Influence of maceration duration, heat treatment, and barrel aging on mineral composition in Teran wines

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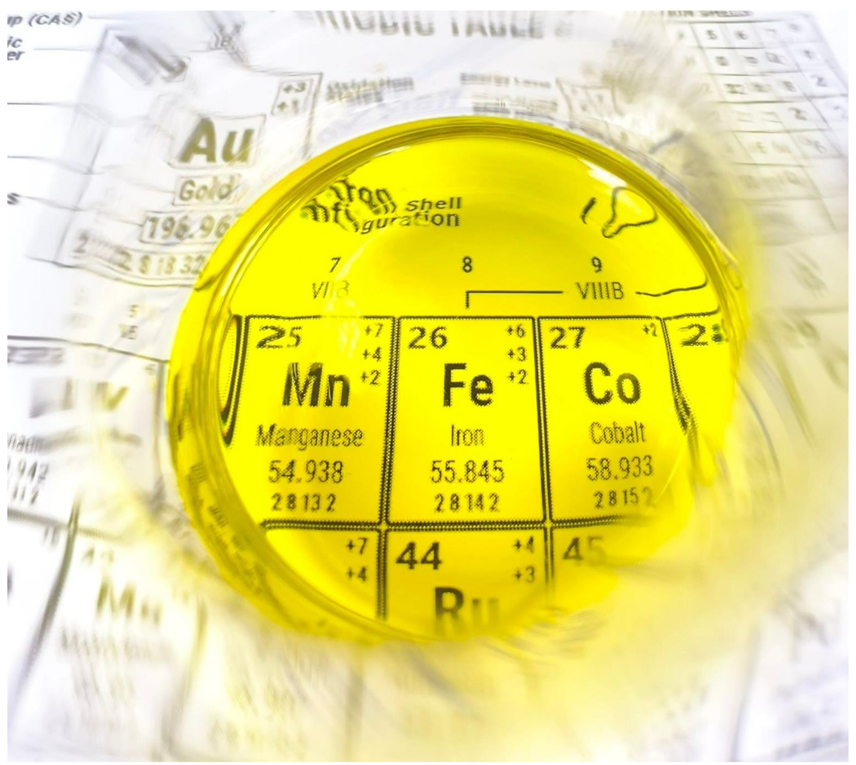
Introduction

Wine is a rich source of various nutritive bioactive compounds, including macro- and microelements. A moderate wine consumption of 250-300 ml/day contributes to the requirements of the human organism for essential elements. Current studies attribute the consumption of foods rich in nutrients even as potential inhibitors of SARS-CoV-2. Moreover, supplementation of micronutrients may positively impact the recovery from COVID-19 infection. However, some metals can be potentially toxic when consumed in excess, and the maximum acceptable levels in wine have been established. The aim of this study was to determine the effects of vinification techniques on mineral composition and estimate the changes in composition during the barrel aging.



Materials and Methods

The experiment was performed in vintage 2019, with grapes from Teran (*Vitis vinifera* L.) variety. The study covered seven days of maceration as a control treatment (TM7), prolonged 10-day maceration (TM10), prolonged post-fermentative 21-day maceration (TM21), and 48-h pre-fermentative maceration heat treatment at 45 °C followed by eight-day standard maceration (TPHT). The fermentation of all treatments was conducted at 24 °C. Accordingly, all the wine samples were aged in oak barrels for six months (TM7-B, TM10-B, TM21-B, TPHT-B). The determination of eight elements was conducted by Optima DV 2000 inductively coupled plasma-optical emission spectrometer. Analysed elements were identified by ICP-OES and were quantified by the direct calibration method.

