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PHYSICOCHEMICAL EVALUATION OF THE GRAPE AND WINE OF THE BLATINA, TRNJAK AND VRANAC IN DIFFERENT VINTAGES

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Abstract

Typicality and style of wine are closely related to the varietal character of grapes, ecological properties of the locality, and the specificities of the winemaking process. For this reason, autochthonous and indigenous grape varieties are increasingly the subject of many studies. To protect their uniqueness, in the region of Hercegovina (Bosnia and Herzegovina), indigenous grape varieties are part of the current grape and wine production. Therefore, the subject of a two-year study (2018-2019) were indigenous wine varieties: Blatina, Trnjak, and Vranac. Variations in the values of the analyzed parameters were a consequence of the significant and/or highly significant influence of the variety and year. Blatina stood out from other varieties with the highest average cluster weight (364.90 g) and the highest wine color intensity (10.71). Trnjak had the highest total anthocyanin content in the grape skin and total polyphenol content in the grape seeds (1090.198 mg/kg grapes; 1755.195 mg/kg grapes), while Vranac had the highest polyphenol content in the grape skin (1823.961 mg/kg grapes), the highest TSS level (21.55% Brix), and consequently, the highest alcohol content in the wine (12.07% v/v).

Key words*: grape, indigenous varieties, quality, wine.*

INTRODUCTION

The territorial structure of modern viticultural production in Bosnia and Herzegovina, as in the past, consists of two regions: Herzegovina, in the south of the country, and Northern Bosnia (Beljo et al., 2014). The region of Herzegovina, where the largest part of grape production is concentrated, is also recognizable by the existence of a large number of old, indigenous varieties (Djurić et al., 2018; Mandić et al., 2019), some of which still occupy a significant place in the production assortment. One of them, traditionally and economically the most significant, is the Blatina (red) variety, which due to fertilization issues (functionally female flower) is often grown in combination with accompanying pollenizer varieties, such as Trnjak and Vranac (Jovanović-Cvetković et al., 2016a; Jovanović-Cvetković et al., 2022). It is a well-known fact that the quality and character of the wine is related to the grape quality, which in a broader sense is conditioned by various factors: genotype, pedoclimatic conditions and applied agrotechnical and ampelotechnical measures during production. In addition to the above, according to Zoecklein et al. (2010) the quality of grapes depends to a large extent on different metabolites (primary and secondary), the course and completeness of ripening, and the synchronization of ripening of the skin, seeds, stem and pulp. According to the same author, all the mentioned factors should be observed and analyzed together, because this is the only way to obtain adequate knowledge about the necessary, optimal quality of grapes for a certain type and style of wine. According to the above, the assessment and decision of the harvest time significantly affects the final quality of grapes and future wine. According to Ribéreau-Gayon et al. (2004), the assessment of the optimal grape harvest time, i.e. oenological ripeness includes, in addition to the evaluation of technological, aromatic and phenolic ripeness, which reflects not only the potential amount of phenolic compounds in grapes, but also the state when the capacity of their extractability and distribution into wine is the highest. Indigenous varieties in the area of Herzegovina were previously examined mainly from the genetic and

production aspects (Tomić et al., 2012; Jovanović-Cvetković et al., 2015). For this reason, the aim of this work was a more comprehensive characterization of three domesticated varieties, Blatina, Trnjak and Vranac, through the analysis of the following parameters: basic morphological characteristics of grape cluster and grape berries, phenolic potential of grapes and basic physicochemical parameters of grape juice and wine.

MATERIALS AND METHODS

The research was conducted in 2018 and 2019, on grapes and wine of the Blatina, Trnjak and Vranac varieties, grown in Mostar (43º20'N; 17º48'E) in Herzegovina. All varieties were grafted on Kober 5BB rootstock and plant spacing for all analyzed varieties was 2.8 m _ 1.0 m. The training system was Moser cordon two-armed cordon. Mixed pruning was carried out in all the analyzed grapevines during the dormancy period, where 12 fertile buds were left per grapevine.

