

# Understanding how smoke compounds get into fruit and wine

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# ***Smoke in the Vineyard***

*During a 'smoke event' there are many factors within the vineyard that can affect the level of taint in wine*

e.g.

- Phenological stage of berry growth
- Varietal differences
- Fuel types



# Research Questions

How do smoke related chemicals enter the grapevine?

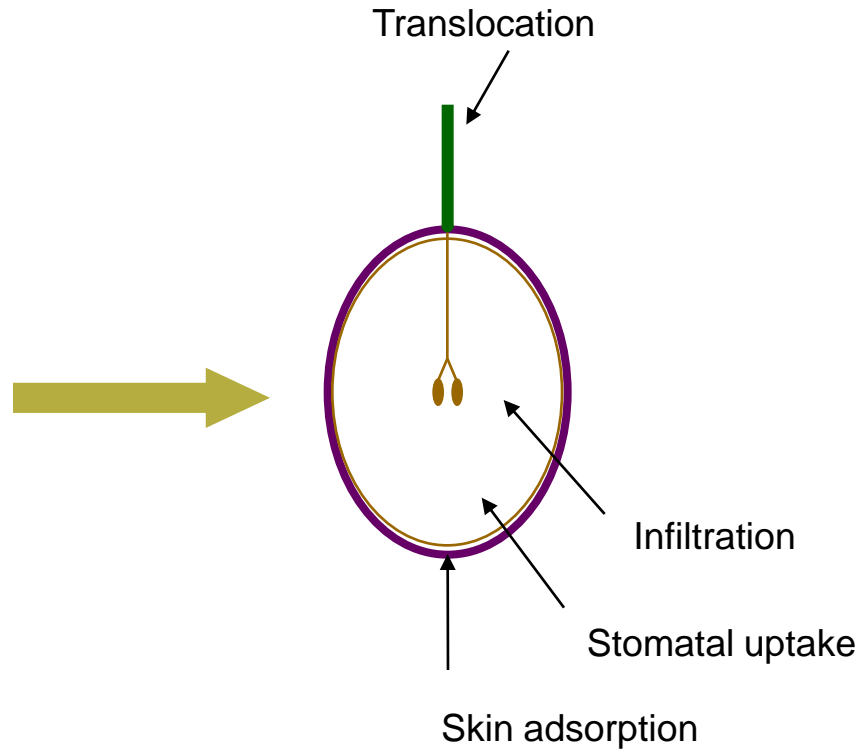
Where are they located?

Can smoke taint compounds move?

e.g. from leaf to fruit  
from the roots



# Mode of Entry - Grapes



# Location within Berries

## Guaiacol Glycoside Analysis of Smoked Berries:

- Separation of berries into skin, pulp and seeds
  - no significant difference between skin and pulp (seed levels minimal)
- Extraction techniques of glycosides from smoked berries
  - whole berry homogenate vs supernatant juice
    - lower levels of guaiacol glycosides in juice

Dungey, K. *et al. Food Chemistry*, **2011**, 126, 801

# *Localisation of Guaiacol Glycosides in Grapes*

- Treated leaves and berries with mixture deuterated ( $d_3$ ) and undeuterated ( $d_0$ ) guaiacol
- Analysed skin and pulp of berries
- All  $d_0$  and  $d_3$  congenates of guaiacol were present in both skins and pulp
- Seemed to be non-specifically distributed

