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Original article

Study of the Possibilities for Production of White Wine from the Varieties Misket Vrachanski and Misket Kaylashki, Grown Organically and Conventionally

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Abstract

Over four consecutive harvests (2017-2020), the possibilities for organic cultivation of the Misket Vrachanski (susceptible) and Misket Kaylashki (resistant) varieties were studied in the region of Pleven, Central Northern Bulgaria. Two variants were grown in the experimental vineyards – with conventional and with organic methods of plant protection against the diseases downy mildew (Plasmopara viticola) and powdery mildew (Oidium, tuckeri). In both varieties, the damage to the leaves and clusters from the observed diseases was higher in the organic cultivation but that did not have a negative impact on the quantity and quality of the grape harvest. Misket Vrachanski showed greater susceptibility to downy mildew and powdery mildew in both cultivation practices. In Misket Kaylashki, the damage index was minimal. No significant difference was found in the rates of the studied indicators of the chemical composition of grapes from the organic and conventional cultivation. The differences due to the varietal specifics were more significant. The Misket Kaylashki variety exhibited higher sugar accumulation rates and titratable acidity in both variants. In the Misket Vrachanski wines, the conventional samples had higher extract and titratable acids, while the organic ones contained more total phenols. In the Misket Kaylashki wines, from both investigated variants, the amount of total extract, titratable acidity and phenolic components was similar, with the sugar-free extract being higher in the conventional samples. The organoleptic features of the experimental wines Misket Vrachanski and Misket Kaylashki, from the organic and conventional variants, were close, therefore the differences in their tasting ratings were insignificant.

Keywords: Misket Vrachanski, Misket Kaylashki, Organic And Conventional Cultivation, Grapes, White Wine, Chemical Composition, Tasting Evaluation.

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INTRODUCTION

The improvement of the existing and the development of new technological solutions for organic production of food and beverages worldwide is imposed by the ever-increasing requirements for the production of healthy, safe and quality products, with maximum environmental protection, preservation of soil fertility and biodiversity (Vukosavljević et al., 2016; Krasteva, 2017; Volkova et al., 2020).

A healthy lifestyle and environmental protection play a big role in today's contemporary society. Modern consumers prefer to have quality food, such as organic farming provides, without the use of pesticides, which contributes to a healthier and more environmentally friendly lifestyle (Krasteva, 2017; Castrillo and Blanco, 2023; Dordevic et al., 2023; Bajer et al., 2024; Slavikova et al., 2024).

Organic viticulture as part of organic agriculture is considered an alternative system for obtaining of quality and environmentally friendly produce, based on methods and practices that exclude the application of chemical fertilizers, synthetic preparations, genetically modified organisms and other chemical agents (Geier et al., 2000; Klimenko et al., 2004; Ivanov et al., 2012; Castrillo and Blanco, 2023; Slavikova et al., 2024). In organic viticulture, there must be a balance between environmental conditions, varieties and methods of cultivation. Organic grape growing implies limitation in the products that can be used in the vineyard, especially in fertilization and in the treatment of vine pathogens. Organic viticulture allows the use of only authorized plant protection agents. Among fungicides, only copper and sulphur products are permitted for controlling fungal diseases (Slavikova et al., 2024).

Europe is the leading producer of organic grapes and wine globally as this continent is the home of the largest proportion of organically grown vineyards. Organic viticulture is widespread mainly in the Mediterranean countries because of the climate – hot dry summers and constant air currents limiting the development of pests and diseases on grapevines. The wine-growing countries with humid climates apply another concept of organic viticulture that is the use of varieties resistant to pests and diseases. The choice of suitable climatic conditions is important for organic and conventional viticulture in order to get the best quality of grapes and wine (Vukosavljević et al., 2016). Furthermore, organic wine consumers are looking for not only an organic product but also one with a specific nature, resulting from the uniqueness of the variety and terroir combination. This requires a change in the varietal structure and focusing towards local varieties suitable for organic grape and wine production (Miteva, 2018).

A significant challenge is the development of organic viticulture in the context of global climate warming, which intensifies sugar accumulation and reduces acidity in grapes. The directions of development of organic viticulture and winemaking are identified using local grape varieties, local yeast races, and no additives, appropriate temperature control during fermentation and less sulphites. Consumers' demands are growing and they expect high nutritional quality, natural properties, microbiological safety and minimal chemical processing from the food products (Kamenieva and Verechuk, 2024).

Wine's chemical and sensory features determine its quality and acceptance by consumers. Different regions provide distinctive characteristics of organic and conventional wines. The quality of the wine is determined by its overall chemical composition and organoleptic characteristics. Approximately 600-800 compounds affect white wine quality and impact on their sensory attributes, consumer acceptance and preference (Tinttunen and Lehtonen, 2001; Han et al., 2022; Castrillo and Blanco, 2023; Bajer et al., 2024).