Analysis of the grape and wine parameters were carried out in the Laboratory for Ampelography and Oenology, Faculty of Agriculture, University of Banja Luka. The basic morphological characteristics of grape clusters and grape berries were determined on a sample of 10 representative grape clusters and 100 grape berries. Weight of clusters and berries was measured using a KERN 440 digital balance, Germany. The evaluation of the grape phenolic potential of the analyzed varieties was carried out by analysis of the total anthocyanin and total polyphenol content in the extract of grape skins and seeds, according to the methods recommended by Rustioni et al., 2014. Preparation and analysis of the samples was performed in triplicate. After extraction, the total anthocyanin content was determined by measuring the absorbance at a wavelength of 540 nm, or 700 nm in the case of total polyphenol content (Spectrophotometer UV mini-1240, Shimadzu, Japan). Based on the absorbance values read, the total anthocyanin content is expressed in mg equivalent of malvidin-3-O-glucoside/l, according to the formula: total anthocyanins (mg/l) = E540 × 16.17 × d , where E540 = absorbance at 540 nm; d = dilution, while the concentration of total polyphenols is expressed in mg equivalent of catechin/l, according to the formula: catechin (mg/l) = 186.5 x E700 x d, where E700 = absorbance at 700 nm; d = dilution. The obtained concentrations (mg/l) were then converted into mg/kg of grapes. Analysis of the basic physicochemical properties of grape juice was performed during the first stage of microvinification and included the determination of: total soluble solids content - sugar (TSS) measured with a digital refractometer (Atago-Pal-3, Japan) and expressed in % Brix, total titratable acidity (TTA) determined by the acid neutralization method with a 0.1N NaOH solution, expressed in g/l tartaric acid and the pH value of the grape juice, measured with a ph-meter (Hanna HI2211, Japan). Grape microvinification of all three analyzed varieties was carried out in an identical manner, according to the classic protocol for the production of red wines. After the grapes have been crushed, must was protected from oxidation by adding potassium metabisulfite (Vulcasulph, Vulcascot GH m.b.H. & Co KG, Germany, 10 g/100 l). Then, yeast starter was added (Vitamon Combi, Erbslöh Geisenheim GmbH•Erbslöhstraße, Germany) and inoculation with a culture of selective yeast *Saccharomyces cerevisiae* was performed (Oenoferm Color, ErbslöhGeisenheim GmbH•Erbslöhstraße, Germany), in the quantities recommended by the manufacturer. Fermentation took place at a temperature of 20-22ºC, with must submersion (twice a day), until the level of remaining sugar in the wine was 1.0 g/l to 2 g/l. The determination of the basic chemical parameters of the young wine quality (alcohol content, sugarless extract, reducing sugars, total acidity, volatile acids, pH value and wine color intensity and shade) was carried out after five months, using standard methods prescribed by the International Organization for Vine and Wine (OIV, 2015).

The statistical analysis of grape cluster and grape juice quality were performed using Statgraphics Centurion. The obtained results were subjected to analysis of variance (ANOVA) according to a factorial design, where the sources of variation were year and variety, as well as their interaction. Comparison of means was performed by the Tukey test (α =

0.05). The results are presented as the mean value ±standard error of mean (SEM).

RESULTS AND DISCUSSIONS

Climatic Conditions

Considering the importance of climatic factors in the grape, and therefore wine production, an evaluation of the basic climatic indicators (average monthly air temperature and total monthly precipitation) was performed for the area of Mostar, in the years of research (Federal Hydrometeorological Institute, 2019; 2020). Located in the south of the country, Mostar is characterized by a Mediterranean climate (https://www.fhmzbih.gov.ba/latinica/KLIMA/klimaBIH.php). Based on the attached data, it is evident that the average monthly temperatures were quite uniform, slightly higher in the period from June to August 2019 (25.8-27.7ºC) compared to the previous year (23.3-27.2ºC), while the amount of precipitation in the growing season was relatively low during both research years (Figure 1).

