

Characteristics of red wines depending on the applied maceration method

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Abstract

Wine is an alcoholic beverage created as a product of alcoholic fermentation. It is a complex compound consisting of a large number of components (water, alcohols, acids, sugars, mineral substances, phenols, esters, glycerol, etc.). The chemical composition and quality of wine largely depend on the variety, wine type, production, and storage methods. Maceration is an essential part of the red wine production process. During maceration, numerous compounds are separated from the solid parts of the grape and berry and they are extracted into wine, and thanks to this process, red wine acquires most of its characteristics. It is considered that temperature and duration are the most important maceration factors that affect the quality of red wines. This paper aims to determine the influence of different maceration regimes on the quality of red wines of the Vranac and Merlot varieties. Vinification was carried out in 2021 in the Microbiology Laboratory of the Faculty of Technology in Banja Luka, where maceration regimes for 6 and 12 days were applied, at temperatures of 16 and 25°C. Wine quality analyses were done in the Laboratory for Ampelography and Winemaking at the Faculty of Agriculture in Banja Luka. Differences in wine quality were observed depending on the maceration regime. The highest alcohol content was observed after 6 days of maceration at 25°C, while prolonged maceration led to reduction in the alcohol content. The increased temperature had

a positive effect on the total extract, as well as on the wine chromatic characteristics of both varieties. The wines of the Merlot variety had lower total acidity at longer maceration, while the wines of the Vranac variety had lower total acidity at shorter maceration. All analyzed wines had a satisfactorily low volatile acidity, as well as pH. The Merlot wines had the highest ash content after 12 days of maceration at 25°C, and the Vranac wines after 6 days of maceration at 25°C.

Key words: Vranac, Merlot, maceration, wine quality

Introduction

There are many grapevine types and varieties in the world. The most appreciated wines are wines made from *Vitis vinifera* (European grapevine) wine varieties. Blesić (2016) points out that the grape variety plays a crucial role in wine production. In addition to the variety characteristics, the quality of wine and its organoleptic properties are also influenced by the grape and wine production method, according to Pichler et al. (2015).

The basic process that distinguishes the production technology of red and white wines, and at the same time the most important process of red wine production, is maceration (Ribéreau-Gayon et al., 1970). The maceration process implies the extraction of certain compounds from the solid parts of the berry, and their extraction into the liquid phase, i.e., must and wine (Blesić et al., 2013). Primarily, during maceration, phenolic compounds are separated from solid parts, but also a number of other substances important for wine quality (aromatic compounds, polysaccharides, nitrogenous compounds, mineral substances) (Ribéreau-Gayon et al., 2006).

Modern production of red wines involves maceration in strictly controlled conditions (temperature and duration), and this process depends on variety properties, harvest year and terroir, and enables winemakers to produce the desired style of wine (Herjavec, 2019).

The aim of this study is to determine the influence of the maceration duration and temperature on the quality of red wines of the Vranac and Merlot varieties.

Material and Methods

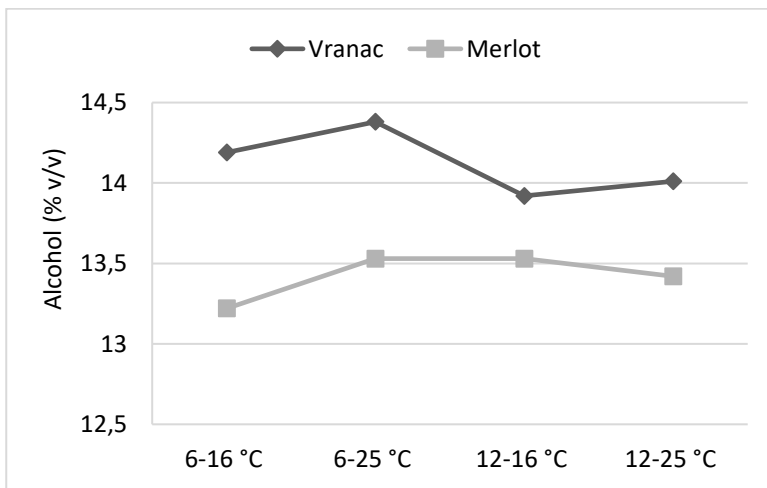
The research was conducted in 2021. Grape samples for wine production were obtained from the "Dabić" Winery located near Trebinje (Bosnia and

Herzegovina). The analysis included two varieties: Vranac and Merlot. Microvinification was performed in the Microbiology Laboratory at the Faculty of Technology of the University of Banja Luka. For each variety, 4 maceration regimes were applied (6 and 12 days at temperatures of 16 and 25°C).