There are some legal restrictions for organic wine production compared to the conventional one. Organic wine must be produced exclusively from organic grapes and only the addition of certain products and substances authorized under the legislation should be allowed. The maximum sulphur dioxide (SO_2) content should not exceed 150 mg/l for white wines with a residual sugars of less than 2 g/l. Organic yeast and lactic acid bacteria are required for use if are available. Spontaneous fermentation involving the contribution of autochthonous yeasts strains from grapes and which are specific to each winery contribute to the complexity and distinctive characteristics of the wines (Castrillo and Blanco, 2023). There are research findings proving the impact of viticulture practices, particularly the use of synthetic pesticides, on the elemental composition of wines. Except Mg, higher concentrations of Zn, Ni, Mn, Al, Cd were found in samples of conventional white wines because of the application of the dithiocarbamate mancozeb, a fungicide commonly utilized in conventional viticulture (Fragoulis et al., 2009; Slavikova et al., 2024). Drava and Minganti (2019) found no significant difference in the mineral composition of Italian wines, except Ni, which showed a higher concentration in organic samples.

The objective of this study was to investigate and compare the technological characteristics (chemical composition and organoleptic qualities) of white wines from the Misket Vrachanski and Misket Kaylashki varieties, obtained from grapes grown organically and conventionally in the region of the town of Pleven, Central Northern Bulgaria.

MATERIALS and METHODS

Varieties, experimental plantations, cultivation and plant protection practices.

The object of the study were grapes and white wines from the Misket Vrachanski and Misket Kaylashki varieties, from four consecutive harvests (2017-2020). Both varieties were grown at the Experimental vineyards of the Institute of Viticulture and Enology (IVE) – Pleven, Central Northern Bulgaria.

Misket Vrachanski is a local variety for Bulgaria. It is grown on small areas in the country. It is a wine, late-ripening variety. The grapes ripen in the second half of September. It has an average fertility and yield. It is not resistant to downy mildew, but resistant to grey rot. It is susceptible to low winter temperatures and drought. The grapes accumulate sufficient sugars (21 - 24%), with relatively low titratable acids (4,6 – 5,8 g/l). The must theoretical yield is 88,13%. Dry, semi-dry and sweet wines of straw-golden colour, insufficient freshness and extractivity could be made from this variety. The muscat aroma is intense, specific and develops with aging (Roychev, 2012).

The Misket Kaylashki variety was bred through the method of intraspecific hybridization of Misket Hamburgski x Villard Blanc 12 375. Its areas occupy 0,19% of the white wine varieties in Bulgaria. The variety is late ripening and the grapes ripen in late September and early October. When matured well the berries are prone to wilting. It has good fertility and yield. The variety has increased resistance to downy mildew, powdery mildew and low winter temperatures. At technological maturity, the grapes contain 18-21% sugars and about 9-10 g/l of titratable acids. The wines have a straw-yellow colour with a golden hue, a fresh and harmonious taste, with a well-pronounced muscat aroma, which quickly decreases with aging (Roychev, 2012).

The experimental areas of the studied varieties were of equal size (0,5 ha), as one of them was treated with preparations for organic production and the other one with products for conventional vine growing. The distance between the rows was 3,20 m, and in the row – 1,20 m. The amount of precipitation and air temperature were recorded from the meteorological station METOS WEATHER data 000003 CA. In the experimental area, the soil type was slightly leached chernozem, formed on clay loess.

In the plantation with organic cultivation of the Misket Vrachanski and Misket Kaylashki varieties, in the plant protection scheme, throughout the period, the products Funguran OH 50 WP and Thiovit Jet 80 WG were applied that were permitted for use in organic viticulture. Funguran OH 50 WP (77% copper hydroxide), at a dose of 1,5 kg/ha, was applied for control of downy mildew (*Plasmopara viticola*). Thiovit Jet 80 WG (80% sulphur), at a dose of 3,0 kg/ha before flowering of the vines and 2,5 kg/ha after flowering, was used against powdery mildew (*Oidium, tuckeri*). During the study period, a total of 7 treatments with these products were carried out annually, applied from mid-May to the end of July, as follows in Table 1.

Table 1. Date of treatments for downy mildew and powdery mildew control in organic cultivation of the studied varieties, during the period 2017-2020.

Treatments	2017	2018	2019	2020
№ 1	19/05/	17/05/	13/05/	11/05/
№ 2	31/05/	26/05/	27/05/	28/05/
№ 3	14/06/	06/06/	11/06/	12/06/
№ 4	22/06/	20/06/	18/06/	25/06/
№ 5	05/07/	04/07/	02/07/	10/07/
№ 6	17/07/	18/07/	16/07/	24/07/
№ 7	28/07/	03/08/	30/07/	10/08/

An important requirement in organic grape production is the amount of elementary copper (Cu) imported. In the experiment conducted, the pure copper introduced for 1 year, with the product Funguran OH 50 WP at a dose of 1,5 kg/ha, was 4,6 kg/ha and it was significantly below the maximum permissible rate for perennial crops (Regulation EU 22/4.07.2001; Regulation EU 889/5.09.2008).

In the conventional cultivation of the Misket Vrachanski and Misket Kaylashki varieties, during the period 2018-2020 (from mid-May to the end of July), six combined treatments were carried out for downy mildew and powdery mildew control, and in 2017 – five treatments, as follows in Table 2.

