Eucalyptol (1,8-cineole) in wine

Dimitra L. Capone
The characteristic aroma is ‘eucalyptus’, ‘fresh’, ‘cool’, ‘medicinal’ and ‘camphorous’.

Aroma detection threshold in a Californian Merlot is 1.1 µg/L

(ETS Laboratory)

Study by the AWRI sensory team found consumers preferred a wine spiked (4 & 30 µg/L) over the unspiked wine. With a cluster (38%) strongly preferring the wine spiked at 30 µg/L.

(AWRI Tech Rev. #189)
Background on 1,8-cineole

The origin of 1,8-cineole in wine is unclear

- Herve et al reported that the ‘eucalypt’ character in wines occurs when vineyards are surrounded by *Eucalyptus* trees

- Farina et al proposed that terpene compounds such as $\alpha$-terpineol and limonene are possible precursors of 1,8-cineole

We wanted to identify the source of 1,8-cineole in wine and study factors which affect its concentration
Developed a method for measuring 1,8-cineole in wine

Solid phase micro-extraction (SPME) + stable isotope dilution analysis (SIDA – with $d_6$-1,8-cineole) combined with gas chromatography/mass spectrometry (GC/MS)

- This has been used to determine the origin of 1,8-cineole in Australian wines
- Initially examined how widespread this character is in Australian wines
How wide spread is 1,8-cineole in commercial Australian red wines?

40% contained 1,8-cineole above reported detection threshold. The highest level of 1,8-cineole found was 19.6 μg/L.
65% of the current Pinot Noir wines analysed contained 1,8-Cineole at or above its aroma detection threshold.

50% of the purchased Victorian, 89% of Victorian commercial sent in by industry & 37% of the Tasmanian Pinot Noir wines analysed had 1,8-Cineole at or above its aroma detection threshold.
1,8-cineole in commercial Australian Coonawarra Cabernet Sauvignons
Is 1,8-cineole found in significant concentrations in Australian white wine?

NO!

Out of 44 white wines (12 Rieslings, 10 Sauvignon Blancs, 10 Semillons and 12 Chardonnays) 1,8-cineole was not detected above 0.8 µg/L in any wine.
Formation of 1,8-cineole from precursors?

% Conversion to 1,8-Cineole from terpenoid precursors

% Conversion to 1,8-cineole vs Time (weeks)

- pH = 3.4, at 25 deg
- pH = 3.0, at 25 deg

limonene and α-terpineol not significant precursors

After 12 months of storing model wine spiked with unnaturally high amounts of terpenoid there was less than 0.4% conversion to 1,8-cineole (i.e. sub-threshold formation) at two different pH
Wines obtained from a single vineyard in Western Australia & the Yarra Valley

- Margaret River
- Barossa Valley
- Adelaide Hills
- McLaren Vale
- Coonawarra
- Riverland
- Hunter Valley
- Riverina
- Heathcote
- King Valley
- Yarra Valley
- Mornington
- Granite Belt
- NT
- QLD
- SA
- NSW
- TAS
1,8-Cineole concentration decreases further away from Eucalyptus trees.
Commercial ferments

- Low concentration found in all white wines – is compound accumulated in the skins and extracted during extended maceration?

- Therefore two commercial ferments were monitored each day throughout fermentation for 1,8-cineole concentration
Cineole increases during fermentation – with skin contact

Changes of 1,8-cineole during fermentation
Two commercial shiraz fermentations - Samples were collected and analysed daily

Ferment (1) 20 tonne closed fermentor with Padthaway fruit and

(2) 10 tonne open fermentor with McLaren Vale fruit

Continuous increase in 1,8-cineole concentration, which ceased at pressing off of the skins. This indicated to us that the compound was extracted from the skins and/or MOG
Vineyard studies

A more detailed study of the relationship between grape composition and proximity to *Eucalyptus* trees was conducted over three vintages.