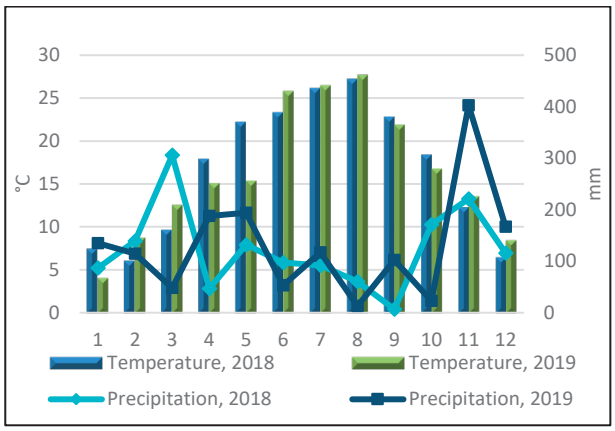

Figure 1. Average monthly temperatures and total monthly precipitation - 2018 and 2019

Grape cluster and grape berries

Individual, average weights of grape clusters and grape berries of the analyzed varieties, during the research period are shown in Figures 2 and 3.

The highest grape cluster weight in 2018 was recorded in the varieties Blatina (400.89 g) and Trnjak (391.24 g), which had a higher grape cluster weight compared to the variety Vranac (337.06 g). The grape cluster weight of analyzed varieties in 2018 did not statistically significantly differ. In 2019, the Blatina variety (328.94 g) had the highest average weight, which was statistically significantly higher compared to the weight of the Trnjak (216.73 g) and Vranac (213.47 g) varieties, which had a relatively uniform weight and were not statistically significantly different from each other.

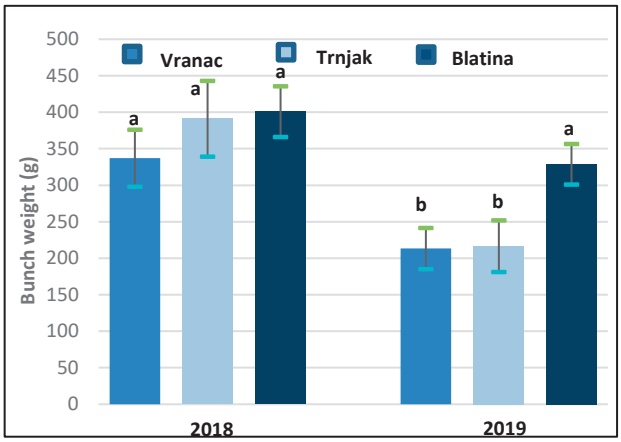

Figure 2. Average claster weight

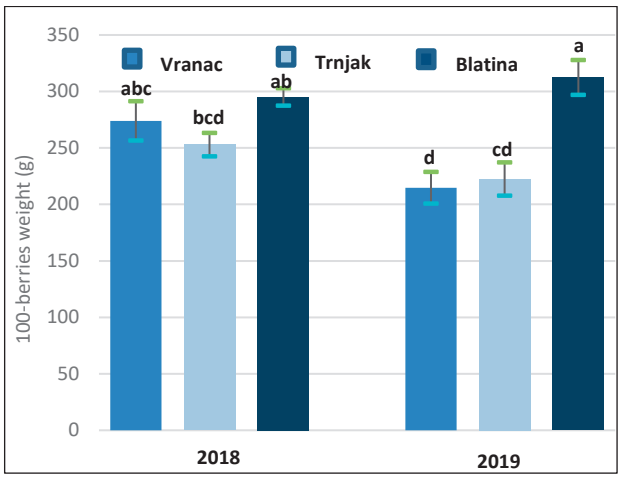

Figure 3. Average weight of 100 berries

The year had the greatest influence on the grape cluster weight (Table 1), bearing in mind that the average cluster weight in 2018, regardless of the variety, was 376.40 g and it was statistically highly significantly higher compared to the average cluster weight of the analyzed varieties in 2019 (253.00 g).

The variety had no effect on grape cluster weight, nor did it interact with the research year. In the years of research, regardless of the variety, the weight of 100 berries was higher in 2018 (274.0 g) compared to 2019 (249.90 g). The highest weight of 100 berries, regardless of the research year, had the Blatina variety (303.70 g). The Blatina variety had the highest weight of 100 berries in 2019 (312.42 g), which is statistically significantly higher than the

Trnjak variety in 2018 and 2019, as well as the Vranac variety in 2019. The effect of year and the interaction of year x variety was highly significant on the weight of 100 berries (Table 1).

