



ask the
AWRI

Understanding the risk of smoke taint from grape analysis

Although devastating, the fires of 2019/2020 provided an opportunity for the AWRI to conduct a major research trial which investigated the relationship between the concentration of smoke markers in grapes and the intensity of smoky flavours in wine made from them. The results have significantly improved our understanding of smoke taint risk and strengthened the AWRI's ability to interpret smoke analysis results for industry.

In this column, Senior Oenologist **Adrian Coulter** explains what the research found and how grapegrowers and winemakers can use this information to better assess risk of producing smoke tainted wine.

What were the aims of the 2020 research trial?

The primary objective was to establish how concentrations of smoke marker compounds in grapes relate to the perception of smoke flavour in wine. More specifically, the research aimed to answer the following questions:

1. [What level of the smoke markers in grapes will make wine taste distinctly smoky?
2. Which markers have the strongest influence on smoke flavour in both grapes and wine?
3. Can smoke flavour in wine be reliably predicted by measuring specific smoke marker compounds in grapes?

How was the trial conducted?

In 2020, more than 60 Pinot Noir, Shiraz and Chardonnay small lot (50-80kg) wines were made from grapes with various degrees of smoke exposure. The

grapes were analysed at the AWRI for the standard suite of 13 smoke marker compounds. These included:

- Seven volatile phenols; guaiacol, 4-ethylguaiacol, syringol, methylsyringol, *o*-, *m*- and *p*-cresol.
- Six volatile phenol glycosides, or phenolic glycosides; syringol gentiobioside, methylsyringol gentiobioside, phenol rutinoside, cresol rutinosides, guaiacol rutinoside and methylguaiacol rutinoside.

Chardonnay grapes were crushed and pressed with minimal skin contact, following standard white winemaking practices. The red wines were made in full-bodied style with skin contact. No interventions were made to reduce the smoke impact.

Over a period of 39 months, the wines underwent sensory evaluation four times and were analysed for the 13 smoke

marker compounds. Sensory evaluation was conducted by trained panellists using formal sensory methodology.

What did the trial show?

1. Defining risk categories

Wines of each variety were classified as 'smoky' if their smoke flavour was rated significantly higher than the control wines of the same variety (Dunnett's test). The concentrations of smoke marker compounds in the grapes from which the smoky wines were made were then used to define the 'high-risk' thresholds for grape. That is, grapes with marker compound values greater than or equal to the high-risk thresholds are considered to be at high risk of producing a wine with perceivable smoke flavour.

Some wines showed a smoky flavour, but the difference was not statistically significant compared with the control wines of the same variety. The levels of smoke marker compounds in the grapes

from which these wines were made were used to define the ‘moderate-risk’ thresholds for grapes. In other words, grapes with marker levels between moderate and high risk thresholds *could* produce wine with noticeable smoke flavour, but it’s possible other flavours in the wine may mask it. Grapes with marker levels below the moderate risk threshold produced wines with no smoke flavour.

2. Identifying the most influential markers

The statistics used to model smoke flavour identified a subset of smoke marker compounds in grapes that had the strongest influence on smoke flavour in wine.

The most influential markers were:

- Guaiacol
- *o*-, *m*- and *p*-cresol
- Guaiacol rutinoideside
- Cresol rutinoideside.

While syringol gentiobioside is not a particularly good indicator of smoke flavour, it remains a reliable indicator of smoke exposure and is therefore still included in risk tables.

3. Confirming predictive value

Finally, the study demonstrated a strong relationship between smoke marker concentrations in grapes and the perception of smoke flavour in wine. The subset of markers listed above provided the strongest predictive power (Parker *et al.* 2023). The results of the study provides industry with a stronger evidence base and confidence in interpreting grape smoke analysis results.

How do these findings improve interpretation of smoke analysis?

Previously, the interpretation of smoke analysis was limited to determining the presence or absence of smoke exposure. Now, when smoke exposure is detected for Pinot Noir, Shiraz and Chardonnay grapes, the results can be compared against established moderate and high-risk thresholds (see Table 1 and the AWRI smoke taint webpage). This allows growers and winemakers to better assess the risk of smoke-exposed grapes producing wine with perceptible smoke flavour. Note that in cases where results for a grape sample show only one marker

Table 1. Concentrations of the key marker compounds in grapes that were at moderate and high risk of producing wines with perceivable smoke flavour. Syringol gentiobioside is included in the table because it is a reliable smoke exposure marker.

Analyte in grapes	Chardonnay		Pinot Noir		Shiraz	
	Moderate risk	High risk	Moderate risk	High risk	Moderate risk	High risk
Guaiacol	1.0	9.0	2.0	3.0	4.0	10.0
<i>o</i> -Cresol	0.5	7.0	3.0	5.0	0.5	3.0
<i>m</i> -Cresol	0.5	7.0	0.5	1.0	0.5	0.5
<i>p</i> -Cresol	0.5	7.0	0.5	0.5	0.5	0.5
GuRG	2.0	8.0	3.0	4.0	6.0	23.0
CrRG	3.0	9.0	6.0	7.0	5.0	12.0
SyGG	32.0	101.0	22.0	31.0	29.0	164.0

GuRG=guaiacol rutinoideside, CrRG=cresol rutinoideside, SyGG=syringol gentiobioside

compound elevated, depending on which compound is elevated, the risk might not be as high as indicated in Table 1. In such cases, it is advisable to contact AWRI Heldesk for advice.

Can these thresholds be applied to other varieties?

More work is required to validate these findings across other varieties, and with data from other fire events. In the absence of variety-specific data, white varieties can be compared with Chardonnay data, and red varieties with Pinot Noir or Shiraz. While not ideal, this approach provides a reasonable estimate of risk until further research becomes available.

What options are available for grapes at risk of producing wines with smoke flavour?

Several approaches have been used to mitigate smoke impact, particularly for white styles:

- Hand harvesting
- Minimising skin contact
- Fining juice with activated carbon products
- Blending.

All these techniques have been used to produce commercially acceptable wines from smoke-affected grapes. Currently, managing smoke flavours in full-bodied red wine styles remains a significant challenge.

Further reading

Readers are encouraged to consult:

- Interpreting AWRI smoke panel analysis results, Coulter (2022)

- Recent smoke research and what it means for industry, Parker and Robinson (2023)

AWRI helpdesk

The AWRI helpdesk provides a free-of-charge technical advisory service to Australia’s grapegrowers and winemakers. For further information on interpretation of smoke panel analysis results, contact the helpdesk on (08) 8313 6600 or helpdesk@awri.com.au.

References

- Coulter, A. 2022. Ask the AWRI: Interpreting AWRI smoke panel analysis results. *Aust. N.Z. Grapegrower Winemaker* (698): 42-43.
- Parker, M., Jiang, 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.* <https://doi.org/10.1155/2023/4964850>
- Parker, P., Robinson, E. 2023. Recent smoke research and what it means for industry. *Aust. N.Z. Grapegrower Winemaker* (698): 48-52.

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