Wine quality can be determined by the following analyses: wine alcohol content (Daničić, 1985), total extract content in wine (Daničić, 1985), wine pH value (OIV-MA-E-AS313-15), wine total acidity (OIV-MA-E-AS313-01), volatile acidity (OIV-MA-E-AS313-02), wine chromatic characteristics (OIV-MA-AS2-07B), and ash content in wine (OIV-MA-E-AS2-04). The analyses were done in the Laboratory for Ampelography and Winemaking at the Faculty of Agriculture, University of Banja Luka.

Results and Discussion

The wine alcohol content (Graph 1.) is often used as a parameter for evaluating the strength of wine. The alcohol content is expressed in volume percentages (% v/v), which represents millilitres of pure alcohol in 100 ml of wine (Daničić, 1988).



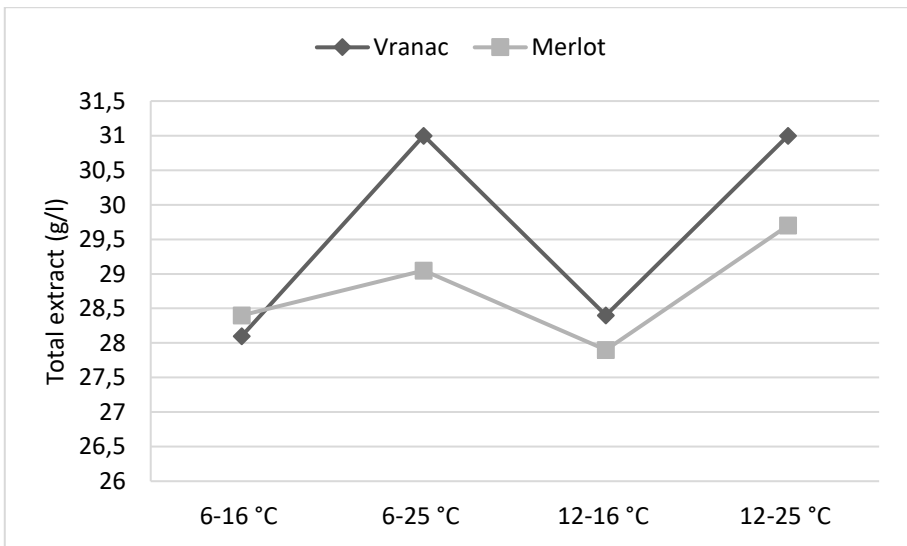
Graph 1. Alcohol content in the Vranac and Merlot wines produced at different maceration duration and temperature

The highest measured alcohol content in both varieties was observed after 6 days of maceration at 25°C. Under the stated conditions, the Merlot wine had 13.53% v/v alcohol, and the Vranac wine had 14.38% v/v alcohol. By extending

the duration of maceration in the Vranac variety, a drop in alcohol content could be noticed, while the alcohol content remained fairly uniform in the Merlot variety.

According to Pajović et al. (2011), wines of the Vranac variety had the lowest alcohol content (9.6% v/v) at maceration at 28-31°C, and the highest at maceration at 24-27°C (11.3% v/v). According to a research by Daudt and Fagaça (2013), the lowest alcohol content of the Merlot wines was determined after maceration for 4 days, 10.7-13.6% v/v, and the highest after longer maceration (15 days), 11.1-13.9% v/v /v.