Table 1. Influence of year, variety and interaction of year x variety on the examined parameters of clasters and berries

Factor	Cluster mass (g)	Mass of 100 berries (g)
Year (Y)	16.55^{***}	4.69^{*}
Variety (V)	3.04^{ns}	14.25^{***}
Y×V	0.95^{ns}	4.04^{*}
Year		
2018	$376.4^{a} \pm 24.26$	$274.0^{a} \pm 7.65$
2019	$253.0^{b} \pm 19.85$	$249.9^{b} \pm 11.61$
Variety		
Vranac	$275.3^{b} \pm 27.43$	$244.3^{b} \pm 12.80$
Trnjak	$304.0^{ab} \pm 36.57$	$237.7^{b} \pm 9.41$
Blatina	$364.9^{a} \pm 23.24$	$303.7^{a} \pm 8.60$

***, **, *, ns: significant at the 0.001, 0.01, 0.05 probability level and non-significant, respectively
$^{a–d}$ means followed by different letter(s) are significantly different (Duncan, α=0.05)

The observed average weight of the Blatina grape cluster (364.90 g) is higher compared to the results of earlier research conducted on this variety, also grown in the Mostar area (Jovanović-Cvetković et al., 2016b). On the other hand, research conducted by Kojić et al. (2010) showed that the Blatina grape cluster can weight as much as 588.40 g. According to the results of recently conducted, three-year research (Banjanin, 2022), the average grape cluster weight of this variety was 326.30 g, and the average weight of 100 grape berries was 302.52 g, which is relatively consistent with our results, while according to the same research, the average grape cluster weight and 100 grape berries weight of the Vranac variety (350.49 g, respectively 314.42 g) was higher compared to the values of the mentioned parameters in our research (275.30 g, respectively 244.30 g). Research by other authors, who analyzed the production potential of Vranac (Maraš et al., 2012a; Bogićević et al., 2015) show that the grape cluster weight ranged from 226.83 g to 235.00 g, which is in accordance with our research. The obtained results of grape cluster and grape berries weight of Trnjak are mostly in line with the results of the research conducted by Mucalo et al. (2021).

Phenolic composition

The phenolic potential of grapes was assessed by determining the total anthocyanin content (TA) and total polyphenol content in the grape skin (TPSkin) and grape seeds (TPseed). The results of the research are presented in Table 2. Analysis of total anthocyanins content in grape skins of selected indigenous local grape varieties in years of research showed that the specific effect of the research years was statistically highly significant ($p=0.004$) and there was also statistically significant ($p<0.001$) difference between analyzed varieties. However, analysis showed statistically highly significant ($p<0.001$) interaction between the two analyzed factors, i.e. variety and year. Namely, Blatina was significantly better in 2018 compared to 2019 ($p=0.026$), while Trnjak performed in opposite way and was statistically significantly ($p<0.001$) better in 2019 compared to 2018 and Vranac performed the same in both years ($p=0.207$).

Analysis of total polyphenol content in grape skins, in years of research evidently showed statistically highly significant ($p<0.001$) effect of the research year. There was also statistically highly significant ($p<0.001$) difference between analyzed varieties. Blatina had significantly lower polyphenol content ($p<0.001$) compared to both Trnjak and Vranac. Trnjak and Vranac performed without statistically significant difference ($p=0.567$). There was no observed statistically significant ($p=0.162$) interaction between the two analyzed factors, i.e. variety and year.

Analysis of total polyphenol content in grape seeds in selected indigenous local grape varieties in years of research evidently showed the statistical significance ($p<0.001$) in the terms of research year. There was also statistically significant ($p<0.001$) difference between analyzed varieties. However, analysis showed highly significant ($p<0.001$) interaction between the two analyzed factors, i.e. variety and year. Although all varieties were significantly ($p<0.001$) better in 2019 compared to 2018, Trnjak had highest phenol content in 2019, while in 2018 by comparison to Vranac it was significantly lower ($p=0.017$).

