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ENOLOGICAL POTENTIAL OF MONTENEGRIN WINES PRODUCED FROM CLONES OF AUTOCHTHONOUS GRAPE VARIETY VRANAC

Abstract: The main objective of this study was to compare the enological potential of 7 clones of Vranac grapevine variety based on the principal chemical composition of wines produced in vintages 2013 and 2015. Descriptive sensory analysis was carried out with a panel of seven trained assessors.

Clone 1 was characterized by the highest glycerol formation and the highest total dry and sugar-free extracts content in both vintages. High glycerol was reflected in the most expressed full-body taste as compared to other clones. On the contrary, the lowest glycerol content was found in clone 3 that consequently had the emptiest taste.

In general, wines of the vintage 2013 had statistically significantly lower content of total phenols and the FC index as compared to the control wine, while the soluble CO_2 content was higher. Wines of vintage 2015 had lower total acidity and therefore higher pH value, all which might be a result of completed malolactic fermentation.

Based on the results of descriptive sensory analysis, the clone 1 was aromatically more balanced, with the harmonious fruity flavor and taste in both studied vintages. Taste of the clone 5 was evaluated as the best one because of perceived fullness, harmony. It is the only sample where fruitiness is more expressed in taste than in odour. For this reason, it was recommended as the best clone for great young wine. The overall quality and taste of clone 6 was described as very complex and rounded; perceived astringency works pleasantly and increases volume. Therefore, this clone was recommended as the best one for maturation.

Key words: *wine, Vranac, clone, chemical composition, enological potential, sensory quality*

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INTRODUCTION

Favourable geographical position and warm climate of Montenegro are a main reason for long tradition of grapevine breeding and wine making. The most common variety in Montenegro is autochthonous variety Vranac, representing close to 80% of all wine production. Vranac grapes are well known for their high colour potential, as well as their strong polyphenol potential and are used for the production of high quality red wines [1–3]. Vranac is characterised by a dark red ruby colour, full body, fruity taste and pleasant astringency, all that results in high potential for aging and maturating in oak.

The most commonly used method for genetic improvement of autochthonous grapevine varieties is individual clonal selection. Different clones can produce wines with differences in organoleptic characteristics and differences in their productive characteristics [4, 5]. Given the importance of autochthonous grapevine varieties for Montenegrin viticulture and wine making sector, researchers are intensively working on clonal selection of autochthonous grapevine varieties in Montenegro, especially on variety Vranac.

In 2004, University of Montenegro, Faculty of Biotechnology and the "13. jul — Plantaže" started to work on developing different clones of Vranac with improved agro biological, economic and technological characteristics. After conducting mass positive selection, genotypes with the best characteristics were chosen. Selected mother vines that passed complete sanitary control were selected, propagated, planted and included in the further process of selection [6]. Owing to its economic importance, several studies of this variety have been carried out [3, 7–9] and now the enological potential of the different clones is being studied.

Analysis of various parameters is necessary in order to characterize wines that have favourable chemical composition. The characterization of wines according to their chemical composition has been extensively used to differentiate clones of the same variety [5]. The aim of this study was to conduct a preliminary study of chemical characteristics of the wines from different clones of Vranac in vintages of 2013 and 2015.

MATERIALS AND METHODS

PLANT MATERIAL

Seven clones of Vranac (*Vitis vinifera* L.) grown at micro locality Nikolj Crkva, Ćemovsko field, sub-region Podgorica were studied. The space between vines was 2.6×1.0 m and double horizontal cordon training system was formed. Short winter pruning with 10–12 buds per vine was applied. All plants have been subjected to identical cultivation practices and had received identical protection treatments. The trial was carried out during the 2013 and 2015 vintage.