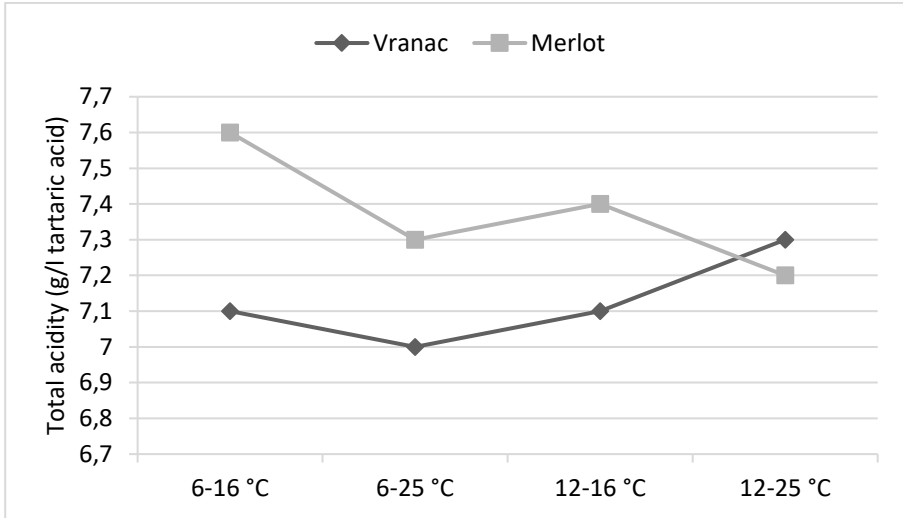
The wine extract contains many non-volatile components of wine, such as glycerine, organic acids, mineral substances, nitrogenous substances, coloured, and tannic substances (Daničić, 1988). As a rule, wines that contain more extract have a fuller flavour and better quality. Graph 2. shows the influence of the maceration duration and temperature on the total extract in the wines of the Vranac and Merlot varieties.



Graph 2. Total wine extract in the Vranac and Merlot wines produced at different maceration duration and temperature

A temperature of 25°C had a positive effect on the increase in the wine extract content. After maceration at 25°C the wines of the Vranac variety had 31 g/l of total extract, and after maceration at 16°C the total extract content was around 28 g/l. In the Merlot wines, produced at a temperature of 25°C, the total extract content was more than 29 g/l, while at a maceration temperature of 16°C,

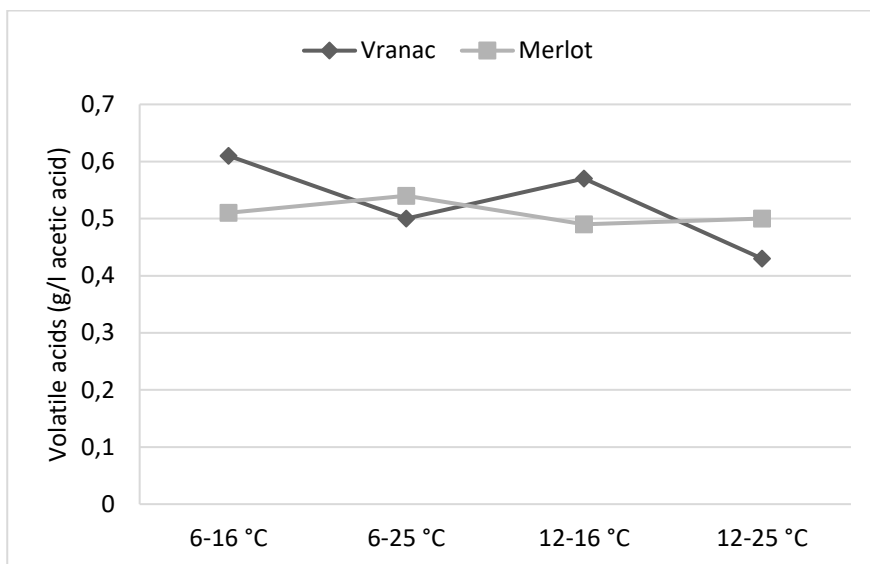
the total extract content was lower (around 28 g/l). Acids give freshness to wines. Graph 3. shows the total acidity of the Vranac and Merlot wines produced at different maceration durations and different temperature conditions.



Graph 3. Total acidity in the Vranac and Merlot wines produced at different maceration duration and temperature

The Merlot wine had the highest total acidity after 6 days of maceration at 16°C (7.6 g/l). Longer maceration and an increase in temperature led to a slight decrease in total acidity in the Merlot wine. The total acidity was lower in the Vranac variety. The highest total acidity in the Vranac variety was obtained after 12 days of maceration at a temperature of 25°C (7.3 g/l). After 6 days of maceration at 25°C, the lowest total acidity (7.0 g/l) was measured in the wine of the Vranac variety.

According to Pajović et al. (2011), the total acidity in the Vranac variety wines ranged between 4.79 g/l (maceration temperature 28-31°C) and 4.95 g/l (maceration temperature 24-27°C). Banjanin et al. (2019) found that the total acidity in the Merlot wines was between 4.56 and 4.72 g/l.

