sulfur dioxide, such as lower aldehyde content and lower volatile acidity, the organic wines seemed relatively poorer.

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REFERENCES

- Amanova SHS, Hajiyeva AZ, Jafarova FM, Sadigov RA, Muhammad D (2026). Vegetation development and productivity in agrolandscapes using satellite imagery and ground surveys. *SABRAO J. Breed. Genet.* 58 (2) 762-770. <http://doi.org/10.54910/sabrao2026.58.2.26>.
- Asadullayev RA, Salimov VS, Huseynov MA (2024). Grapes with fungal infection during long-term storage. *SABRAO J. Breed. Genet.* 56(5): 2026-2032. <http://doi.org/10.54910/sabrao2024.56.5.25>.
- Bagirzade A, Omarov Y, Aliyeva J, Gurbanova S, Omarova E, Gasimova A, Nabiye A (2024a). Establishing a pattern of change in the quality indicators of tokaj-type wine materials prepared by different variants. *Eastern-European J. Enterp. Technol.* 5(11): 92-108.
- Bagirzade A, Omarov Y, Haydarov E, Ismayilov M, Gasimova A, Cavadov M, Nabiye A (2024b). Improvement of technology for producing wine material for tokay wine. *Eastern-European J. Enterp. Technol.* 1(11): 52-63.
- Bagirzadeh A, Omarov Y, Hacıyeva A, Gurbanova S, Gasimova A, Ismayilov M, Nabiye A (2023). Improvement of the production technology of tokay wines on the basis of revealing the effect of enzyme activity on the quality of grape variety. *Eastern-European J. Enterp. Technol.* 2(11): 49-62.
- Bora FD, Călugăr A, Bunea C-I, Rozsa S, Bunea A (2022). Assessment of physicochemical, macro- and microelements, heavy metals, and related human health risk from organically, conventionally, and homemade Romanian wines. *Horticulturae* 8(5):382. <https://doi.org/10.3390/horticulturae8050382>
- Candar S (2024). Understanding the impact of artificial stress on the morphological characteristics of cv. 'Merlot' Berry and cluster. *Appl. Fruit. Sci.* 66:257-267. <https://doi.org/10.1007/s10341-023-01002-7>
- Capp R (2002). Insights into Growing and Making Organic Wines.
- Costafreda-Aumedes S, Leolini L, Menz C, Yang C, Argenti G, Dibari C, Bindi M, Fraga H, Santos J, Molitor D (2025). Uncertainties in predicting the medium-term future occurrence of grapevine budburst in Europe: The role of phenological models and climate scenarios. *OENO One* 59(2):1-20. <https://doi.org/10.20870/oenone.2025.59.2.8056>
- Cravero MC (2019). Organic and biodynamic wines quality and characteristics: A review. *Food Chem.* 295:334-340. doi: 10.1016/j.foodchem.2019.05.149
- Fataliyev HK (2011). Wine technology. *Science*. pp. 596.
- Geffroy O, Feilhès C, Favarel J-L, Lopez R (2021). Pre-fermentation heat treatment: A multitool technique to keep the pot boiling. *IVES Technical Reviews, vine and wine*. <https://doi.org/10.20870/ives-tr.2021.4779>
- GOST (2014). State Standard 32115-2013. Production of alcohol and corresponding raw materials. Method for determination of free and total sulfur dioxide. *Moscow: Standartinform*, pp. 10.
- Gumbatov MO, Sadigov RA, Huseynov MA, Shirinova DB (2024). Intensification of the process of producing phosphorus-containing fertilizers using industrial waste. *BIO Web Conf.* 126, 01001. <https://doi.org/10.1051/bioconf/202412601001>
- Huseynov M, Gasimova A, Salimov V, Mirzayev G, Gasimova G, Majnunlu U (2026a). Investigation of patterns associated with the effect of soil and climatic conditions at the Absheron peninsula on the quality indicators

- of introduced grape varieties and wine samples prepared from them. *East.-Eur. J. Enterp. Technol.* 2(11): 27–41. <https://doi.org/10.15587/1729-4061.2026.358676>
- Huseynov MA, Aghayev UJ (2024). Qualitative parameters of grapevine (*Vitis vinifera* L.) cultivars grown in the Mountainous Shirvan Region of Azerbaijan. *SABRAO J. Breed. Genet.* 56(5): 1994–2003. <http://doi.org/10.54910/sabrao2024.56.5.22>.