The fungicides used contained the following active substances:

- Acrobat Plus WG - 90 g/kg Dimethomorph + 600 g/kg Mancozeb
- Bayfidan 250 EC - 250 g/l Triadimenol
- Cuproseyt Gold M - 640 g/kg Mancozeb + Simoxanil 80 g/kg
- Cuprotsin Super M - 30% Cuprous oxychloride + 20% Mancozeb
- Funguran OH 50 WP - 77% Copper hydroxide (50% Cu)
- Kumulus DF **- 80% Sulphur**
- Ridomil Gold MC 68 WG - 4% Mefenoxam + 64% Mancozeb
- Spirox - 500 g/l Spiroxamine
- Systane Super 24 EC - 240 g/l Myclobutanil
- Thiovit Jet 80 WG - 80% **Sulphur**
- Top Plus 70 WP - 700 g/kg Thiophanate - methyl
- Topas 100 EC - 100 g/l Penconazole
- Topsin M 70 WDG - 700 g/kg Thiophanate-methyl
- Triomax 45 WP - 120 g/kg Mancozeb + 40 g/kg Cymoxanil + 290 g/kg Copper oxychloride
- Verita WG - 667 g/kg Fosetyl - aluminum + 44.4 g/kg Fenamidone

The response of the studied varieties to the diseases downy mildew and powdery mildew was monitored, as recordings were performed in mid-June and at the end of July. The damage index on the leaves and clusters in organic and conventional cultivation was calculated using the formula of Mc Kinnay (Yankova and Masheva, 2010; Nedelcheva and Maneva, 2016).

The condition in the experimental plantations was maintained through mechanized green pruning of the vine contour, and for weeds control in the vine row – manual hoeing and mechanical treatments (Peykov, 2019).

Grape harvesting and processing

During the ripening period, the dynamics of sugar accumulation in the grapes of both studied variety variants was monitored annually. Upon reaching technological maturity, the grapes were hand-harvested in plastic cassettes. The picked quantity of 30 kg from both variants was delivered to the Experimental Wine Cellar of the IVE – Pleven. The classical technology for white wine making was applied under the conditions of micro-vinification (Abrasheva et al., 2008): white grapes → crushing → sulfitation (50 mg/l SO_2) → straining off → pressing → must clarification → alcoholic fermentation → decanting → further sulfitation → storage.

Table 2. Treatments for downy mildew and powdery mildew control in conventional cultivation of the studied varieties, during the period 2017-2020.

Treatments	Date of treatment	Products applied
2017		
№ 1	18/05/	Verita WG (2.0 кg/ha) + Systane Super 24 EC (10 ml/ha)
№ 2	30/05/	Verita WG (2.0 кg/ha) + Topas 100 EC (150 ml/ha)
№ 3	12/06/	Ridomil Gold MC 68 WG (3.0 кg/ha) + Top Plus 70 WP (1.0 кg/ha)
№ 4	21/06/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Kumulus DF (3.0 кg/ha)
№ 5	07/07/	Triomax 45 WP (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
2018		
№ 1	15-16/05/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 2	26/05/	Funguran OH 50 WP (1.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 3	05/06/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 4	18-19/06/	Triomax 45 WP (2.0 кg/ha) + Thiovit Jet 80 WG (2.5 кg/ha)
№ 5	03/07/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 6	18/07/	Acrobat Plus WG (2.0 kg/ha) + Bayfidan 250 EC (0.1 l/ha)
2019		
№ 1	14-17/05/	Topas 100 EC (150 ml/ha)
№ 2	23-27/05/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Bayfidan 250 EC (0.1 l/ha)
№ 3	07-11/06/	Triomax 45 WP (2.0 кg/ha) + Bayfidan 250 EC (0.1 l/ha)
№ 4	18-20/06/	Triomax 45 WP (2.0 кg/ha) + Bayfidan 250 EC (0.1 l/ha)
№ 5	27/06/ - 02/07/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 6	16-25/07/	Triomax 45 WP (2.0 кg/ha) + Bayfidan 250 EC (0.1 l/ha)
2020		
№ 1	08 -12/05/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Topas 100 EC (150 ml/ha)
№ 2	29 – 05/06/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Spirox (60 ml/ha)
№ 3	12 – 16/06/	Ridomil Gold MC 68 WG (2.5 кg/ha) + Spirox (60 ml/ha)
№ 4	24 - 02/07/	Triomax 45 WP (2.5 кg/ha) + Bayfidan 250 EC (0.1 l/ha)
№ 5	13 – 17/07/	Cuproseyt Gold M (1.5 кg/ha) + Topsin M (1.0 кg/da)
№ 6	03 – 07/08/	Cuprotsin Super M (2.0 kg/ha) + Topas 100 EC (150 ml/ha)

The grape processing and vinification were done in compliance with the requirements for organic winemaking – the equipment and vessels were without exposed metal parts, made of stainless steel or glass; the alcoholic fermentation was carried out with non-genetically modified wine yeast. In winemaking, low doses of SO_2 were used for sulfitation (Regulation EU 203/2012; Regulation EU 848/2018). After completion of the alcoholic fermentation, the young wines were sulfited to 20 mg/l (organic sample) and to 30 mg/l (conventional sample) free SO_2.