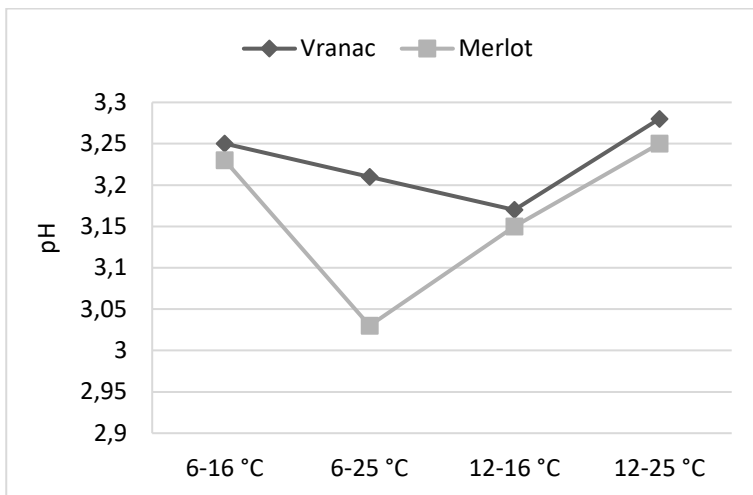


Graph 4. Volatile acidity in the Vranac and Merlot wines produced at different maceration duration and temperature

All wines contain a certain amount of volatile acids. Their content depends on the method of wine production and storage. The volatile acidity (Graph 4.) is the most important indicator of the wine quality and health (Daničić, 1988). If the volatile acidity is high, the development of acetic and lactic acid bacteria has most likely occurred in the wine.

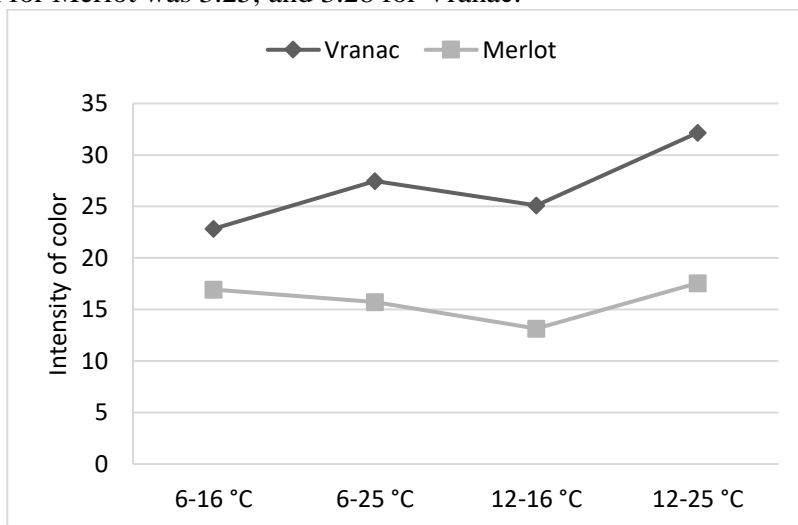
All analyzed wines had a satisfactorily low volatile acidity. In the case of the Merlot variety, the lowest volatile acidity was observed in the wine produced after 12 days of maceration at 16°C (0.49 g/l), and the highest after 6 days of maceration at 25°C (0.54 g/l). In the Vranac variety, the wine had the lowest volatile acidity after 12 days of maceration at 25°C (0.43 g/l), and the highest after 6 days of maceration at 16°C (0.61 g/l).

The wine pH value (Graph 5.) is a very important parameter when evaluating the wine quality. Wines with lower pH values have a fresher taste. In addition, the lower wine pH value ensures easier storage because the development of microorganisms in them is difficult.