Clear varietal differentiation in terms of the content of phenolic compounds was also shown by the results of some other research. According to Río Segada et al. (2009), the difference in the total anthocyanin content in grapes of domestic varieties grown within the grapevine germplasm collection (Viticultura e Enológia de Galicia, Spain) ranged from 191±10 g/kg of grapes to 2660±53 g/kg of grapes. By comparing the results of our research, with the results of research conducted in countries with a notable indigenous grapevine gene pool, Georgia and Armenia, where identical methodology was applied for the determination of phenolic compounds in the grape skin and seeds, generally satisfactory agreement of the results was observed regarding the content of total anthocyanins and total polyphenols in skins, while the total polyphenol content in seeds was lower compared to our results (Abashidze et al., 2015; Ujmajuridze et al., 2015; Margaryan et al., 2017).

Tabele 2. Total anthocyanins (TA) and total polyphenols in the skins (TPSkin) and seeds (TPSeed) of grapes of Blatina, Trnjak and Vranac (mg/kg of grape)

Year	Variety	TA (mg/kg of grape)			TPSkin (mg/kg of grape)			TPseed (mg/kg of grape)		
		□	±	SD	□	±	SD	□	±	SD
2018	Blatina	803.42	±	217.56	1277.48	±	146.08	415.31	±	39.23
	Trnjak	745.02	±	76.83	1477.90	±	176.37	511.03	±	89.40
	Vranac	809.93	±	132.50	1485.55	±	180.18	651.35	±	196.01
2019	Blatina	676.38	±	62.75	1368.46	±	117.65	729.42	±	69.84
	Trnjak	1090.19	±	70.70	1755.19	±	198.57	1776.51	±	17.38
	Vranac	880.52	±	51.06	1823.96	±	314.05	1392.93	±	50.87
F_{year}, p_{year}		9.11**, 0.004			18.97**, <0.001			580.12**, <0.001		
$F_{variety}$, $p_{variety}$		10.47**, p>0.001			15.03**, <0.001			117.06**, <0.001		
$F_{year*variety}$, $p_{year*variety}$		18.44**, p<0.001			1.89, 0.162			73.34**, <0.001		
$LSD_{variety}$		78.101			133.151			-		
$LSD_{year*variety}$		110.446			-			80.349		

In recent decades, the characterization of domesticated varieties based on phenolic potential has been the subject of both domestic and local research. A recently conducted two-year study of the characteristics of Blatina and Vranc (Jovanović-Cvetković et al., 2023), also grown in Herzegovina (Mostar and Trebinje), showed a clear difference between the varieties, production location and the year of harvest. According to the results of the same research, grapes from Blatina had a lower content of phenolic compounds compared to Vranac grapes, in both localities, which is consistent with the results of our research.

Also, during the characterization of the indigenous variety Vranac (Montenegro) based on the level of total extractable anthocyanins and total polyphenol content in the grape skin and seeds (Pajović et al., 2014), the influence of the harvest year (vintage) and different microlocalities of production on the content of the mentioned compounds was clearly manifested in grapes. In this research, the average concentration of total extractable anthocyanins in Vranac variety grapes in the years of research was 960 mg/kg of grapes (2011) and 1113 mg/kg of grapes (2012), which is higher than the results of our research (809.933 mg/kg grapes; 880.525 mg/kg of grapes, while variations in the content of total extractable polyphenols (expressed as the sum of concentrations in the skin and seeds) depending on the year of harvest were even more pronounced (1908 mg/kg (+) catechin - 1598 mg/kg (+) catechin), which is in accordance with our observations of the variability of the mentioned compounds during the research period, not only in Vranac grapes, but also in other varieties, Trnjak and Blatina. Studies carried out by Katalinić et al. (2010) showed a high total anthocyanin and total phenol content in the grape skin extract of the Trnjak variety compared to other domestic and introduced varieties analyzed (1286 ± 32.8 malvidin 3-glucosides/kg berry, i.e. 3486 ± 54.7 GAE/kg berries). In addition, according to Andabaka et al. (2022), based on the results of research related to the grape skin phenolic character of a large number of indigenous varieties (22), this variety was classified into a