MICROVINIFICATION

At harvest, grapes from all seven clones were harvested manually and transported to the experimental cellar. Wines were produced on a microvinification scale in the experimental cellar of the winery "13. jul — Plantaže". Alcoholic fermentations of all trials were performed in Ganimede fermenters (Italy) each of 300 L capacity. For the vinification, an average of 200–250 kg grapes of all clones was used. Potassium metabisulfite, purchased from Agroterm KFT, Hungary was added; 8 g/100 kg of grapes from all clones. All enzymes, wine yeasts, lactic acid bacteria and yeast nutrients were obtained from Lallemand, France. Enoferm BDX commercial yeasts was used (30 g/hL), Lalvin EX–V for maceration (2 g/100 kg) and yeast nutrient Go-ferm protect (30 g/hL) were added at the beginning of fermentation, while yeast nutrient Fermaid E (25 g/hL) was added when alcoholic fermentation proceeded to 1/3. During the first two days of alcoholic fermentation the frequency of pumping over was set on 8 h, while to the end of alcoholic fermentation the frequency was set on every 6 hours. After alcoholic fermentation wines were racked and commercial lactic acid bacteria Lalvin VP41 was added to perform malolactic fermentation. After completion of the malolactic fermentation wines were racked, potassium metabisulfite was added in order to achive 25 mg of free SO_2. Cold stabilization was conducted (4 weeks at T of — 5 °C). All wines then aged for a period of three months prior bottling. Bottled wines were stored in cellar at ~ 15 °C.

PHYSICO-CHEMICAL ANALYSIS OF THE WINES

The enological potential of seven different clones was investigated by analysis of 17 physico-chemical parameters in comparison to the control wine (population) using Bacchus 3 FTIR instrument (Tecnología Difusión Ibérica, S. L., Barcelona, Spain).

SENSORY ANALYSIS

All wines were also sensorially assessed. A descriptive sensory analysis was carried out with a panel of seven trained assessors, according to sensory analysis guidelines [10].

RESULTS AND DISCUSSION

PHYSICO-CHEMICAL ANALYSIS OF THE WINES

Physico-chemical analysis of seven investigated clones revealed several differences between them as well as between studied vintages. Table 1 shows the results of analyses carried out on wines from different Vranac clones. Average total dry extract content of clones from vintage 2013 was 27.87 ± 0.97 g/L, while vintage 2015 averaged at 28.46 ± 1.06 g/L. Clone 1 was characterized by the highest glycerol content and the highest total dry and sugar-free extracts content in both production years (Table 1, Figure 1). All this, was reflected in the most expressed full-body taste of wine of clone 1. The lowest values of mentioned parameters were found in clone 3 resulting in the emptiest taste of the wine.

Table 1. Physico-chemical parameters of wine produced from different clones of vintages 2013 and 2015 in relation to control

	Sample	Relative density (/)	Total Dry Extract (g/L)	Reducing sugars (g/L)	Total acidity (g/L as tartaric acid)	Volatile acidity (g/L as acetic acid)	Citric acid (g/L)	Tartaric acid (g/L)	Metanol (mg/L)	FC index (/)
2013	control	0.99423	30.3	2.28	5.95	0.415	0.098	2.29	210	73.54
	1	0.99375	29.74	1.66	6.07	0.238	0.152	2.18	230	49.78
	2	0.99441	27.56	1.76	5.74	0.261	0.104	2.35	210	42.47
	3	0.99440	26.75	1.55	6.83	0.883	0.041	2.4	200	39.81
	4	0.99419	27.92	1.67	5.56	0.211	0.123	2.28	210	44.30
	5	0.99407	27.03	1.52	5.93	0.326	0.080	2.41	210	41.59
	6	0.99356	27.91	1.57	5.65	0.229	0.076	2.39	240	46.09
	7	0.99365	28.21	1.42	5.73	0.192	0.160	2.14	230	45.31
	clone average		27.87 ±0.97	1.59 ±0.11	5.93 ±0.43	0.33 ±0.25	0.11 ±0.04	2.31 ±0.11	219 ±15	44.19 ±3.29
2015	control	0.99351	27.02	1.56	5.48	0.251	0.093	2.15	190	47.16
	1	0.99511	30.16	1.70	6.07	0.899	0.104	1.66	200	52.29
	2	0.99411	27.37	1.45	5.37	0.575	0.092	1.73	170	46.17
	3	0.99454	27.5	1.22	5.66	0.588	0.089	1.83	170	46.48
	4	0.99415	27.82	1.72	5.32	0.604	0.058	1.81	180	52.30
	5	0.99457	27.97	1.55	5.26	0.440	0.051	2.04	180	52.30
	6	0.99460	29.15	1.74	5.72	0.421	0.034	2.20	210	57.64
	7	0.99381	29.26	1.77	5.64	0.334	0.071	1.98	220	59.58
	clone average		28.46 ±1.06	1.59 ±0.20	5.58 ±0.28	0.55 ±0.18	0.07 ±0.03	1.89 ±0.19	190 ±20	52.39 ±5.05