Graph 5. pH value in the Vranac and Merlot wines produced at different maceration duration and temperature

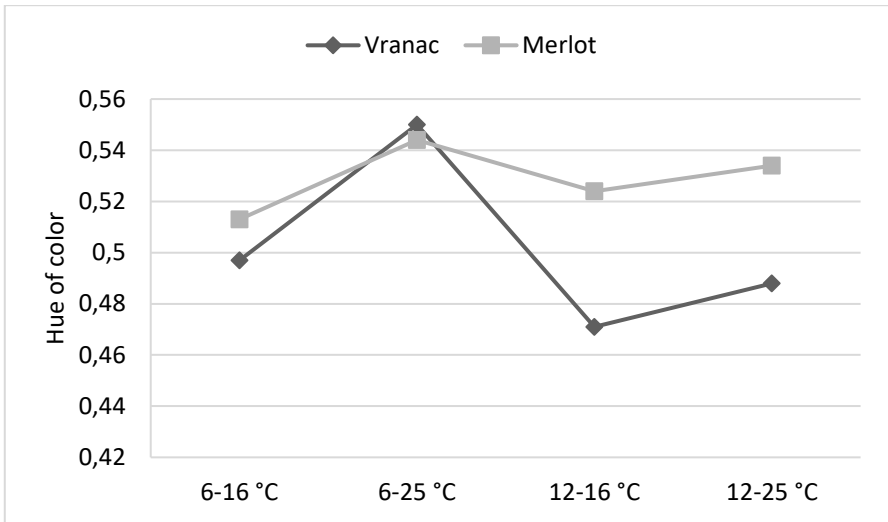
All analyzed wines had a low pH. The Merlot wine had a slightly lower pH. The lowest pH in the Merlot wine was obtained after 6 days of at 25°C (3.03), and in Vranac after 12 days of maceration at 16°C (3.17). Longer maceration and an increase in temperature affected the increase in the wine pH, so that the highest pH was observed in the wines produced after 12 days of maceration at 25°C. The highest pH for Merlot was 3.25, and 3.28 for Vranac.



Graph 6. Colour intensity of the Vranac and Merlot wines produced at different maceration duration and temperature

According to Pajović et al. (2011), the highest pH of the Vranac variety wine was observed after maceration at 24-27°C (3.44). According to Daudt and Fagaça (2013), the wines of the Merlot variety had the lowest pH after 4 days of maceration, while longer maceration led to an increase in pH.

The colour intensity of Vranac and Merlot produced under different maceration regimes is shown in Graph 6., and the colour shade is shown in Graph 7.

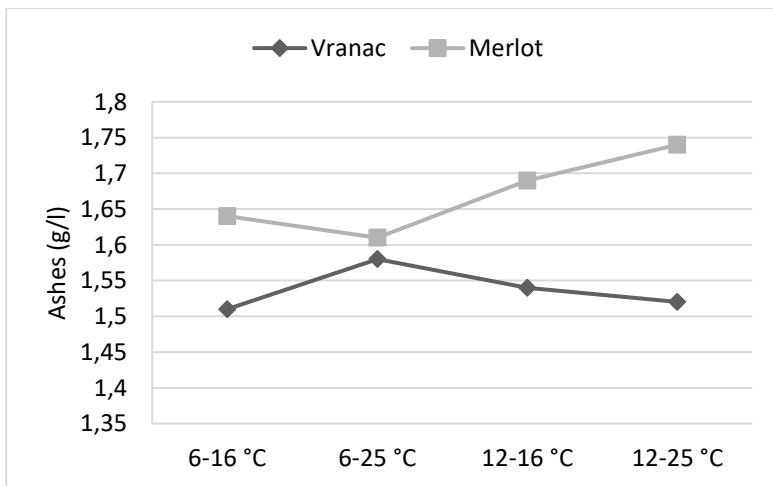


Graph 7. Colour shade of the Vranac and Merlot wines produced at different maceration duration and temperature

Graph 6. shows how a longer maceration at higher temperatures had a positive effect on the colour intensity, while with a shorter maceration, the colour was less intense. After 12 days of maceration at 25°C, the wine of the Vranac variety had the strongest colour intensity (32.17), and the lowest after 6 days of maceration at 16°C (22.84). The wine of the Merlot variety also had the strongest colour intensity after 12 days of maceration at 25°C (17.57), and the weakest after 12 days of maceration at 16°C (13.15). Based on the results shown in Graph 7, it can be concluded that higher temperatures had a positive effect on the wine colour shade. The wines of the Merlot variety had the weakest colour shade after 6 days of maceration at 16°C (0.513), and the strongest colour shade after 6 days of maceration at 25°C (0.544). Further prolongation of the maceration up to 12 days for the Merlot variety had no significant effect on the wine colour. In the case of the Vranac variety wine, the strongest shade was observed after 6 days of maceration at 25°C (0.550). Further prolongation of the maceration had a

negative effect on the colour shade of the Vranac variety wine, so the shade of the wine after 12 days of maceration at 16°C was the lowest (0.471).

