Recent smoke research and what it means for industry

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Introduction

Following three cooler and wetter years, warm and dry conditions have been forecast for the 2023/24 growing season, bringing bushfires and smoke back onto the agenda of grape and wine producers. The 2019/20 vintage was the most challenging to date in Australia for smoke in vineyards, after fires affected numerous wine growing regions across Australia. That very difficult vintage did, however, provide an opportunity for researchers to initiate a number of studies and take some big steps forward in understanding the effects of smoke in grapes and wine. The goodwill and contributions of growers and winemakers across the country, collaborating with AWRI researchers, enabled us to address many of the big questions that were being asked by industry in 2020. The research completed since then has now been published in a number of open access peer-reviewed publications that are available to both producers and researchers. This article summarises key findings in AWRI smoke research since 2019/20.

Does early-season smoke damage wine-grapes?

Earlier model experiments had suggested that grapes were at relatively low risk until veraison. However, data from early-season fires in Hunter Valley and Adelaide Hills in 2019 showed impacts from smoke exposure as early as growth stage E-L 29 (peppercorn sized green berries) (Jiang *et al.* 2021, Jiang *et al.* 2022). Significant smoke exposure early in the growing season (pea-size green berries) led to elevated phenolic glycosides in grapes at harvest and resulted in observable smoky flavours in wine. An unexpected finding was that the concentration of phenolic glycosides in early-season grapes was not diluted out during berry growth and maturation. Phenolic glycosides were also found in leaves of grapevines exposed to early-season smoke both soon after the exposure and at harvest, meaning it's important to try and avoid incorporation of leaves in ferments following a smoke event.

What are the baseline concentrations of smoke markers found in non-smoke-exposed grapes and wine?

Because low levels of smoke markers are found in non-smoke-exposed grapes, it's important to understand their baseline concentrations, when assessing potentially smoke-affected grapes. If smoke markers exceed baseline concentrations, this is evidence of smoke exposure.

These smoke markers (seven volatile phenols and six glycosides) have now been rigorously determined for grapes and wine for most prominent varieties grown in Australia. Baseline data for the first 12 varieties are published in an open-access peer-reviewed paper, based on more than 1,000 non-smoke-exposed grape and wine samples collated over several years (Coulter *et al.* 2022). Baseline marker concentrations for an additional nine varieties have been added since the paper was published. When customers receive smoke analysis reports from Affinity Labs, the baseline data are now plotted alongside sample results in all reports, making it easy to see whether samples have any evidence of smoke exposure.

How well does the baseline data classify clean vs smoke-exposed samples?

In 2020, no samples that had been classified as 'clean' according to baseline data produced 'smoky' wines upon thorough investigation by formal sensory assessment. In other words, the comparison of potentially affected samples to baseline values gave no false negatives. Over the years, we have occasionally heard reports of smoky wine being produced from grapes classified as clean by comparing to the baseline,

From this work we have defined high-risk and medium-risk zones based on concentrations of smoke markers in grapes.

Smoke blanketing Hunter Valley vineyards during the bushfires of late 2019

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and would appreciate the opportunity to investigate these cases in the future if any are observed.

What are the concentrations of smoke markers in grapes that translate into smoky wine?

The biggest gap in our knowledge in 2020 was to understand what concentrations of smoke markers in grapes would translate into smoky wine. We can now answer that question for Chardonnay, Pinot Noir and Shiraz, based on data from 65 small-scale wines produced in 2020 from grapes with a range of smoke exposure sourced from South Australia, New South Wales, and Victoria (Parker *et al*. 2023). From this work we have defined high-risk and medium-risk zones based on concentrations of smoke markers in grapes. All wines made from grapes with concentrations in the high-risk zone were significantly smokier than controls. After making wine from grapes in the medium-risk zone, some, but not all wines were smoky. Armed with these data, we have a clearer picture of the risk of producing smoky wine from smoke-exposed grapes and can support producers to use these risk zones to make decisions.

What else has changed since 2020?

Following the 2020 vintage, Affinity Labs conducted a review of the smoke analysis services provided to industry, what went well and what could have

been improved (Wilkes 2021). The AWRI also conducted a broader review of technical support provided by the helpdesk and extension teams. Significant numbers of conversations with industry members about smoke taint have since also been conducted as part of co-design activities for potential new smoke research projects. Based on the feedback received, a number of improvements have been made to AWRI services in preparation for future smoke events. These include:

- Increased capacity for smoke analysis by Affinity Labs
- Plans for processing of samples in-region if a major smoke event occurs and simplifying sample transportation and biosecurity management.
- Inclusion of graphs displaying background smoke marker concentrations on all Affinity Labs analytical reports.
- Updates to technical advice regarding mini-ferments, where they are now seen as an optional extra rather than a recommendation.
- Updated information on website and fact sheets incorporating the latest research findings and results of trials of a wide range of remediation techniques.

Conclusions

Smoke remains a significant risk to grape and wine producers in Australia and around the world. While there are not yet any silver bullet treatments that can prevent uptake of smoke or return smoke-affected grapes to their original condition, researchers are continuing to fill in knowledge gaps and translate findings into practical improvements in services and support for producers. While we all hope vintage 2024 does not feature bushfires in grapegrowing regions, if smoke events occur, our industry now has more information to assess the risk of smoky flavours in wines and the AWRI has greater knowledge on which to base its technical support. The AWRI is also continuing to work closely with industry on ways to further improve management of the effects of smoke.

For assistance with smoke taint or any other technical grapegrowing or winemaking issue, contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8 313 6600.

References and further reading

AWRI smoke resources: www.awri.com.au/industry_support/winemaking_resources/smoke-taint

Coulter, A., Baldock, G. A., Parker, M., Hayasaka, Y., Francis, I. L., Herderich, M. 2022. The concentration of smoke marker compounds in non-smoke-exposed grapes and wine in Australia. *Aust. J. Grape Wine Res.* 28(3): 459-474.

Jiang, W., Parker, M., Hayasaka, Y., Simos, C., Herderich, M. 2021. Compositional changes in grapes and leaves as a consequence of smoke exposure of vineyards from multiple bushfires across a ripening season. *Molecules* 26(11): 3187.

Jiang, W.W., Bilogrevic, E., Parker, M., Francis, I.L., Leske, P., Hayasaka, Y., Barter, S., Herderich, M. 2022. The effect of pre-veraison smoke exposure of grapes on phenolic compounds and smoky flavour in wine. *Aust. J. Grape Wine Res.* 2022: 9820204.

Parker, M., Jiang, W.M., Bilogrevic, E., Likos, D., Gledhill, J., Coulter, A.D., Cowey, G.D., Simos, C.A., Francis, I.L. Herderich, M.J. 2023. Modelling smoke flavour in wine from chemical composition of smoke-exposed grapes and wine. *Aust. J. Grape Wine Res.* 2023: 4964850.

Wilkes, E. Smoke analysis at the AWRI: a testing year. 2021. *Aust. N.Z. Grapegrower Winemaker* (684): 58-61.

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