group of varieties with a unique polyphenolic profile. Except for the lower total anthocyanin content in 2018, the Trnjak variety also showed a noticeable phenolic potential in our research. Based on the obtained values of the total polyphenol content in the seeds of the analyzed varieties, a lower level of these compounds is evident in all varieties in the first year of the research, which can be attributed to the established difference in the degree of maturity of the seeds in the years of the study. Multi-year research carried out by Katalinić (1999) also showed clear deviations in (+) catechin content in the extract of all analyzed varieties (10) in relation to the vintage, which is in line with our observations. Research on the content of bioactive components in the seeds of some domestic and international varieties, also grown in the Herzegovina region (Banjanin et al., 2019a), showed that the total polyphenol content in the seeds of Blatina and Vranac grapes was higher than Merlo and Cabernet Sauvignon. However, it is interesting that the same research found a significantly lower concentration of (+)-catechin (68.21 mg/100 g of seeds) in the extract of Blatina seeds, compared to Vranac seeds (960.00 mg/100 g of seeds), which indicates a high phenolic potential of this variety seeds, which was confirmed by our and research conducted by Šuković et al. (2020).

Grape juice

The basic characteristics of the grape juice of the analyzed varieties, as well as the influence and interaction of the variety and the year, are presented in Table 3.

Table 3. Effect of year, variety and interaction of year x variety on the physicochemical parameters of grape juice

Factor	TSS (% Brix)	TTA (g/l tartaric acid)	pH
Year (Y)	137.42***	153.53***	266.96***
Variety (V)	40.83***	242.93***	57.32***
Y × V	13.70***	33.06***	5.38*
	Mean ± Standard Error of Mean		
Vranac/2018	$17.65^{a} \pm 0.34$	$4.57^{c} \pm 0.10$	$3.27^{a} \pm 0.03$
Trnjak/2018	$17.51^{a} \pm 0.32$	$5.02^{b} \pm 0.04$	$3.14^{b} \pm 0.01$
Blatina/2018	$16.64^{b} \pm 0.27$	$6.19^{a} \pm 0.05$	$3.03^{c} \pm 0.04$
Vranac/2019	$21.55^{a} \pm 0.35$	$5.08^{b} \pm 0.08$	$3.46^{a} \pm 0.01$
Trnjak/2019	$20.80^{a} \pm 0.27$	$6.31^{a} \pm 0.02$	$3.47^{a} \pm 0.04$
Blatina/2019	$17.69^{b} \pm 0.11$	$6.42^{a} \pm 0.09$	$3.29^{b} \pm 0.01$
Year			
2018	$17.26^{b} \pm 0.194$	$5.26^{b} \pm 0.132$	$3.15^{b} \pm 0.024$
2019	$20.01^{a} \pm 0.343$	$5.94^{a} \pm 0.120$	$3.40^{a} \pm 0.015$
Variety			
Vranac	$19.60^{a} \pm 0.506$	$4.83^{c} \pm 0.087$	$3.36^{a} \pm 0.026$
Trnjak	$19.15^{a} \pm 0.430$	$5.66^{b} \pm 0.149$	$3.30^{b} \pm 0.037$
Blatina	$17.16^{b} \pm 0.187$	$6.30^{a} \pm 0.059$	$3.16^{c} \pm 0.036$

The highest TSS content in the years of research was observed in the variety Vranac (21.55%) in 2019, and the lowest content of TSS was obtained in the variety Blatina in 2018 (16.64%). First, the year of research had a statistically highly significant influence on the analyzed characteristic, bearing in mind that all selected varieties had a significantly higher TSS content during 2019, which was 20.01%. The Blatina variety had a lower TSS content (17.16%) compared to the Trnjak and Vranac varieties. The TTA content was strongly influenced by the variety and research year, as well as their interaction (Table 2). All analyzed varieties had a slightly higher content of TTA during 2019. During 2018, the highest content of TTA was recorded in the Blatina variety (6.19 g/l tartaric acid), while the lowest was the Vranac variety (4.57 g/l tartaric acid). During 2019, the Blatina variety had the highest TTA content (6.42 g/l tartaric acid) and the Vranac variety had the lowest (5.08 g/l tartaric acid). The year and variety had a statistically significant influence on the pH value of the grape juice. The tested varieties had a higher pH value in 2019, which was 3.40. The Blatna