Pajović et al. (2012) found that the most intense colour of Vranac was observed on the seventh day of maceration, and then gradually decreased, while the colour shade gradually intensified with longer maceration. The research by Daudt and Fogaça (2013) shows that the values of the intensity and colour shade of Merlot are the highest after 8-15 days of maceration.



Graph 8. Ash content in the Vranac and Merlot wines produced at different maceration duration and temperature

The mineral substances found in the wine make up the wine ash. These substances are important for the wine taste and fullness. Graph 8. shows the ash content in Vranac and Merlot produced at different maceration durations and temperatures.

Graph 8. shows how the ash content in wines changes differently for the Vranac and Merlot varieties. The Vranac variety had the highest ash content in the wine after 6 days of maceration at 25°C (1.58 g/l). Further prolongation of the maceration had a negative effect, so that the lowest ash content of the Vranac variety was observed in the wine produced after 12 days of maceration at 25°C (1.52 g/l). The opposite is observed in the Merlot variety. The lowest ash content (1.61 g/l) in the Merlot wine was measured after 6 days of maceration at 25°C, and, after 12 days of maceration at 25°C, Merlot had the highest ash content (1.74 g/l).

Conclusion

The maceration duration and temperature influenced the production of wine with different characteristics. Both varieties had the highest alcohol content after 6 days of maceration at 25°C, with the fact that in the case of the Vranac variety, larger variations are noticeable depending on the applied maceration regime. Higher temperatures had a positive effect on the total extract in the wines of both varieties. The wines of the Merlot variety had the lowest total acidity after 12 days of maceration at 25°C, and at that maceration regime, the wines of the Vranac variety had the highest total acidity. In the Vranac wine, the higher volatile acidity was observed after maceration at 16°C, and in Merlot after maceration at 25°C. Higher values of colour intensity and shade in the wines of both varieties were observed after maceration at 25°C, with the fact that the Vranac variety was better suited to a shorter (6 days) and the Merlot variety to a longer (12 days) maceration. The Vranac wines had the highest ash content after 6 days of maceration at 25°C, and the Merlot wines after longer maceration (12 days at 25°C).

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Карактеристике црвених вина у зависности од примијењеног метода мацерације

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Сажетак

Вино је алкохолно пиће настало као производ алкохолне ферментације шире. То је сложено једињење које се састоји од великог броја компоненти (вода, алкохоли, киселине, шећери, минералне материје, феноли, естри, глицерол,...). Хемијски састав и квалитет вина у највећој мјери зависе од сорте, типа вина, начина производње и складиштења. Мацерација је суштински дио процеса производње црвених вина. Током мацерације из чврстих дијелова грозда и бобица издвајају се многобројна једињења и прелазе у вино, те захваљујући томе црвена вина стичу највећи број својих карактеристика. Сматра се да су температура и дужина трајања најважнији фактори мацерације који утичу на квалитет црвених вина. Овај рад има за циљ утврдити утицај различитих режима мацерације на квалитет црвених вина сорти Вранац и Мерло. Винификација је обављена у току 2021. године у Лабораторији за микробиологију Технолошког факултета у Бањој Луци, при чему су примијењени режими мацерације у трајању 6 и 12 дана, при температури 16 и 25°C. Анализе квалитета вина рађене су у Лабораторији за ампелографију и винарство Пољопривредног факултета у Бањој Луци. Уочене су разлике у погледу квалитета вина зависно од режима мацерације. Највећи садржај алкохола измјерен је при мацерацији 6 дана на 25°C, док је продужена мацерација имала утицај на смањење садржаја алкохола. Повишена температура имала је позитиван утицај на садржај укупног екстракта, као и на хроматске карактеристике вина обје сорте. Мање киселина вина сорте Мерло имала су при дужој мацерацији, док је код вина сорте Вранац мање киселина измјерено при краћој мацерацији. Сва анализирана вина имала су задовољавајуће низак садржај испарљивих киселина, као и рН вриједност. Највећи садржај пепела вина сорте Мерло имала су при мацерацији 12 дана на 25°C, а вина сорте Вранац при мацерацији 6 дана на 25°C.

Кључне ријечи: Вранац, Мерло, мацерација, квалитет вина

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