Wines from clones 1, 4 and 6 from 2013 vintage showed significantly higher alcohol content as compared to the same clones from 2015 vintage (Figure 2). Regardless of vintage, wines from clone 7 were characterised by similar, above average alcohol content (13.82 vol% and 13.90 vol%, respectively) indicating clone stability regarding this parameter.

Conversion of the malic acid to the lactic acid results in a reduction in the total acidity and a concomitant increase in the pH value. The transformation of malic acid, a possible substrate for further metabolic reactions, also

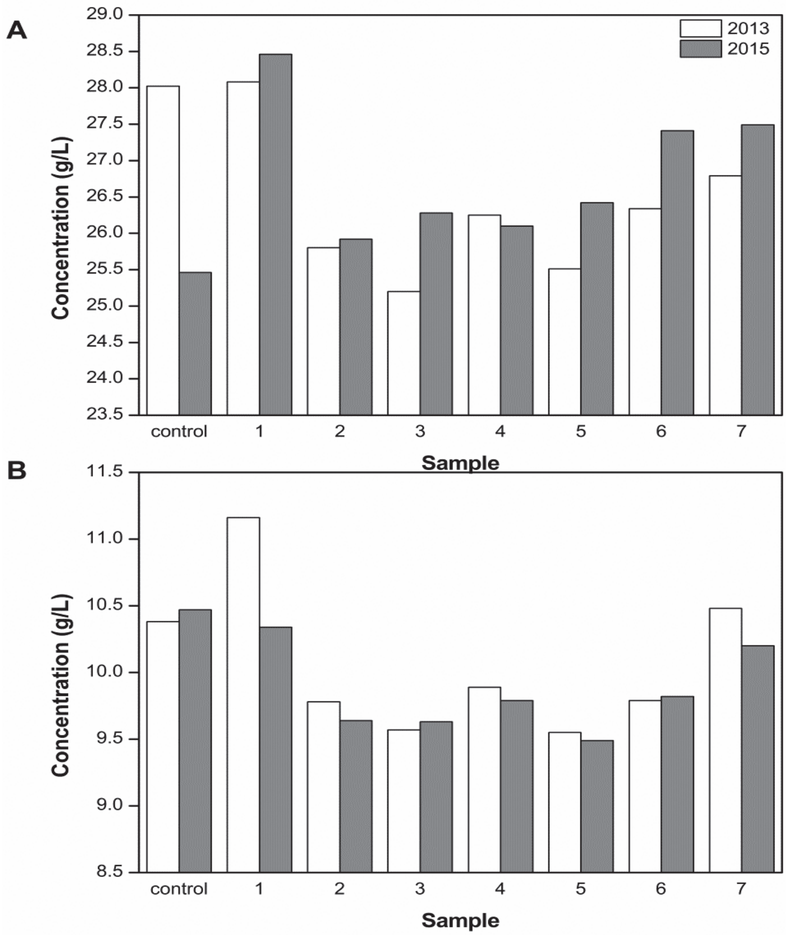


Figure 1. Concentration of sugar-free extract (A) and glycerol (B) in wine from of seven different clones

