Impact of pre-fermentative mash cooling, heating, *saignée* technique and prolonged macerations on antioxidant capacity and total phenolic content in Teran red wine

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Introduction

Wine is one of the beverages with the highest phenolic content including its health-promoting properties like antioxidant activity which is attributed to the capacity of scavenging free radicals. In order to increase phenolic extraction, various winemaking techniques and macerations are applied.

Pre-fermentative mash cooling (cold soaking or *cryomaceration*) could be adopted to extract water soluble compounds in the absence of alcohol at low temperatures (5 - 10 °C), mainly phenolic and volatile compounds.

Pre-fermentative mash heating, entails short heating of the skins from 50 to 80 °C, for a longer period (up to 24 h), where heat damages the hypodermal cell membranes, in this way enhancing phenolic extraction.

Saignée (juice runoff) is technique, in which juice is removed before fermentation, thus increasing the skin to juice ratio, thereby enhancing the extraction of phenolic compounds and stabilizing apparent color of the wine.

Prolonged maceration is based on extending the contact of the solids with the wine after fermentation is completed. This technique is used to alter the mouthfeel of the wines, by facilitating proanthocyanidin extraction and the formation of polymeric pigments.

The **aim** of this study was to investigate how pre-fermentative cooling or heating procedure, *saignée* technique, and different maceration durations affect the total phenolic content (TPC), and antioxodant capacity (AC) in Teran red wines.

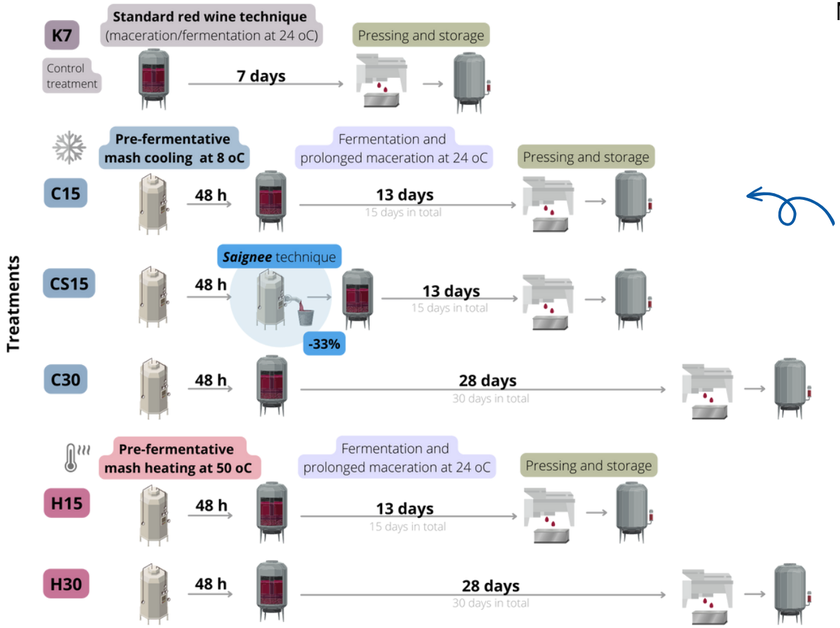

Figure 1: Vinification plan of the experiment

K7 Control wine with a standard technique of a 7-day fermentation/maceration
C15 48-hour pre-fermentative mash cooling followed by fermentation and prolonged 13-day maceration
CS15 48-hour pre-fermentative mash cooling followed by *saignée* technique, fermentation and prolonged 13-day maceration
C30 48-hour pre-fermentative mash cooling followed by fermentation and prolonged 28-day maceration
H15 48-hour pre-fermentative mash heating followed by prolonged 13-day maceration
H30 48-hour pre-fermentative mash heating followed by prolonged 28-day maceration

Materials and methods

- Teran (*Vitis vinifera* L.), an autochthonous Istrian red grape variety
- Grown in Western Istria, the town of Poreč
- The harvest was held in 2020
- Manually harvested grapes were destemmed and crushed with standard equipment, homogenized and equally divided
- **Six vinification treatments were performed**
  - in three replications in 220 L stainless steel tanks

