*Technical Note*

ARC TRAINING CENTRE FOR INNOVATIVE WINE PRODUCTION

# What effect does grape maturity variability have on Cabernet Sauvignon wine chemical and sensory attributes?

*Investigators: Claire Armstrong, David Jeffery*

## Background and Aims

Grape berries within a vineyard, vine or bunch can ripen at different rates, resulting in diverse physical and chemical grape qualities that can be defined as grape heterogeneity. This includes variability in berry size and colour, as well as berry sugar and acid concentrations, among other measures. Underripe and overripe/shrivelled fruit will be picked together at the time of harvest as grape heterogeneity remains at significant levels throughout the growing season.

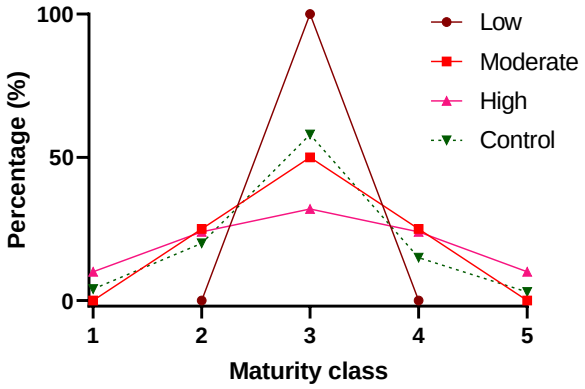
To date, there is minimal understanding of the effect on wine chemical composition and sensory attributes arising from grape heterogeneity, but as Table 1 outlines, differences in grape maturity can clearly lead to varying wine characteristics.[1-4] Wines made from overripe fruit had an increased ethanol concentration so it is envisaged that managing grape heterogeneity could be a method to avoid high-ethanol wines, which can be especially problematic during hot and dry vintages. This project set out to explore what happens if heterogeneity is purposely maintained or created from sorted berries with several maturity classes.

**Table 1**: **Characteristics of red wine made from under-ripe or overripe fruit**

| Wine made from underripe fruit† | Wine made from overripe fruit‡ |
|---|---|
| Sour and bitter | Lack balance |
| Green flavour | Port wine and hotness descriptors |
| Lower total soluble solids (TSS) | Increased ethanol |
| Lower pH | Higher concentration of pigments |
| Higher titratable acidity (TA) | Larger tannin molecules |

†Underripe fruit refers to fruit picked early or determined as underripe by berry sorting based on density or colour

‡Overripe fruit refers to fruit picked late or determined as overripe by berry sorting based density or colour




We achieved wines with high, moderate, and low grape heterogeneity by sorting commercially ripe Cabernet Sauvignon grape berries sourced from Eden Valley in 2019 (Fig 1). We used five density baths consisting of sugar solutions that increased in density, resulting in underripe berries floating and overripe berries sinking.

**Figure 1**: Illustration of the proportion of maturity classes 1-5 in low, moderate, and high heterogeneity wine. Maturity class 1 was underripe fruit and maturity class 5 was overripe fruit. Control wine was made from unsorted fruit that represented the natural grape heterogeneity of the 2019 vintage.

## Key outcomes

Our research explored the effects of grape heterogeneity on the chemistry and sensory characteristics associated with aroma, flavour, colour, taste, and mouthfeel attributes of Cabernet Sauvignon wines arising from a temperate warm growing season.

Full results are described in the publication by Armstrong et al. (2021).[5] Briefly, the key outcomes were:

