

Understanding the impact of maceration conditions on the extraction and preservation of phenolic compounds in Nebbiolo winemaking

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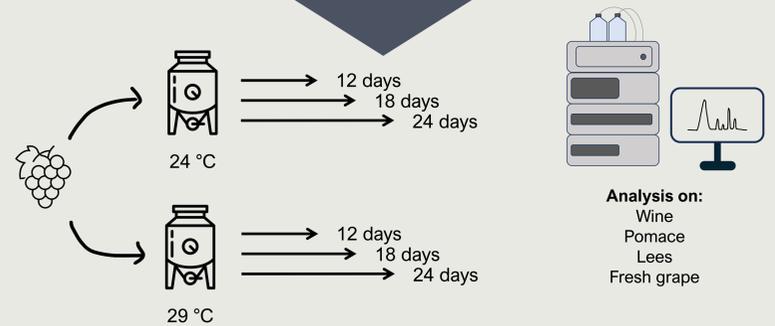
Introduction

The maceration process is crucial for modulating the phenolic properties of red wines, as the extraction and retention of phenolic compounds from grape skins and seeds are primarily influenced by the maceration technique [1]. Various maceration approaches have been proposed to enhance extraction [2], but the interactions among maceration parameters remain complex and not fully understood. This study examines how maceration temperature and duration affect phenolic compounds in Nebbiolo wines, a variety known for its low, oxidation-prone anthocyanin content and high tannin levels in the skins [3].

Materials & Methods

This study investigates how maceration temperature and duration affect phenolic compounds in Nebbiolo wines.

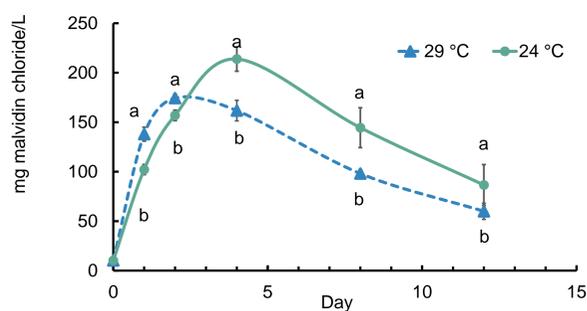
- Nebbiolo grapes were fermented at 24 or 29 °C for 12, 18, and 24 days, with three replicates for each condition.
- The final wines and phenolic extraction during the first 12 days were analyzed using spectrophotometric and HPLC-DAD analysis [4].
- Total phenolic content was measured in fresh grapes, pomace, and lees to evaluate the extracted, unextracted, reabsorbed, and degraded phenolic fraction.



Results

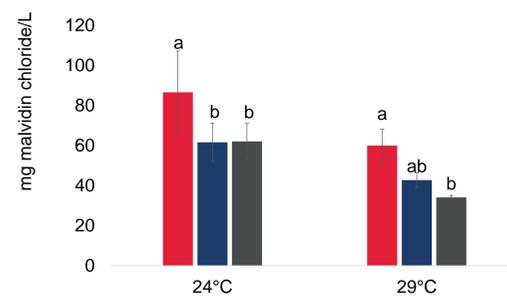
Macerations at 29 °C exhibited an initially fastest anthocyanin extraction. However, by the end of the maceration period, wines produced at 24 °C had a higher anthocyanin content compared to those macerated at higher temperature (29 °C).

Anthocyanin extraction kinetic

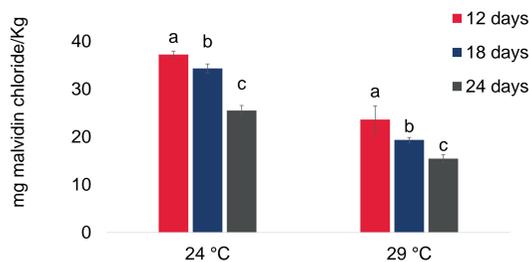


Generally, longer macerations resulted in wines with fewer anthocyanins and a slightly higher proportion of polymeric pigments. The amount of unextracted anthocyanins in the pomace was lower when the maceration was conducted at 29 °C. Likewise, 24-day maceration treatments reduced the share of unextracted anthocyanins.