- Huseynov MA, Mirzoev G, Sadigov R, Bilgin A (2026b). Genetic diversity and distribution of macrozoobenthos species in South Caspian Sea sector of Azerbaijan. *SABRAO J. Breed. Genet.* 58 (1) 171–180. <http://doi.org/10.54910/sabrao2026.58.1.16>
- Huseynov MA, Mirzoev GS, Mamedova KHM (2026c). Assessment of vineyards' soil properties in the Mountain Shirvan Region of Azerbaijan. *SABRAO J. Breed. Genet.* 58 (3): 1464–1473. <http://doi.org/10.54910/sabrao2026.58.3.49>.
- Huseynov MA, Shukurov AS, Salimov VS, Adilov AA, Mirzoev GS, Sadigov RA, Nasibov HN, Guliyeva AA (2025). Quality characteristics of technical grape (*Vitis vinifera* L.) cultivars grown under environmental conditions of the mountains and sea. *SABRAO J. Breed. Genet.* 57(6): 2564–2573. <http://doi.org/10.54910/sabrao2025.57.6.29>
- Kazimova I, Mikayilov V, Omarova E, Gasimova A, Nabiyevev A (2025). Establishment of regularities of biochemical transformations in grape berries during refrigerated storage with preliminary thermal treatment. *Technol. Audit Prod. Reserves* 1 (3 (81)): 31–38. <https://doi.org/10.15587/2706-5448.2025.323631>
- Kazimova I, Omarova E, Nabiyevev A, Gasimova A (2024). Comparative analysis of the composition of Bayan Shirey, Rkatsiteli and Cabernet Sauvignon grape varieties for production of brandy wine materials. *Ukr. Food J.* 13(4): 694–707.
- Kose B, Odabash F (2005). Organic agriculture in viticulture. *J. Fac. Agric. OMU.* 20(3): 96–104.
- Kuliyev V, Najafov J, Asadov H (2026). Ampelographic Characteristics of New Grape Varieties. *Sci. Work.* 20 (3):230–241.
- Mammadov G, Mammadova S, Yusifova M, Sadigov R, Ahmedova G (2025). Agroecological fertility model and management of vineyard soils of the Lankaran-Astara economic region of Azerbaijan. *Int. J. Agric. Biol.* 34: 340104. <https://doi.org/10.17957/IJAB/15.2339>
- Mammadov MI, Mustafayev MG, Sadigov RG, Mustafayev FM, Akhundov AY, Muhammad D (2026). Morphogenetic diagnostics and fertility variations in dry subtropic soils with grape cultivation in Azerbaijan. *SABRAO J. Breed. Genet.* 58 (4) 1982–1991. <http://doi.org/10.54910/sabrao2026.58.4.48>.
- Maykish A, Rex R, Sikalidis AK (2021). Organic winemaking and its subsets; biodynamic, natural, and clean wine in California. *Foods* 10(1):127. doi: 10.3390/foods10010127
- Mira-de-Orduña R (2021). Microbial processes in modern winemaking. *Appl. Microbiol. Biotechnol.* 105: 567–581.
- Musayeva EV, Huseynov MA, Salimov VS (2026). Grape (*Vitis vinifera* L.) response to fertilizer combinations through agrobiological and economic efficiency in the Garabagh, Azerbaijan. *SABRAO J. Breed. Genet.* 58 (3) 1454–1463. <http://doi.org/10.54910/sabrao2026.58.3.48>.