Chemical composition and organoleptic characteristics of grapes and wine

To determine the chemical composition of the grapes and the experimental wines, generally accepted methods in winemaking practice were applied (Ivanov et al., 1979; Chobanova, 2007):

- Grapes composition: sugars, % – hydrometer of Dujardin; glucose, g/l – iodometric method; fructose, g/l – calculation method; titratable acids (TA), g/l – titration with NaOH with bromothymol blue indicator; tartaric and malic acid, g/l – Pochinok's method; pH - pH-meter; glucoacidimetric index (GAI) – calculation method as the ratio of sugars (%) and titratable acids (g/l).
- Wine composition: sugars, g/l – Schoorl's method; alcohol, vol. % - distillation method, Gibertini apparatus with densitometry of the distillate density; total extract (TE) g/l - Gibertini apparatus with densitometry; sugar-free extract (SFE), g/l – calculation method (the difference between the total extract and sugars); titratable acids (TA), g/l – titration with NaOH with bromothymol blue indicator; tartaric and malic acid, g/l – Pochinok's method; volatile acids, g/l – distillation method with titration with NaOH with phenolphthalein indicator; free and total SO_2, mg/l – iodometric method, total phenolic compounds, g/l gallic acid - Singleton et Rossi method with Folin–Chiocalteu reagent; colour intensity I, [abs. units] – method of Somers.
- Organoleptic properties – determined by a tasting committee of the IVE – Pleven according to 100-score scale for the indicators colour, aroma, taste and general impressions (Tsvetanov, 2001).

Statistical Processing of the Results

The statistical processing of the results was performed using the standard deviation (±SD) method, using Excel 2007 from the Microsoft Office software.

RESULTS and DISCUSSION

Protection of the experimental vineyards from pests and the effect of the applied products for downy mildew (*Plasmopara viticola*) and powdery mildew (*Oidium, tuckeri*) control.

The differences between conventional and organic viticulture are mainly due to the applied technological measures in terms of the fertilization scheme, the maintenance of the soil surface and plant protection. In organic vine growning, the obtaining of optimal conditions for effective pest control in the vines depends to a large extent on maintaining a good condition of the plantation. This aims to achieve maximum environmental protection and preservation of biodiversity in the ecosystem (Volkova et al., 2020; Castrillo and Blanco, 2023; Slavikova et al., 2024). Klimenko et al. (2021) found that organic farming positively affected the growth, productivity, and quality of Chardonnay grapes – the number and average mass of clusters increased, as well as the sugar ratio in the grape berry.

The data presented in Table 3 show that during the study period, the products used (Funguran OH 50 WP and Thiovit Jet 80 WG) for plant protection in the organic cultivation of the Misket Vrachanski and Misket Kaylashki varieties had relatively good efficiency against downy mildew and powdery mildew. At technological maturity, both varieties had insignificant or minimal downy mildew attacks and powdery mildew damage on the leaves and clusters. The identified damage indices from both diseases demonstrated significantly higher values in the susceptible Misket Vrachanski variety compared to Misket Kaylashki, which was genetically more resistant. For the period 2017 – 2020, the greatest damage to the leaves from downy mildew was detected in 2019 (Misket Vrachanski – damage index 16,8), and to the clusters from powdery mildew in 2018 and 2019 (Misket Vrachanski – damage indices 75 and 26,7). This was due to the weather conditions during the months of May, June and July, which favoured the appearance and development of the observed diseases (Figure 1).

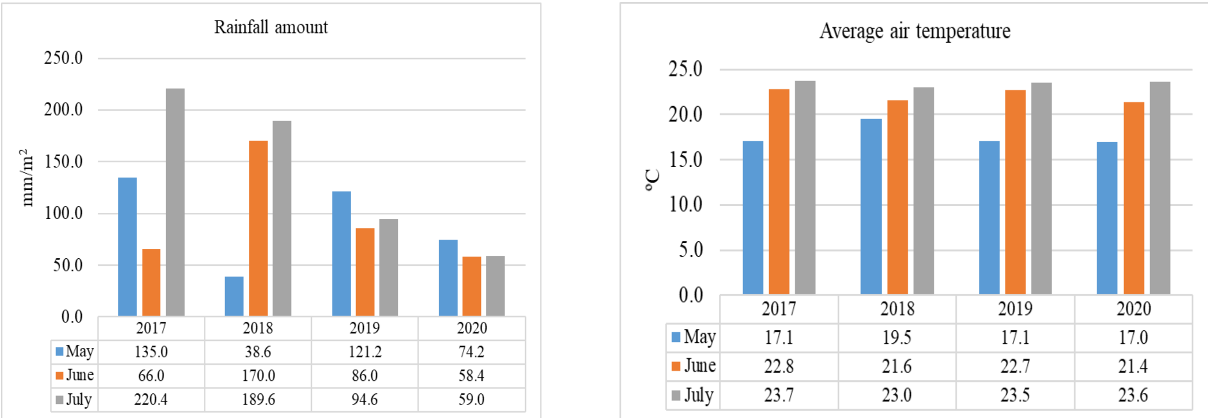

Figure 1. Weather conditions during the months of May, June and July for the period 2017 – 2020.

In the plantation with conventional plant protection, the leaves and clusters of the studied varieties were slightly affected by downy mildew and powdery mildew, with the downy mildew damage index being higher in the second counting. Higher damage rates from both diseases were found in the Misket Vrachanski variety, due to its susceptibility as a varietal feature. In 2018, powdery mildew damage index of 15,42 was recorded for it, and in 2019 – an index of downy mildew damage of 12,0 and powdery mildew damage of 13,7. The difference in the studied indicators between the resistant Misket Kaylashki variety and the susceptible Misket Vrachanski is presented in Table 3.