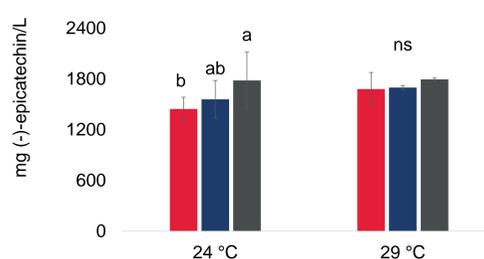
Total Anthocyanin in wines



Total Anthocyanin in pomace

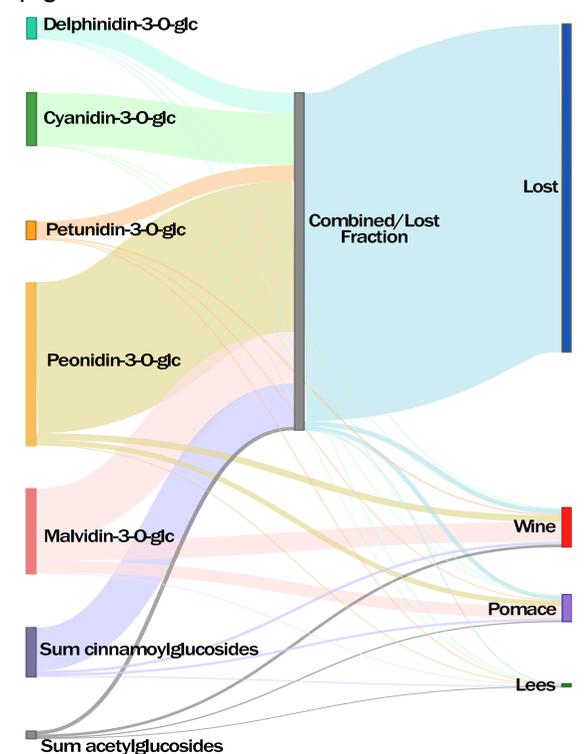


Condensed Tannin in wine



Where do anthocyanins go?

The majority of grape anthocyanins, particularly di-substituted forms, were lost during maceration. On average, less than 10% of the grape anthocyanins remained as free forms in the wine, and only 1% of the initial amount was found as polymeric pigments.



Discussion

These findings suggest that while higher maceration temperatures may accelerate the initial extraction of anthocyanins, they can also increase their degradation as the maceration progresses. This observation was further corroborated by the fact that the pomace showed fewer unextracted anthocyanins at 29 °C. The extended skin contact time did not correspond with an increase in the anthocyanin content in the wine. Therefore, the prolonged maceration period appeared to facilitate a higher anthocyanin degradation rather than enhancing the preservation of free anthocyanins. Overall, the anthocyanin profile of the wine, lees, and pomace was found to be similar among these, but distinct from that of the fresh grapes. Notably, there was a greater loss of disubstituted anthocyanins, while malvidin was the most preserved. At 24 °C, prolonged maceration enhanced tannin extraction, enriching the wine with a higher tannin content.

Conclusion

This study explored the effect of two maceration parameters widely used to manage the maceration process, highlighting that the conditions that enhance the extraction of anthocyanins (high temperature, long skin-contact period) promote also their degradation. **Higher maceration temperature and length increased anthocyanin extraction from Nebbiolo skins without increasing their concentration in wines.**

Selected References

- [1] Unterkofler et al. (2020). *Appl. Microb. Biotechnol.* 104: 4737-4755
- [2] Setford et al. (2017). *Trends Food Sci. Technol.* 69: 106-117
- [3] Giacosa et al. (2021). *Food Res. Int.* 143: 110277
- [4] Paissoni et al. (2020). *Food Chem.* 320: 126633
- [5] Spranger et al. (2004). *Anal. Chim. Acta.* 513: 151-161
- [6] Busse-Valverde et al. (2012). *Eur. Food Res. Technol.* 235: 1117-1123