- Mustafayev MG, Sadigov RA, Mirsalahov MM, Gurbanov EA, Jalilova LZ, Mustafayev FM, Ahmedova AR (2025). Salts deposition and groundwater mineralization effect on soil salinization in the Shirvan Plain and Ganja-Gazakh Massif, Azerbaijan. *SABRAO J. Breed. Genet.* 57(5): 2147–2155. <http://doi.org/10.54910/sabrao2025.57.5.35>
- Nabiyevev A, Kazimova I, Omarova E, Gasimova A (2025). Variation in enzymatic activity and phenolic content in grapes across maturity stages. *Ukr. Food J.* 14(2): 273–289. <https://doi.org/10.24263/2304-974X-2025-14-2-7>
- Najafov JS, Salimov VS, Salayeva ZK, Huseynov MA (2026). Appraisal of less-cultivated grape (*Vitis vinifera* L.) cultivars through productivity indicators in the Nakhchivan Region, Azerbaijan. *SABRAO J. Breed. Genet.* 58 (4) 1808–1815. <http://doi.org/10.54910/sabrao2026.58.4.31>.
- OIV (2025). Compendium of International Methods of Wine and Must Analysis. International Organisation of Vine and Wine. <https://www.oiv.int/>
- Parpinello GP, Ricci A, Rombolà AD, Nigro G, Versari A (2019). Comparison of Sangiovese wines obtained from stabilized organic and biodynamic vineyard management systems. *Food Chem.* 283:499–507. doi: 10.1016/j.foodchem.2019.01.073
- Ribereau-Gayon P, Glories Y, Maujean A, Dubourdieu D (2021). Handbook of Enology, Volume 2: The Chemistry of Wine Stabilization and Treatments, 3rd Ed., J. Wiley & Sons, Chichester, pp. 560.

- Sadigov RA, Alverdiyeva NF, Gurbanova FH, Muhammad D (2026a). Morphogenetic indicators and diagnostic criteria of alluvial-meadow soils on the northeastern slope of the lesser Caucasus, Azerbaijan. *SABRAO J. Breed. Genet.* 58 (4) 1960-1971. <http://doi.org/10.54910/sabrao2026.58.4.46>.
- Sadigov RA, Jafarova FM, Muhammad D, Hajiyeve AZ, Amanova SHS (2026b). Sainfoin (*Onobrychis Adans.*) response to mineral fertilizers through productivity and quality traits under gray-brown soil conditions. *SABRAO J. Breed. Genet.* 58 (3) 1415-1425. <http://doi.org/10.54910/sabrao2026.58.3.44>.
- Salimov VS, Huseynov MA (2025). Polymorphism features in grape (*Vitis vinifera* L.) variety Bayanshira populations. *SABRAO J. Breed. Genet.* 57(2): 516-528. <http://doi.org/10.54910/sabrao2025.57.2.11>
- Salimov VS, Huseynov MA, Huseynova AS (2025). Phenotypic variability in the vegetative generation of grape (*V. vinifera* L.) protoclonal and selection with stable signs. *SABRAO J. Breed. Genet.* 57(3): 999-1008. <http://doi.org/10.54910/sabrao2025.57.3.12>.
- Shukurova V, Huseynov M, Salimov V, Gasimova A (2026). Establishing the patterns of influence of environmental conditions on the biochemical indicators of grape must and the wine produced from it. *Technol. Audit Prod. Reserves* 1(3): 29-37. <https://doi.org/10.15587/2706-5448.2026.353015>
- Teymurov MA, Mammadov ZR, Mammadov GSH, Sadigov RA, Gasimov AM, Muhammad D, Mustafayev MG (2026). Assessment of the synergistic impact of climate change and human activities on landscape ecozones. *SABRAO J. Breed. Genet.* 58 (3) 1214-1223. <http://doi.org/10.54910/sabrao2026.58.3.25>.
- Uygun AI, Boz I, Eynalov H, Guliyev Y (2018). Organic agriculture in Azerbaijan: Current status and future development potential. Food and Agriculture Organization of the United Nations (FAO). pp. 106.
- Van-Leeuwen C, Darriet P (2023). The concept of terroir in modern enology. *J. Wine Res.* 34(1): 1-15.