During the study period, the data on leaf and cluster damage from the observed diseases downy mildew and powdery mildew were higher in the organic variant, but the differences found did not significantly affect the quantity and quality of the grape harvest. Misket Vrachanski showed greater susceptibility to both diseases and in both cultivation methods, with the cluster damage index being higher in organic production than in the conventional one throughout the period. In Misket Kaylashki, the damage index for downy mildew and powdery mildew was minimal.

Table 3. Efficiency of of plant protection products used in organic and conventional cultivation of the Misket Vrachanski and Misket Kaylashki varieties.

Year	Variant	Described leaves			Described clusters		
		Total number	Infected, %	Downy mildew damage index	Total number	Infected, %	Powdery mildew damage index
Misket Vrachanski							
2017	organic	200	6	1,5	100	8	2,16
	conventional	200	4	1,08	100	6	1,5
2018	organic	200	5	2,55	100	96	75
	conventional	200	3	1,83	100	48	15,42
2019	organic	200	56	16,8	100	66	26,7
	conventional	200	42	12	100	43	13,7
2020	organic	200	11	1,75	100	12	4,3
	conventional	200	3	1,18	100	8	2,1
Misket Kaylashki							
2017	organic	200	3	0,66	100	3	0,66
	conventional	200	1,5	0,33	100	2	0,33
2018	organic	200	2	0,33	100	0	0
	conventional	200	0	0	100	0	0
2019	organic	200	4	0,6	100	0	0
	conventional	200	2	0,3	100	0	0
2020	organic	200	0	0	100	0	0
	conventional	200	0	0	100	0	0

Composition and characteristics of the grape and wine harvest from the Misket Vrachanski and Misket Kaylashki varieties, grown organically and conventionally.

Grape must composition and sensory attributes are influenced by the terroir, which included soil microbiome and properties, climatic conditions, cultivation practices and grapevine variety. The different approach applied in agricultural practices and plant protection when growing crops in an organic and conventional way is decisive for the qualitative and quantitative characteristics of the grape and wine harvest (Hasanaliyeva et al., 2021; Ostroukhova et al., 2021; Castrillo and Blanco, 2023).

The data in Table 4 and Table 5 on the grape must composition from both studied varieties did not show a significant difference in the value of the investigated indicators in organic and conventional cultivation of the vineyards. More significant were the differences due to the varietal specifics. The Misket Kayilashki variety had higher sugar accumulation and titratable acids in both cultivation practices. Due to the higher titratable acidity, the glucoacidimetric indicator was lower compared to that of Misket Vrachanski. For both varieties, the grapes with higher sugar accumulation were from the 2019 or 2020 harvests, while the ones with the lowest sugars and highest acidity were from the 2017 harvest.

In the Misket Vrachanski variety, the average sugar content for the study period was 234,50±19,74 g/l (organic) and 236,25±20,98 g/l (conventional). The grapes from the conventional variant had a higher concentration of glucose (average 114,45±5,20 g/l) and a lower concentration of fructose (average 121,80±15,88 g/l). In both cultivation methods, of the analysed monosaccharides, fructose predominated. Titratable acids were without significant differences, respectively 5,46±0,91 g/l (organic) and 5,59±0,72 g/l (conventional). The content of the main organic acids was also determined in the grape must. In both cultivation variants, malic acid was quantitatively predominant over tartaric acid. The 2017 harvest had the highest concentration of both acids. GAI was an indicator related to the quality of wines and their intended use. The higher values indicated an optimal ratio between sugars and acids in grapes, which was vital for the harmony and balance in the taste of the resulting wines (Yankov, 1992). The average value of the indicator in the organic cultivation (4,44±1,18) was slightly higher than in conventional one (4,31±0,92). Per harvests, in both variants, the indicator increased in the order: 2017 < 2018 < 2019 < 2020, i.e. the 2020 harvest had an optimal chemical composition for producing quality white wines from the Misket Vrachanski variety.

The grapes of the Misket Kaylashki variety, obtained from the organically grown vineyard, showed higher sugar accumulation, both on the average for the period and per harvests. The sugar content was 262,00±4,00 g/l (organic) and 256,75±10,90 g/l (conventional). In the organic variant, the change in sugars per harvests was 2020 < 2017 < 2019 < 2018, while in the conventional variant it was 2017 < 2018 < 2020 < 2019. The concentration of glucose was higher and fructose lower in the organic grape must. In all experimental variants, fructose was predominant. The ratio of titratable acids, tartaric and malic acid, did not differ much depending on the cultivation method. Their ratio was respectively 7,11±0,62 g/l, 3,36±0,63 g/l, 4,48±0,18 g/l in organic cultivation and 7,15±0,68 g/l, 2,78±0,24 g/l, 4,56±0,66 g/l in conventional cultivation. Malic acid was predominant. The grapes from the 2020 harvest had the lowest acid content and the highest GAI, correspondingly.