contributes to the microbial stability of the wine and has a profound effect on the wine aroma profile and sensorial perception [11, 12]. As compared to the control, significant differences in malic acid content after completed malolactic fermentation were observed between studied vintages of wines produced from clones. In 2015 vintage malolactic fermentation was brought to an end completely, with the exception of clone 7, where 0.02 g/L of malic acid remained. In 2013 vintage an average of 0.15 ± 0.06 g/L malic acid remained in wines produced from clones (Figure 3B). The difference is a result of higher alcohol content and lower pH (Figure 3A) of 2013 vintage (13.26 ± 0.71 vol%; pH 3.49±0.03) compared to vintage 2015 (12.94 ± 0.48 vol %; pH value 3.54 ± 0.06). Alcohol content and pH are factors that in combination with the presence of SO_2 act synergistically and make the environment more

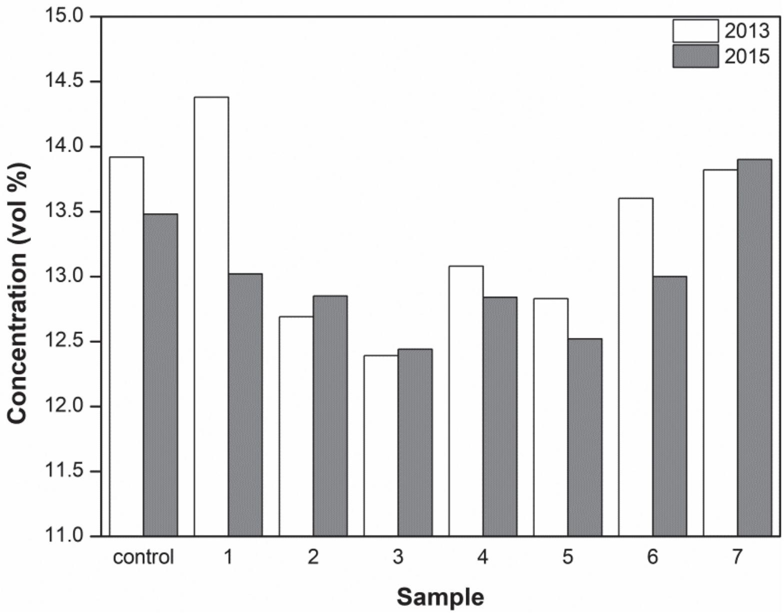
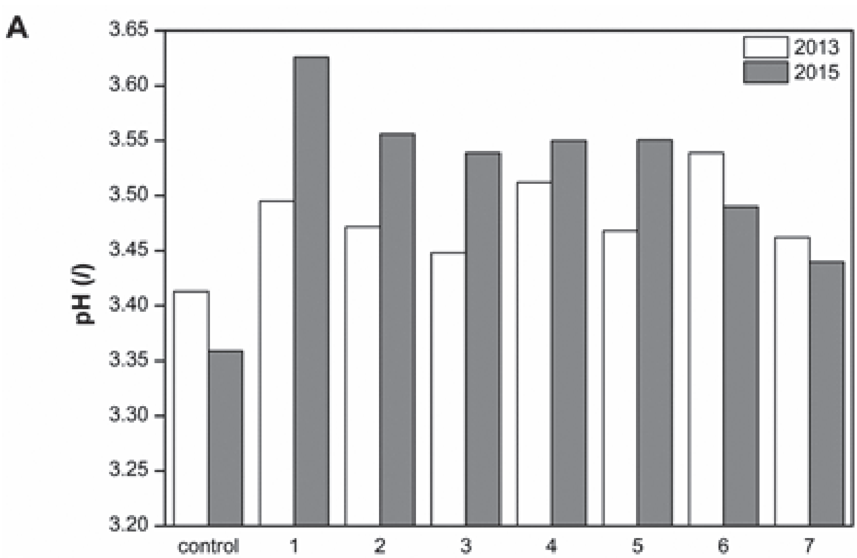


Figure 2. Alcohol content in wine from of seven different clones

hostile for bacteria [13]. Compared to control wine clones of 2013 vintage contained on average less lactic acid (1.02 ± 0.09 g/L), while wine from clones of 2015 vintage contained more lactic acid (1.14 ± 0.14 g/L) (Figure 4).