Results

Fig 1

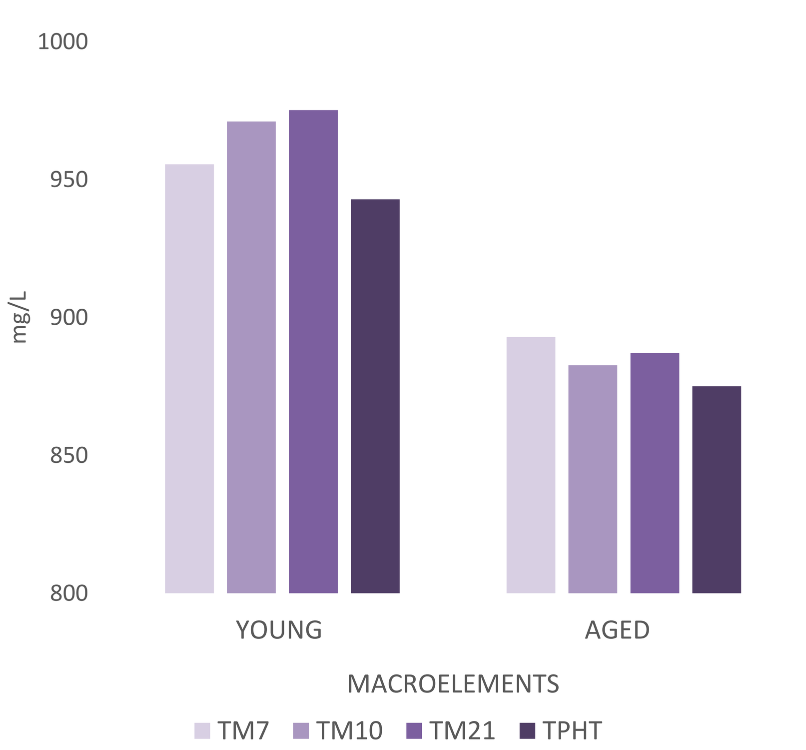
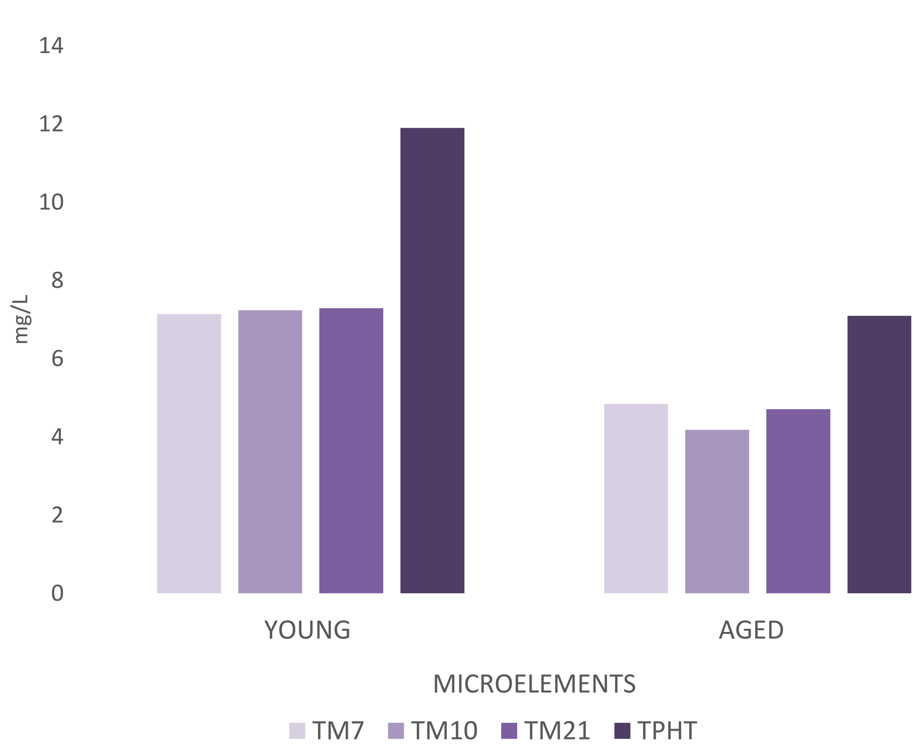


Fig 2



Different small letters above bars represent statistically significant differences among young and aged wines separately, different capital letters above bars represent statistically significant differences between young and corresponding aged wine, with respect to macroelemental content on Figure 1, and with respect to microelemental content on Figure 2, both at $p < 0.05$ obtained by one-way ANOVA and LSD test.

In the investigated wines, K, Ca, Mg, and Na were identified as macroelements, and Al, Cu, Fe, and Mn as microelements. Results in this study showed the significant impact of different treatments on mineral composition. Compared to control, TM10, and TM21 treatments showed significantly higher concentrations of total macroelements. Wine barrel aging significantly reduced the level of all investigated macroelements except Mg, which remained stable. The content of total microelements in young wines was significantly the highest in pre-fermentative heating treatment. The same trend continued in aged wines. It should be pointed that the concentration of all investigated microelements was significantly reduced during barrel aging. This result indicates that some interesting differences can be obtained among wines by applying maceration, heating, and barrel aging in the composition of macro- and microelements. In addition, since metals can form organometallic complexes with anthocyanins and tannins and cause the formation of precipitates, it was very interesting to monitor the evolution of wines during maturation and aging. Obtained results can probably be attributed to the different extraction mechanisms/kinetics from solid parts of grapes, particularly the skin, which was shown to be the most important fraction in terms of metal concentration.