variety had the lowest pH value (3.16) in both years of research compared to the Trnjak and Vranac varieties. The obtained results regarding the TSS content in Blatina grape juice partially agree with the statements of some authors who analyzed the grape quality of this variety in different localities, also in Herzegovina (Kojić et al., 2010; Buntić et al., 2010). The values of the total titratable acidity are in accordance with the results of the research conducted by Lavrić & Prusin, 2020, while the measured pH values are also roughly in accordance with the statements of the same authors. Although during the research period, the quality of Trnjak grape juice had evident variations, the grape juice TSS content of this variety in 2019 (20.80% Brix) largely coincides with the results of recently conducted research in the neighboring region, Croatia, (Jagatić Korenika et al., 2020; Mucalo et al., 2021), while the measured pH value was lower in both years of the research compared to the results of the mentioned authors. The results of multi-year research (Katalinić & Maleš, 1999) also showed that the TSS content in grape juice of this variety ranged from 21.1% Brix to 21.9% Brix, while the level of total titratable acidity in certain years of research, was between 5.25 to 5.50 g/l tartaric acid, which to a some extent is in line with the results of our research in 2018 (5.02 g/l). Variations in the values of the basic chemical components of Vranac grape juice, primarily TSS content, are confirmed by the results of two-year research conducted by Šućur et al. (2016), during which the determined TSS content ranged from 18.8% Brix to 21.2% Brix. Regarding the total titratable acidity, the results of our research are in accordance with the results of research on the grape quality of this variety, also grown in Herzegovina (Banjanin et al., 2018). According to the authors who conducted multi-year research on the Vranac variety in the area where it is most abundant, Montenegro (Maraš et al., 2012b; Popović et al., 2021), a relatively lower content of total titratable acids was observed in most years of research, which is explained due to the influence of climatic factors, i.e. high temperatures during the ripening period, which condition the well-known occurrence of higher sugar levels and lower acidity of grape juice. The determined pH value of grape juice (3.26 and 3.46) is partially in accordance with the results of the research conducted by Pajović et al. (2014).

Wine quality

Oscillations in the values of the analyzed parameters of grape juice were partially reflected on the quality of the wine, which also play a role in the complex fermentation process. The results of the analysis of the basic physicochemical parameters of the wine are presented in Table 4.

Table 4. Basic physicochemical parameters of Blatina,Trnjak and Vranac wines

Parameter	Blatina 2018	Blatina 2019	Trnjak 2018	Trnjak 2019	Vranac 2018	Vranac 2019
Ethanol (% v/v)	9.99	9.62	9.66	11.26	9.91	12.07
Sugar-free extract (g/l)	19.9	25.8	23.4	28.2	24.3	25.5
Reducing sugar (g/l)	1.4	2.0	1.0	1.4	1.1	1.8
Total acidity (g/l tartaric acid)	6.15	6.46	5.33	5.62	5.63	4.82
Volatile acidity (g/l acetic acid)	0.25	0.38	0.17	0.52	0.20	0.32
pH	2.89	3.19	2.98	3.62	3.00	3.50
Color intensity	10.71	7.97	8.30	6.94	8.98	7.30
Color shade	0.576	0.647	0.598	0.789	0.632	0.754

In general, the determined alcohol contents in wine reflect the initial concentration of sugar in the grape juice, which can also be said for the total acidity of the wine, which in all wines was relatively proportional to the initial total acidity of the grape juice, except for Vranac wine in 2018, in which had an increase in total acidity. According to Conde et al. (2007), the increase in the total acidity of wine compared to the initial acidity of grape juice is usually associated with the presence of not only the most common acids in grapes and wine (tartaric, malic and citric), but also some other acids that which are products of the fermentation process itself and

appear in smaller or larger quantities in wine (succinic, shikimic, gluconic acid). Regarding the content of reducing sugars, which ranged from 1.0 to 2.0 g/l, according to international standards, all wines belong to the category of dry wines. Also, the content of volatile acids in all wines (0.17-0.52 g/l acetic acid) was within the permitted limits, prescribed by the International Organization for Vine and Wine (OIV, 2022). Analysis of Blatina wine showed that the alcohol content in the wine and the total acidity were quite uniform during the research period.