- For wine sensory descriptors, only 6 of 48 were significantly different. Notably,
  - *Sour* taste was more closely associated to the high heterogeneity wine.
  - *Fruity* aftertaste, *floral* aroma, and *pepper* aroma and flavour were higher in the low and moderate heterogeneity wines.
  - *Savoury* flavour was lacking in the control wine.
- The alcohol content (% ABV) of treatment and control wines ranged from 11.5 % for the high heterogeneity wine to 12.1 % for the control, and no significant differences for the sensory descriptor *heat* were found.
- Titratable acidity was not significantly different between the wines and pH was only significantly higher (by around 0.06–0.08 pH units) in the control wine. There appeared to be no consequences for wine colour due to pH differences.
- There were higher concentrations of anthocyanins in the low heterogeneity wine.
- Grape heterogeneity level did not impact wine tannin content but the high heterogeneity wine appeared to have significantly shorter-length tannins, which was indicative of “harsher” seed tannins that contribute to astringent mouthfeel.
- Numerous aroma compounds had higher concentrations in the high heterogeneity wine, but corresponding sensory descriptors were not scored higher in those wines, suggesting a level of aroma masking.

Taking the sensory and chemical outcomes together, the influence of grape heterogeneity (based on the fruit used in this study) on the resulting wines appeared to be limited. Differences in grape must composition due to increasing levels of grape heterogeneity are still of potential significance for wine quality and style, however, given the influence on parameters such as tannin size, pigments, and aroma compounds. This would be particularly relevant in years where there is a greater abundance of underripe or overripe fruit.

## Recommendations

Fruit sorting in the vineyard or winery (by hand, optically, or via density baths) to circumvent *sour* taste or target *floral* aroma and *fruity aftertaste* characters, may be suggested for occasions where the respective proportion of underripe and/or overripe berries exceeds 10 % of the total fresh weight.

## What's next?

Research is continuing into the use of conventional vineyard management techniques to evaluate their potential for minimising grape heterogeneity at the time of harvest and to understand treatment effects on wine chemistry and sensory profiles.

## Acknowledgements

We would like to acknowledge Drs Renata Ristic, Paul Boss, and Vinay Pagay for their contributions to the study and co-authorship of the publication described in this work. As outlined in the publication, we extend our gratitude to the others who assisted, including Treasury Wine Estates staff who provided access to vineyards and fruit for the experiments.

Wine Australia's supplementary PhD scholarship to Claire Armstrong (WA Ph1802) is also acknowledged.

## References

1. Carroll, D. E.; Ballinger, W. E.; Mcclure, W. F.; Nesbitt, W. B. Wine quality versus ripeness of light-sorted Carlos-Muscadine grapes. *Am. J. Enol. Vitic.* **1978,** 29, 169-171.
2. Kontoudakis, N.; Esteruelas, M.; Fort, F.; Canals, J. M.; De Freitas, V.; Zamora, F. Influence of the heterogeneity of grape phenolic maturity on wine composition and quality. *Food Chem.* **2011,** 124, 767-774.
3. Schelezki, O. J.; Smith, P. A.; Hranilovic, A.; Bindon, K. A.; Jeffery, D. W. Comparison of consecutive harvests versus blending treatments to produce lower alcohol wines from Cabernet Sauvignon grapes: Impact on polysaccharide and tannin content and composition. *Food Chem.* **2018,** 244, 50-59.
4. Schelezki, O. J.; Suklje, K.; Boss, P. K.; Jeffery, D. W. Comparison of consecutive harvests versus blending treatments to produce lower alcohol wines from Cabernet Sauvignon grapes: Impact on wine volatile composition and sensory properties. *Food Chem.* **2018,** 259, 196-206.
5. Armstrong, C. E. J.; Ristic, R.; Boss, P. K.; Pagay, V.; Jeffery, D. W. Effect of grape heterogeneity on wine chemical composition and sensory attributes for *Vitis vinifera* cv. Cabernet Sauvignon. *Aust. J. Grape Wine Res.* **2021,** 27, 206-218.

## Contact

For further information, please email or visit our website:
**Claire Armstrong:** claire.armstrong@adelaide.edu.au; **David Jeffery:** david.jeffery@adelaide.edu.au
ARC Training Centre for Innovative Wine Production; https://www.arcwinecentre.org.au

Australian Government
Australian Research Council

The ARC Training Centre for Innovative Wine Production is funded by the Australian Government (IC170100008) with additional support from Wine Australia and industry partners.

THE UNIVERSITY of ADELAIDE