Fig 3 a)

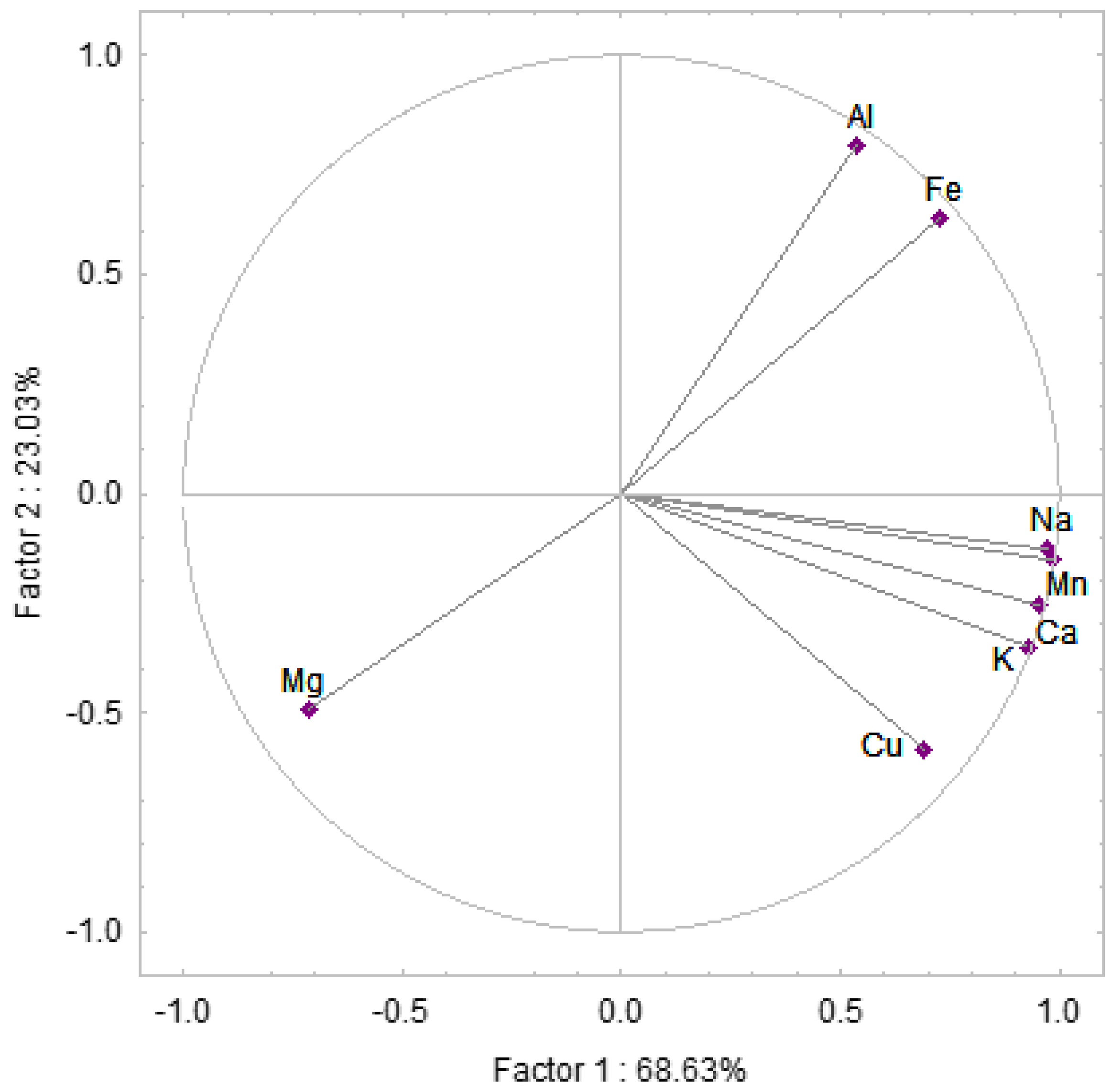


Fig 3 b)