The determined alcohol content of 9.99%v/v (2018) and 9.62%v/v (2019) was lower compared to the results of other authors (Herjavec et al., 2011; Banjanin et al., 2019b), while the total acidity of the wine 6.15 g/l (2018) and 6.46 g/l (2019) was higher compared to the results of the mentioned authors (4.58 g/l-5.3 g/l tartaric acid). The content of the sugarless extract varied (19.9 g/l and 25.8 g/l) and it was lower compared to the results of some authors (Lavrić & Prusina, 2020).

The intensity of the wine color was in accordance with the established values of total anthocyanins in the grape skin in the years of research. The values of most analysed parameters of Trnjak variety wine were generally higher in the second year of research, 2019. The determined alcohol content (11.26% v/v), sugarless extract (28.2 g/l), total acidity (5.62 g/l tartaric acid), as well as the pH value of the wine (3.62) in the given year, are broadly in line with the results of recently conducted research (Jagatić Korenika et al., 2020; Mucalo et al., 2021). Given that the alcoholic fermentation was carried out to the minimum residual sugar, the lower alcohol content in 2018 (9.66% v/v) is a reflection of the lower level of sugar in the grape juice. It is characteristic that the color of the wine of this variety was not in accordance with the level of obtained anthocyanins in the grape skin, which was also observed in the Vranac wine. According to Fulcrand et al. (2006), the anthocyanin content in wine does not depend only on their concentration in the grapes, but also on their diffusion from the grapes into the wine, which is conditioned by the degree of skin cell degradation during the vinification process itself. The results of the Vranac wines analysis, also showed a consequently higher alcohol content in the wines of the 2019 vintage (11.26% v/v) and lower total acidity (4.82 g/l tartaric acid), due to the higher level of sugar in the grape juice (21.55% Brix). The stated results, as well as the pH value (3.50) and the level of sugarless extract (25.5 g/l) in the wine from the mentioned year, partially coincide with the statements of the authors from Montenegro, who conducted multi-year research on the quality of grapes and wines of this variety (Pajović et al., 2013; Raičević et al., 2017; Maraš et al., 2017).

CONCLUSIONS

Based on the results analysis of the selected grape and wine characteristics, it can be concluded that:

- the Blatina variety had the highest average weight of grape cluster and 100 grape berries,
- the highest total anthocyanin content in the grape skin and total polyphenol content in the grape seeds was observed in Trnjak, and total polyphenol content in the skin of Vranac grapes,
- grape juice of all analyzed varieties had a higher level of TSS in 2019 compared to 2018. The highest value of TSS was determined in the grape juice of Vranac, which caused the highest alcohol content in the wine of this variety.
- TTA content and pH value of grape juice were slightly higher in grape juice of all varieties in 2019, which was also observed in the case of wine, excluding the Vranac variety.
- the basic physicochemical properties of wine were generally higher in 2019 and proportional to the initial contents of the analyzed parameters in grape juice. An exception is the observed value of the color intensity of Trnjak and Vranac wines.

Statistical analyzes showed a significant and/or highly significant influence of year and variety on most of the analyzed parameters, while the interaction between variety and year was not observed in all analyzed cases. Taking into account the rather uniform climatic conditions in the years of the research, the lower values of most of the analyzed parameters in 2018 could

also be related to an inadequate assessment of the harvest time, i.e. an earlier harvest compared to 2019. Considering the insufficient research of domesticated varieties in the Herzegovina area, this work represents a contribution in terms of expanding the scope of characterization of the quality of their grapes and wine.

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