In most researches on the chemical composition and characteristics of organic wines, no significant differences in the indicators compared to conventional samples are found. More differences are observed only in individual indicators, depending on the variety, harvest and production technology (Castrillo and Blanco, 2023; Bajer et al., 2024; Slavikova et al., 2024). The research of Dordevic et al. (2023) had not confirmed the claim that organic wines contain more bioactive and beneficial substances for the humans. In many cases the content of these substances was higher in wines from integrated production.

Table 4. Chemical composition of grape must from organically grown grapes for the period 2017-2020.

Indicators / Variant	Vintage	Date of harvest	Sugars, g/l	Glucose, g/l	Fructose, g/l	Titratable acids, g/l	Tartaric acid, g/l	Malic acid, g/l	pH	GAI
Misket Vrachanski	2017	11/09/	216,00	95,40	120,60	6,38	2,76	4,20	3,41	3,38
	2018	15/09/	220,00	90,70	129,30	5,55	2,40	3,78	3,43	3,96
	2019	09/09/	245,00	107,20	137,80	5,70	2,73	3,24	3,38	4,30
	2020	24/09/	257,00	110,70	146,30	4,20	2,14	2,50	3,38	6,12
	±*SD*		*234,50 ±19,74*	*101,00 ±9,48*	*133,50 ±11,05*	*5,46 ±0,91*	*2,51 ±0,29*	*3,43 ±0,73*	*3,40 ±0,02*	*4,44 ±1,18*
Misket Kaylashki	2017	11/09/	258,00	121,50	136,50	7,80	3,75	4,44	3,50	3,31
	2018	11/09/	266,00	128,30	137,70	6,75	2,45	4,70	3,44	3,94
	2019	11/09/	262,00	126,30	135,70	7,43	3,84	4,53	3,67	3,52
	2020	24/09/	241,00	104,40	136,60	6,45	3,39	4,26	3,41	3,73
	±*SD*		*262,00 ±4,00*	*120,13 ±10,86*	*136,63 ±0,82*	*7,11 ±0,62*	*3,36 ±0,63*	*4,48 ±0,18*	*3,51 ±0,12*	*3,63 ±0,27*

In the present study, white wines from the Misket Vrachanski and Misket Kaylashki varieties, obtained from organic and conventionally grown grapes, also had a similar chemical composition (Table 6, Table 7).

The wines from the studied varieties were made according to the same cultivation, plant protection and technological scheme; therefore, the differences between them were mainly due to the respective varietal characteristics. The grapes chemical composition had determined the one of the wines. The higher alcohol, extract and acid content of the samples from the Misket Kaylashki variety was due to that.

The alcohol content of the Misket Vrachanski wines from both cultivation variants was close – on the average of 13,79±0,85 vol. % (organic) and 13,85±1,26 vol. % (conventional). In the organic variants, the highest alcohol concentration was recorded in the 2020 sample, and in the conventional ones – from the 2019 harvest. The amount of residual sugars in the wines from the studied harvests was on the average of 2,13±0,84 g/l and 2,37±1,11 g/l, which defined them in the “dry” category.

Table 5. Chemical composition of grape must from conventionally grown grapes for the period 2017-2020.

Indicators / Variant	Vintage	Date of harvest	Sugars, g/l	Glucose, g/l	Fructose, g/l	Titratable acids, g/l	Tartaric acid, g/l	Malic acid, g/l	pH	GAI
Misket Vrachanski	2017	11/09/	213,00	109,70	103,30	6,38	3,15	4,00	3,42	3,34
	2018	15/09/	224,00	110,20	113,80	5,78	2,48	3,95	3,38	3,87
	2019	09/09/	254,00	119,00	135,00	5,55	2,65	3,67	3,44	4,58
	2020	24/09/	254,00	118,90	135,10	4,65	1,96	3,13	3,40	5,46
	±SD		*236,25 ±20,98*	*114,45 ±5,20*	*121,80 ±15,88*	*5,59 ±0,72*	*2,56 ±0,49*	*3,69 ±0,40*	*3,41 ±0,03*	*4,31 ±0,92*
Misket Kaylashki	2017	11/09/	245,00	105,10	139,90	7,95	2,94	5,10	3,44	3,08
	2018	11/09/	250,00	93,70	156,30	7,28	2,45	4,87	3,25	3,43
	2019	11/09/	267,00	117,20	149,80	7,05	2,73	4,67	3,40	3,79
	2020	24/09/	265,00	119,80	145,20	6,30	2,98	3,60	3,30	4,20
	±SD		*256,75 ±10,90*	*108,95 ±12,02*	*147,80 ±6,96*	*7,15 ±0,68*	*2,78 ±0,24*	*4,56 ±0,66*	*3,35 ±0,09*	*3,63 ±0,48*