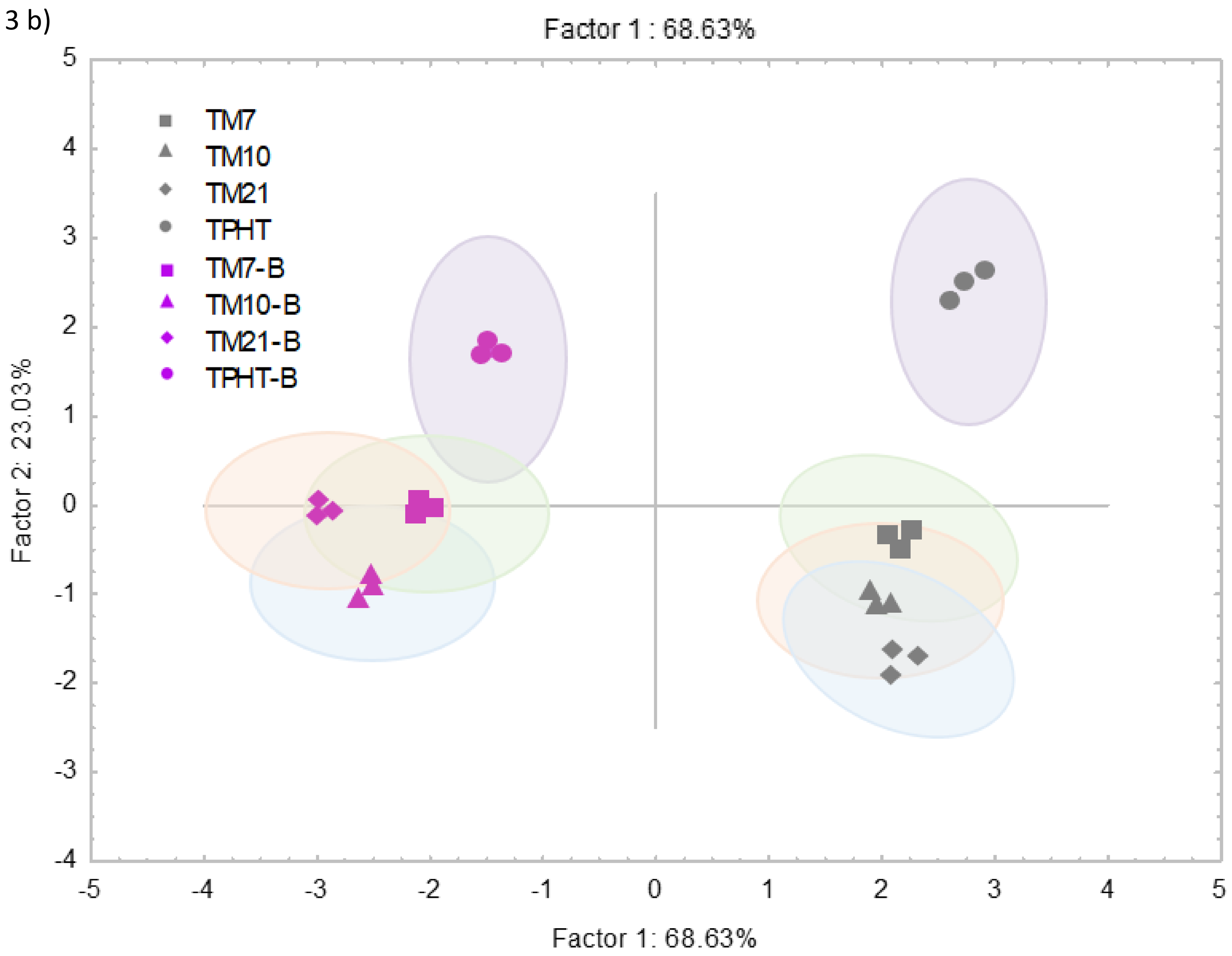


Figure 3 a) Separation of Teran wines produced by different winemaking technologies presented in three replications in two-dimensional space defined by the first two principal components, PC1 and PC2; Figure 3 b) Separation of macro- and microelements on PC1 and PC2.

Conclusion

Based on the obtained results it can be assumed that different vinification processes produced wines with significantly different macro- and microelemental composition. Pre-fermentative maceration heating combined with maceration significantly increased the concentration of microelements, whereas prolonged maceration treatments increased concentrations of macroelements. Regarding aging this study confirmed that macro- and microelemental composition in wine is not stable.

Acknowledgments

This study was funded by Croatian Science Foundation under the projects VINUM SANUM (IP-2018-01-5049) and (DOK-2018-09).

43rd WORLD CONGRESS OF VINE AND WINE, MEXICO, ENSENADA, BAJA CALIFORNIA, 31 October to 04 November, 2022