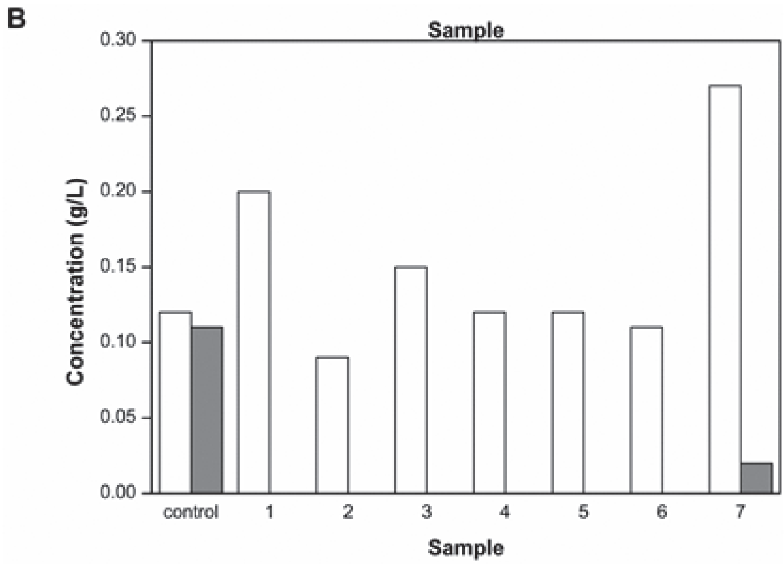


Figure 3. pH (A) and concentration of malic acid
(B) in wine from seven different clones

A further reason for conducting MLF in wine includes the improvement of microbial stability due to the removal of malic acid as a possible substrate for microorganisms.