- After the end of the maceration, fermented mashes were pressed and wine was racked in clean tanks
- After six months the wine was bottled and stored prior to analysis

- The antioxidant capacity (AC) of the wines was determined by
  - the ferric reducing/antioxidant power (FRAP) assay (expressed in mmol/L FeSO4 × 7H2O)
  - the oxygen radical absorbance capacity (ORAC) assay (expressed as mmol/L of Trolox equivalents (TE)

- Total phenolic content (TPC) was determined by the Folin–Ciocalteu colorimetric method
  - expressed as gallic acid equivalents in mg/L of wine (mg GAE/L)

- One-way analysis of variance (ANOVA) and Fisher's least significance difference (LSD) test were used to compare mean values (p<0.05)

Results

Antioxidant capacity

According to the FRAP assay, values in all treatments were statistically higher compared to control wine (K7). Treatment that underwent pre-fermentative heating and prolonged 30-day maceration (H30) provided significantly the highest antioxidant capacity, 23.67 mmol L/Fe2+, with respect to the control treatment where 10.77 mmol L/Fe2+ was measured (Figure 2). Identical situation was obtained with ORAC assay, values were ranged from 17.76 mM Trolox found in K7 to 31.67 mM Trolox in H30 treatment. When correlation coefficients (r) were examined, a very strong correlation between FRAP and ORAC at 0.998 (p<0.05) was noted.

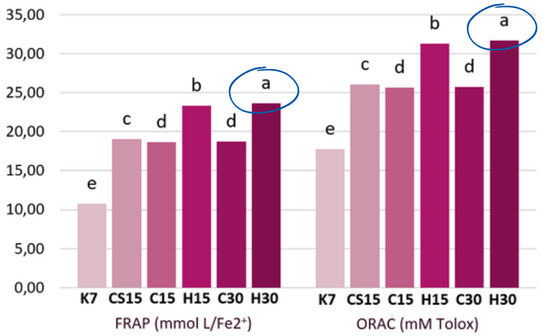

Figure 2: Antioxidant capacity in Teran wines analysed by FRAP and ORAC assay
Lower-case letters above column represent significant differences at p < 0.05 level according to the LSD test.

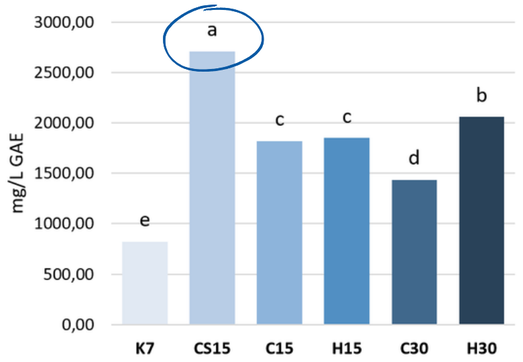

Figure 3: Total phenolic content (mg L/GAE) in Teran wines
Lower-case letters above column represent significant differences at p < 0.05 level according to the LSD test.

Total phenolic content

Total phenolic content (TPC) varied from 821.52 mg GAE/L in control wine (K7) to significantly the highest value, 2710.61 mg GAE/L in treatment where *saignée* technique and 15-day maceration were performed (CS15). In comparison to control wine (K7) TPC in all treatments was statistically higher (Figure 3). Regarding TPC among treatments with pre-fermentative mash cooling or heating and prolonged post-fermentative 15-day maceration (C15 and H15), significant difference was not evident. But the difference was seen in respect of treatments submitted to prolonged post-fermentative 30-day maceration (C30 and H30), where heating procedure in H30 exhibit greater effect on TPC in comparison to cooling procedure in C30.





Conclusions

Obtained results suggested a noticeable impact of *saignée* technique and 15-day maceration on TPC, and the impact of pre-fermentative mash heating and 30-day maceration on antioxidant capacity. According to our results, Teran red wine, affected by particular vinification procedures considered a strong source of bioactive compounds, as well their beneficial properties can contribute to human health.

Acknowledgements

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