Grape bunches

Grape stems

Grape Leaves
Effect of distance to *Eucalyptus* trees
Concentration of 1,8-cineole measured in grapes, grape leaf and stems

- **Grape (µg/kg)**
- **Leaf (µg/kg)**
- **Stem (µg/kg)**

**Amount of 1,8-cineole (µg/kg)**

- **Row 1**
- **Row 10**
- **Row 20**
- **Row 60**
Concentration of 1,8-cineole in grape skins & grape pulp

- Skin: 1.31 μg/kg
- Pulp: 0.36 μg/kg

Average ng/berry:
- SKIN: 1.31
- Pulp: 0.36

Photographed by E. Wilkes
Airborne transmission

To confirm that airborne transmission plausible:

Traps were designed to absorb eucalyptol from the atmosphere.

Polyethylene sheets sewn between wire mesh installed again in:

- Row 1
- Row 10
- Row 20
- Row 60
The traps reaffirm the results obtained for the grape, leaf and stem data i.e. greater amounts of 1,8-cineole are found closest to the *Eucalyptus* trees.
Effect of MOG

In Row 1
Found a bunch of *Eucalyptus* leaves and bark in canopy

Total MOG 67.5 gm in 1 tonne fermenter + with 100% extraction

= 213 µg/L of 1,8-cineole
To determine the effect of MOG on 1,8-cineole concentration

Block with a history of high 1,8-cineole was chosen

Only the first 3 Rows picked

- 550 kg of Shiraz Fruit
- Hand picked & randomised
- Duplicate 50 kg lots
- Then Crushed

Rows 1 to 3
Fermentation design

Treatment 1
Rosé
Pressed Immediately

Treatment 2
Control
Hand Plucked

Treatment 3
Grape Leaves & Stem

Treatment 4
Eucalyptus Mix
Fermentation curves: Influence of MOG

Concentration of 1,8-cineole (µg/L)

Control
Hand plucked
Rep 1 & 2
Fermentation curves: Influence of MOG

Concentration of 1,8-cineole (µg/L)

Grape Leaf & Stem Rep 1, 2 & 3
Control Hand plucked Rep 1 & 2
Fermentation curves: Influence of MOG

Concentration of 1,8-cineole (µg/L)

- Eucalyptus Mix
  Rep 1 & 2

- Grape Leaf & Stem
  Rep 1, 2 & 3

- Control
  Hand plucked
  Rep 1 & 2
33 *Eucalyptus* leaves found –

In 550 kg of hand picked fruit

Imagine what a machine harvester might do!
Additional Experiments

- Translocation is not occurring from the roots of the vine or the grape leaves to the grapes.
- 1,8-Cineole is extremely stable in wine
- Minimal scalping observed for natural cork or screw cap closures and a 14% reduction of 1,8-cineole under synthetic closure over a 12 month period
Conclusions

- Limonene and α-terpineol do not contribute significantly to the 1,8-cineole concentration in young wines.
- The greatest amount of 1,8-cineole in grapes, grape leaf and stem is found in the samples closest to the *Eucalyptus* trees.
- The amount of 1,8-cineole increases during fermentation with skin contact.
- The presence of *Eucalyptus* leaves, and to a lesser extent grape vine leaves and stems can be a major contributor to 1,8-cineole concentration in some wine.
Tips to modulate 1,8-cineole in wine

- Keep fruit harvested close to trees separate from the rest and blend if desired

To decrease concentrations of 1,8-cineole if desired you could-

- Remove *Eucalyptus* leaves & twigs from canopy close to trees before machine-harvesting
- Eliminate other MOG (especially from rows close to trees) from ferments i.e. sorting fruit on a conveyer belt
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Evolution and Occurrence of 1,8-Cineole (Eucalyptol) in Australian Wine

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Vineyard and Fermentation Studies To Elucidate the Origin of 1,8-Cineole in Australian Red Wine

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Thank you – come visit us in Adelaide

Wine Innovation Cluster, Urrbrae SA
1,8-Cineole (eucalyptol)

- Aroma detection threshold in a Californian Merlot is 1.1 µg/L (ETS Laboratory).
- Found only in red wines.
- Lower concentration: 5 µg/L.
- Higher concentration: 40 µg/L.