The results of the analysis showed a higher content of total and sugar-free extract, as well as titratable acids in the samples from the conventional variant, the average values of which were 21,51±1,81 g/l, 19,15±1,02 g/l and 5,37±0,61 g/l, respectively. In both cultivation methods, the samples from the 2020 harvest had the highest extract and the lowest acid ratio. The inverse relationship of these indicators was reported in the 2017 harvest. Of the analysed organic acids in all wines, malic acid predominated over tartaric acid, with the average amount of tartaric acid being almost the same, and malic acid being higher in the conventional variant. Phenolic compounds are an important component of the sugar-free extract, therefore their ratio in wines is essential for their characteristics. Throughout the research period, the samples obtained from the organically grown grapes had a higher content of phenolic components: conventional (0,37±0,074 g/l) < organic (0,46±0,12 g/l). In the organic variants, the highest total phenolic compounds were found in the sample from the 2020 harvest (0,57 g/l), while in the conventional ones – from the 2017 harvest (0,45 g/l). The amount of free and total SO_2 in organic wines is the main indicator, strictly monitored and limited by the legislation. According to Regulation (EU) No. 203/2012, the maximum allowable SO_2 content in white organic wines is up to 150 mg/l. In the obtained experimental wines Misket Vrachanski, from all the studied harvests, no SO_2 concentration exceeding the dose specified by the legislation was analysed. In the organic samples, the average ratio of free SO_2 was 17,65±1,02 mg/l and of total SO_2 – 65,68±9,86 mg/l, which was consistent with the norms defined in the European legislation. This SO_2 concentration ensured the production of wines with normal volatile acidity (average 0,57±0,09 g/l). In conventional samples, the average amount of free SO_2 was 27,50±2,55 mg/l, of total SO_2 – 99,63±10,08 mg/l, and of volatile acids – 0,59±0,11 g/l. The experimental wines from the Misket Vrachanski variety had similar organoleptic features, therefore the differences in the scores of the tasting panel were insignificant – on the average of 76,09±2,03 points (organic) and 76,31±2,92 points (conventional). In both cultivation variants, the samples from the 2018 and 2019 harvests were distinguished by the best sensory characteristics in terms of colour, aroma and taste.

The wines from the conventional variants of these harvests were rated higher – they had a straw-yellow colour, a typical varietal aroma and a harmonious taste.

The experimental wines from the Misket Kaylashki variety had a high alcohol concentration due to the high sugar accumulation in the grapes. The correlation was as follows organic (15,06±0,94 vol. %) > conventional (14,89±0,56 vol. %). In both variants, the lowest alcohol content was recorded in the 2020 harvest.

The results of the chemical analysis showed a similar content of total extract and titratable acids in the samples from both variants. There was a difference in the amount of sugar-free extract, which was higher in the conventional samples – on the average of 21,14±0,15 g/l. There were no significant quantitative differences between the variants in the organic acids content. In all samples, malic acid prevailed over tartaric acid. All wines from the studied harvests had normal volatile acidity. In the samples of the Misket Kaylashki variety, the difference in the content of phenolic compounds was insignificant, respectively 0,37±0,08 g/l (organic) and 0,34±0,07 g/l (conventional). In these experimental samples also, the ratio of SO_2 in the organic variants did not exceed the norms regulated by the legislation (average 17,13±1,58 mg/l free SO_2 and 79,73±5,02 mg/l total SO_2). In the conventional samples, the values of the indicator were higher, respectively 27,03±1,61 mg/l free SO_2 and 95,08±8,25 mg/l total SO_2.

When tasting the experimental wines, no significant differences were found in the organoleptic properties of the organic and conventional samples. The average values of the obtained scores were organic (75,85±1,30 points) > conventional (75,08±0,65 points). The 2018 harvest (77,50 points) had the best tasting indicators among the organic variants, and the 2019 harvest (75,83 points) among the conventional ones.

Table 6. Chemical composition of experimental white wines obtained from organically grown grapes, for the period 2017-2020.

Variant	**Vinatge**	**Indicators**														
		Relative density	**Alcohol, vol. %**	**Sugars, g/l**	**Total extract, g/l**	**Sugar-free extract, g/l**	**Titratable acids, g/l**	**Volatile acids, g/l**	**Tartaric acid, g/l**	**Malic acid, g/l**	**Total phenolic compounds, g/l**	**Color intensity I, [abs. units]**	**pH**	**Free SO_2, mg/l**	**Total SO_2, mg/l**	**Tasting evaluation**
Misket Vrachanski	2017	0,9906	12,88	2,49	20,00	17,59	5,93	0,48	1,75	3,73	0,55	0,10	3,35	17,50	68,20	74,71
	2018	0,9916	13,31	1,00	17,30	16,30	5,50	0,50	1,22	3,09	0,32	0,14	3,33	16,30	55,70	77,83
	2019	0,9917	14,20	2,04	21,10	19,06	5,60	0,66	1,49	3,36	0,41	0,16	3,29	18,70	78,30	77,83
	2020	0,9932	14,75	2,98	23,30	20,32	4,23	0,64	1,34	2,42	0,57	0,29	3,43	18,10	60,50	74,00
	± SD	*0,9918 ±0,02*	*13,79 ±0,85*	*2,13 ±0,84*	*20,43 ±2,50*	*18,32 ±1,75*	*5,32 ±0,74*	*0,57 ±0,09*	*1,45 ±0,23*	*3,15 ±0,55*	*0,46 ±0,12*	*0,17 ±0,08*	*3,35 ±0,06*	*17,65 ±1,02*	*65,68 ±9,86*	*76,09 ±2,03*
Misket Kailashki	2017	0,9931	15,38	3,27	25,10	21,83	7,10	0,42	1,30	4,26	0,28	0,23	3,32	15,40	84,10	74,43
	2018	0,9939	15,73	2,87	23,30	20,43	6,40	0,60	1,41	4,63	0,37	0,47	3,37	19,20	72,80	77,50
	2019	0,9933	15,45	2,01	22,50	20,49	7,00	0,60	1,60	4,20	0,35	0,27	3,28	16,70	79,40	75,33
	2020	0,9916	13,67	2,89	23,60	20,71	6,30	0,66	1,28	4,05	0,49	0,48	3,34	17,20	82,60	76,14
	± SD	*0,9930 ±0,01*	*15,06 ±0,94*	*2,76 ±0,53*	*23,63 ±1,10*	*20,87 ±0,65*	*6,70 ±0,40*	*0,57 ±0,10*	*1,40 ±0,15*	*4,29 ±0,24*	*0,37 ±0,08*	*0,36 ±0,13*	*3,33 ±0,04*	*17,13 ±1,58*	*79,73 ±5,02*	*75,85 ±1,30*