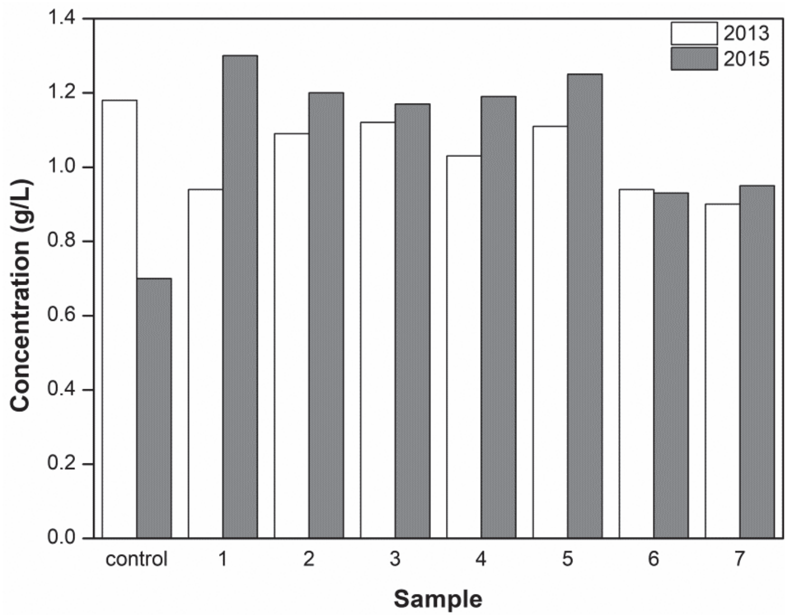


Figure 4. Concentration of lactic acid in wine from seven different clones

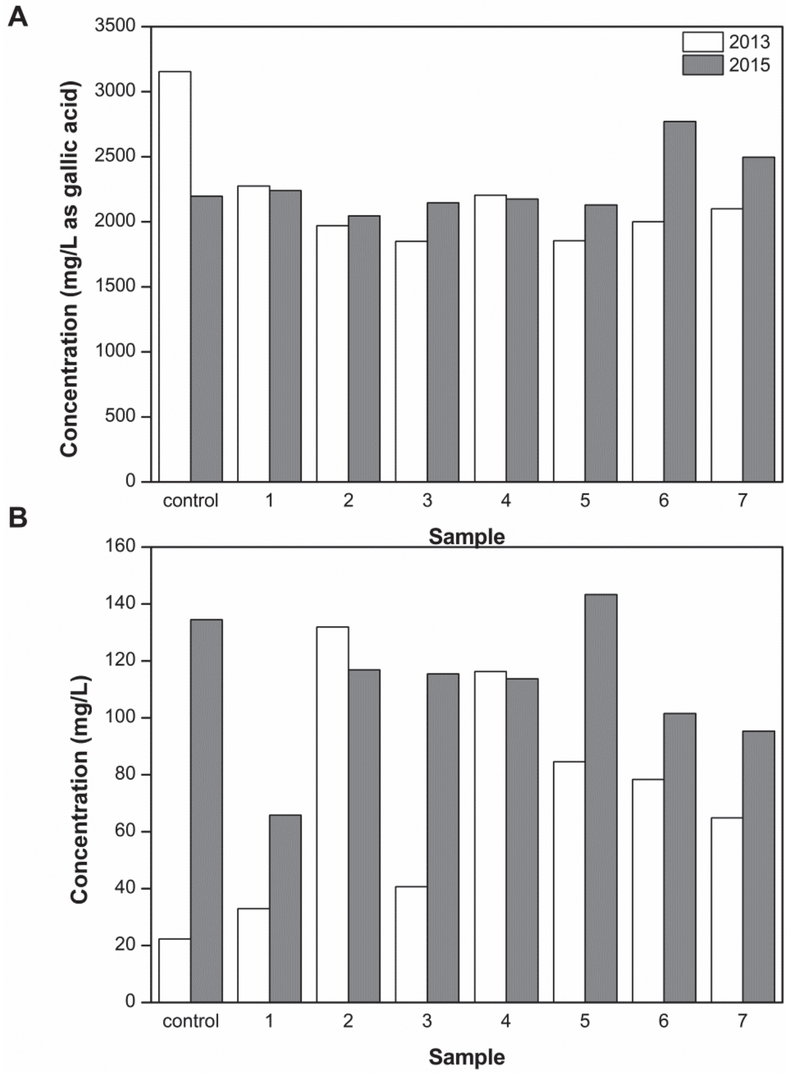


Figure 5. Total phenols (A) and soluble CO2 (B) concentration in wine from seven different clones

The phenolic composition depends on grape variety, as well as on climate, vine location and microlocation, enological practices, storage conditions etc. [14, 15]. Regarding polyphenols content (Figure 5) the highest values were determine in wines from 2015 vintage. Compared to results obtained in the previous study of 2010 vintage [9], control wine from both vintages from this experiment contained more polyphenols. Wines produced from the clones in the 2013 vintage, significantly lower content of total phenols (2.04 ± 0.17 g/L as gallic acid) and the FC index (44.19 ± 3.29) were found in comparison to the vintage 2015 (2.29 ± 0.26 g/L as gallic acid and 52.39 ± 5.05, respectively), while the soluble CO_2 content was higher (Table 1, Figure 5).

SENSORY ANALYSIS

Sensory analysis revealed that wine from clone 1 was aromatically more balanced, with the harmonious fruity flavour and taste in both studied vintages. Clone 5 ranked the best according to the fullness and harmony of taste. This clone was the only clone where fruitiness was more intensively expressed in taste than in odour. For this reason, it is recommended as the best clone for great young wine. The overall quality and taste of clone 6 was described as very complex and rounded; perceived astringency gave a feeling of pleasance and an increased volume (mouthfeel). Therefore, this clone is recommended for maturation.

