

ARC Training Centre for Innovative Wine Production

Technical note

SMOKE TAIN DEVELOPMENT IN GRAPES

Introduction

Vineyard exposure to smoke can lead to tainted grapes and wine, characterised by objectionable smoky, ashy aromas and flavours, commonly referred to as 'smoke taint' [1, 2]. In the last decade, the occurrence of significant bushfires in close proximity to wine regions in Australia, Canada, South Africa and the USA has increased, due to the warmer, drier conditions associated with climate change [3]. As a consequence, considerable research has been undertaken to understand the chemical, sensory and physiological consequences of grapevine exposure to smoke. Ongoing research aims to improve on understanding of the biochemical processes behind the grapevine's glycosylation of smoke derived volatile phenols.


The key outcomes

The smoky, ashy attributes typically associated with smoke tainted wine are thought to result from the presence of several smoke-derived volatile phenols, including guaiacol, 4-methylguaiacol, syringol and cresols, in wine made from smoke-affected grapes [2]. These phenols are known to accumulate in glycoconjugate precursor forms, i.e. with one or more sugar molecules attached [4, 5]. During fermentation glycoconjugates can be hydrolysed to release the volatile phenols and thus, the intensity of smoke-related sensory attributes increases [5]. A range of smoke derived volatiles and their precursors have been identified and analytical methods have been developed to enable their quantification as markers of smoke taint in grapes and wines

Recommendations

No recommendations can be made towards the prevention of smoke exposure or uptake of smoke derived volatile compounds by grapes as yet. However, recommendations for mitigating the impact of smoke or amelioration of smoke taint in wine include:

- handpicking fruit and whole bunch pressing [6],
- minimising the duration of skin contact [5],
- enhancing wine complexity by addition of oak chips and tannins [5],
- using fining agents and reverse osmosis combined with solid phase absorption [6].



Methods for amelioration of smoke tainted wine have also been evaluated and selected fining agents and reverse osmosis solid phase adsorption successfully removed volatile phenols from wine, but may also affect fruit aroma and flavour [7, 8].

What's next?

Despite previous research investigating the possible *in vivo* translocation of guaiacol glycoconjugates [9], the mode of entry of smoke-derived volatiles in grapevines remains largely unknown. Furthermore, little work has been done towards the prevention of smoke taint within the vineyard. Current research is therefore aimed at rapid detection of smoke taint in the vineyard, as well as preventing the uptake of smoke derived volatile compounds.

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References

1. Kennison, K.R., et al., (2008) *Smoke-derived taint in wine: The release of smoke-derived volatile phenols during fermentation of Merlot juice following grapevine exposure to smoke*. Journal of Agricultural and Food Chemistry **56**(16): p. 7379-7383.
2. Parker, M., et al., (2012) *Contribution of several volatile phenols and their glycoconjugates to smoke-related sensory properties of red wine*. Journal of Agricultural and Food Chemistry **60** (10): p. 2629-2637.
3. Beer, T. and A. Williams (1995) *Estimating Australian forest-fire danger under conditions of doubled carbon-dioxide concentrations*. Climatic Change **29**(2): p. 169-188.
4. Hayasaka, Y., et al., (2010) *Identification of a beta-D-glucopyranoside precursor to guaiacol in grape juice following grapevine exposure to smoke*. Analytica Chimica Acta **660**(1-2): p. 143-148.
5. Ristic, R., et al., (2011) *The effect of winemaking techniques on the intensity of smoke taint in wine*. Australian Journal of Grape and Wine Research **17**(2): p. S29-S40.
6. Whiting, J. and M. Krstic (2007) *Understanding the sensitivity to timing and management options to mitigate the negative impacts of bush fire smoke on grape and wine quality—scoping study*. Department of Primary Industries Knoxfield Victoria,.
7. Fudge, A.L., et al., (2011) *Amelioration of smoke taint in wine by reverse osmosis and solid phase adsorption*. Australian Journal of Grape and Wine Research **17**(2): p. S41-S48.
8. Fudge, A.L., et al., (2012) *Amelioration of smoke taint in wine by treatment with commercial fining agents*. Australian Journal of Grape and Wine Research **18**(3): p. 302-307.
9. Hayasaka, Y., et al., (2010) *Investigation into the formation of guaiacol conjugates in berries and leaves of grapevine Vitis vinifera L. Cv. Cabernet Sauvignon using stable isotope tracers combined with HPLC-MS and MS/MS analysis*. Journal of Agricultural and Food Chemistry **58**(4): p. 2076-2081.

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