The Australian Wine Research Institute

Fact Sheet

Smoke taint – entry into grapes and vineyard risk factors

Background

The exposure of vineyards and grapes to smoke may result in wines with undesirable sensory characteristics, such as smoky, burnt, bacon, medicinal or ash, usually described as 'smoke tainted'. Consumers have been shown to respond negatively to smoke tainted wines. The compounds in smoke primarily responsible for the taint are the free volatile phenols (e.g. guaiacol, 4-methylguaiacol, o-cresol, p-cresol, m-cresol, etc). These compounds are produced and released into the atmosphere when lignin in wood is burnt. This fact sheet aims to summarise the most recent scientific findings on how smoke taint enters into vines and viticultural factors affecting uptake.

How do smoke taint compounds enter into the grapevine and fruit?

Recent studies have demonstrated that the primary mode of entry for smoke-related volatile phenols into the vine, and accumulation in the fruit, is directly via the waxy cuticle on berries. While large concentrations of volatile phenols can be found in leaves, it appears that the movement of these compounds from the leaves to the berries is very slow. When free volatile phenols enter grape berries, they can react rapidly with grape sugars to give the glycoside 'bound' forms of the phenols.

Which factors affect smoke uptake by vines?

The risk of smoke exposure causing a perceptible taint in wine is a function of the stage of grapevine growth and development, the grapevine variety exposed, smoke concentration, duration of exposure and the volatile phenol concentration and composition of the actual smoke.

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Grapevine growth stage

The effects of smoke exposure vary depending on stage of grapevine growth and development when smoke exposure occurs. The nearer the fruit is to harvest the higher the risk associated with smoke exposure.

Table 1. Stage of grapevine growth and development and sensitivity of grapes to the uptake of free volatile phenols.

Grapevine growth stage (E-L stage)	Potential for smoke uptake
Shoots 10cm in length (E-L 12)	Low
Flowering (E-L 19-26)	Low
Berries pea size (E-L 31)	Variable – low to medium
Beginning of bunch closure (E-L 32)	Variable – low to medium
Onset of veraison (E-L 34-35)	Variable – medium
Post-veraison leading up to harvest (E-L 36-38)	High

Grape variety

Grapevine varieties differ in their sensitivity to the uptake of smoke taint compounds, e.g. Sangiovese is more sensitive than Cabernet Sauvignon. However, these effects vary between different smoke events, phenological stage, and this area requires further investigation.

Smoke composition

Smoke is made up of particulate matter, secondary organic aerosols and volatile organic carbon compounds. The exact amount of smoke exposure which results in a perceptible taint in wine is not well known, as the chemical composition of smoke changes rapidly in the atmosphere, becoming lower in the concentrations of volatile phenols over time. This means that smoke from recently burnt woody materials will contain higher concentrations of free volatile phenols, and thus have greater potential to cause smoke taint in grapes and wine.

Smoke exposure

The density of smoke particulate matter can be measured using nephelometry. However, the strength of the relationship between measured particulate matter and the risk of smoke taint has not been determined. Low levels of smoke exposure (i.e. where visibility through smoke haze is >10-15km or %obscuration/m is <0.05) will generally not result in a perceptible smoke taint in grapes or wine. However, the exact level of smoke exposure that will cause taint has not been determined. Research thus far has demonstrated there is no carry-over of phenols and their metabolites from one season to the next.

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Further reading

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