Table 2. Results of a descriptive sensory analysis, carried out with a panel of seven trained assessors

Wines	Vintage 2013	Vintage 2015
Control	Taste: more full, pleasantly rounded	Taste: aggressive, harshness, astringency and bitterness
Clone 1	Taste: more fruity, medium fullness, detectable ethyl acetate (also in aftertaste)	Taste: more harmonious but not more full in comparison to control
Clone 2	Taste: very astringent, more acidic, seems more young, fruity flavour last for a long time in aftertaste, but is unfortunately covered with bitterness	Taste: very well balanced with smell, harmonious, very good (the best one of first three samples)
Clone 3	Taste: substantially more oxidative, very flat — as standard of untypical aging note	Taste: too hard (astringency and/or acidity), in the middle seems an empty and very non-harmonic taste, only diacetyl with fatty after-taste; lack of fruity flavour
Clone 4	Taste: very astringent, oxidative and flat (similar to clone 3 of 2013)	Taste: very similar to clone 2 of 2015 (in fruitiness and fullness)
Clone 5	Taste: the best one — fullness, harmonious; the only pattern where fruitiness is more expressive in taste than in odour	Taste: more astringent, less fullness and significantly less aromatic; less pleasant
Clone 6	Taste: seems empty, otherwise soft and rounded; slightly too acidic and bitter; lack of fruity aroma in taste	Taste: very complex and rounded; perceived astringency works pleasantly and increases volume
Clone 7	Taste: acetaldehyde, very volatile and unpleasant, in after-taste unpleasant aroma of rotten fruit; the most acidic pattern	Taste: very astringent and no fruitiness; lack of harmony

CONCLUSIONS

Chemical characteristics and sensory analysis of the wines from seven different clones of Vranac in vintages 2013 and 2015 was conducted. Based on the results of descriptive sensory analysis, the clone 1 was aromatically more balanced, with the harmonious fruity flavor and taste in both studied vintages. Taste of the clone 5 was the best one because of fullness, harmony; the only sample where fruitiness was more expressive in taste than in odour. For this reason, it was recommended as the best clone for great young wine. The overall quality and taste of clone 6 was described as very complex and rounded; perceived astringency works pleasantly and increases volume. Therefore, this clone was recommended as being the best for maturation.

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ENOLOŠKI POTENCIJAL CRNOGORSKIH VINA KOJA SE PROIZVODE OD KLONOVA AUTOHTONE SORTE VINOVE LOZE VRANAC

Sažetak

Glavni cilj ovog istraživanja je uporediti enološki potencijal klonova vranca, ispitujući hemijski sastav proizvedenih vina tokom 2013. i 2015. Deskriptivna, senzorna analiza je izvršena od strane panela, koji se sastojao od sedam obučenih degustatora.

Klon 1 karakteriše najveća formacija glicerola i najveći ukupni sadržaj suvog ekstrakta, kao i ekstrakta bez šećera u obje berbe. Najveća formacija glicerola se odrazila u značajno punom ukusu vina. Sa druge strane, najmanje vrijednosti pomenutih parametara su u karakteristikama klona 3 i kao posljedica toga, prazniji ukus vina.

Generalno, za proizvedena vina berbe 2013, statistički značajno niži sadržaj ukupnih fenola i FC indeks su izmjereni u poređenju sa kontrolnim vinom, dok je sadržaj rastvorljivog CO_2 bio veći. Ukupne kisjeline u berbi 2015. su niže, a stoga je viša pH vrijednost. Sve ovo može biti rezultat potpuno obavljene malolaktičke fermentacije.

Na osnovu rezultata deskriptivne senzorne analize, klon 1 je aromatski izbalansiraniji sa skladnom voćnom aromom i ukusom u obje ispitivane berbe. Na ukusu, klon 5 je najbolji zbog punoće i harmonije. On je jedini u kome je voćnost izraženija u ukusu nego u mirisu. Iz tog razloga, preporučuje se kao najbolji klon za veliko, mlado vino. Cjelokupni kvalitet i ukus klona 6 je opisan kao veoma kompleksan i zaokružen; zapažena oporost prijatno djeluje i povećava volumen. Stoga, ovaj klon se najviše preporučuje za sazrijevanje.

Ključne riječi: vino, vranac, klon, hemijski sastav, enološki potencijal, senzorni kvalitet