Table 7. Chemical composition of experimental white wines obtained from conventionally grown grapes, for the period 2017-2020.

Variant	Vinatge	Relative density	Alcohol, vol. %	Sugars, g/l	Total extract, g/l	Sugar-free extract, g/l	Titratable acids, g/l	Volatile acids, g/l	Tartaric acid, g/l	Malic acid, g/l	Total phenolic Compounds, g/l	Color intensity, I [abs. units]	pH	Free SO_2, mg/l	Total SO_2, mg/l	Tasting evaluation
Misket Vrachanski	2017	0,9907	13,00	2,15	19,90	17,75	6,08	0,42	1,41	4,13	0,45	0,16	3,31	26,30	88,40	74,00
	2018	0,9927	12,60	0,90	20,10	19,20	5,50	0,62	1,30	4,49	0,29	0,12	3,33	24,80	101,20	78,83
	2019	0,9918	15,29	3,00	22,44	19,44	5,28	0,66	1,60	3,86	0,36	0,16	3,42	28,20	96,40	78,83
	2020	0,9921	14,52	3,41	23,60	20,19	4,60	0,64	1,38	3,65	0,39	0,22	3,40	30,70	112,50	73,57
	± SD	*0,9918 ±0,02*	*13,85 ±1,26*	*2,37 ±1,11*	*21,51 ±1,81*	*19,15 ±1,02*	*5,37 ±0,61*	*0,59 ±0,11*	*1,42 ±0,13*	*4,03 ±0,36*	*0,37 ±0,07*	*0,17 ±0,04*	*3,37 ±0,05*	*27,50 ±2,55*	*99,63 ±10,08*	*76,31 ±2,92*
Misket Kaylashki	2017	0,9909	14,62	2,17	23,10	20,93	7,23	0,54	1,53	5,13	0,26	0,22	3,23	25,60	95,30	74,29
	2018	0,9932	14,80	2,42	23,60	21,18	7,08	0,48	1,38	4,40	0,37	0,47	3,26	25,90	84,80	75,33
	2019	0,9929	15,70	2,24	23,50	21,26	6,50	0,51	1,68	4,40	0,31	0,20	3,35	27,50	95,20	75,83
	2020	0,9912	14,44	2,45	23,65	21,20	6,18	0,66	1,01	3,39	0,42	0,49	3,40	29,10	105,00	74,86
	± SD	*0,9920 ±0,01*	*14,89 ±0,56*	*2,32 ±0,14*	*23,46 ±0,25*	*21,14 ±0,15*	*6,75 ±0,50*	*0,55 ±0,08*	*1,40 ±0,28*	*4,33 ±0,71*	*0,34 ±0,07*	*0,35 ±0,15*	*3,31 ±0,08*	*27,03 ±1,61*	*95,08 ±8,25*	*75,08 ±0,65*

CONCLUSION

- During the study period, the data on the damage to the leaves and clusters from the observed diseases downy mildew and powdery mildew were higher in the organic cultivation variant, but the differences established did not affect the quantity and quality of the grape harvest.
- Misket Vrachanski showed greater susceptibility to both diseases in both cultivation practices. In Misket Kaylashki, the damage index from downy mildew and powdery mildew was minimal.
- No significant difference was found in the value of the studied indicators of the chemical composition of grapes from organic and conventional cultivation. The differences due to the varietal specifics were more significant. Misket Kaylashki variety showed higher sugar accumulation and titratable acidity in both cultivation variants.
- Of the experimental wines obtained, the samples from the Misket Kaylashki variety had higher alcohol, extract and acid content. In the case of Misket Vrachanski, the conventional samples had a higher amount of total and sugar-free extract and titratable acids, but the wines obtained from the organically grown grapes contained slightly more total phenols. The Misket Kaylashki wines, from both studied variants, had a similar content of total extract, titratable acidity and phenolic components, with the sugar-free extract being higher in the conventional samples.
- The organoleptic features of the experimental wines from the organic and conventional variants of the studied Misket Vrachanski and Misket Kaylashki varieties were similar, therefore the differences in their tasting ratings were insignificant. The samples from the 2018 and 2019 harvests for both varieties had better sensory characteristics in terms of colour, aroma and taste.

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Responsible Artificial Intelligence Statement

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