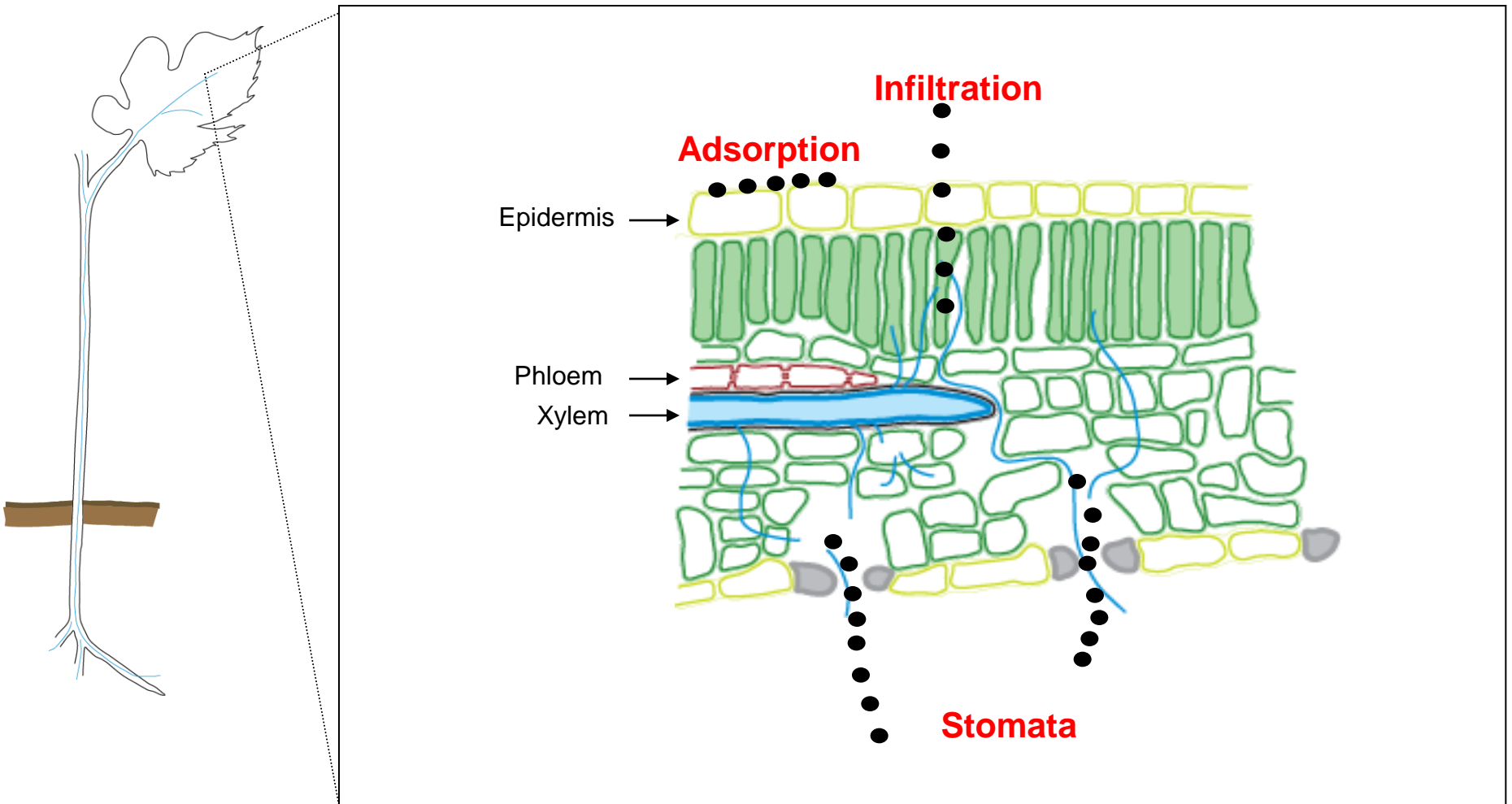
Hayasaka. Y, *et al. J. Agric. Food Chem.* **2010**, 58, 2076

# ***Grape Wax Bloom***

- Investigated the influence of the wax coating on the berry surface on the uptake on smoke compounds
- Enhanced uptake of guaiacol in grapes smoked after wax coating was removed (chloroform) relative to control (wax intact)
- Wax could provide protective mechanism for berry from smoke uptake

Kennison, K. *GWRDC Report, 2009*

# Mode of Entry - Leaves

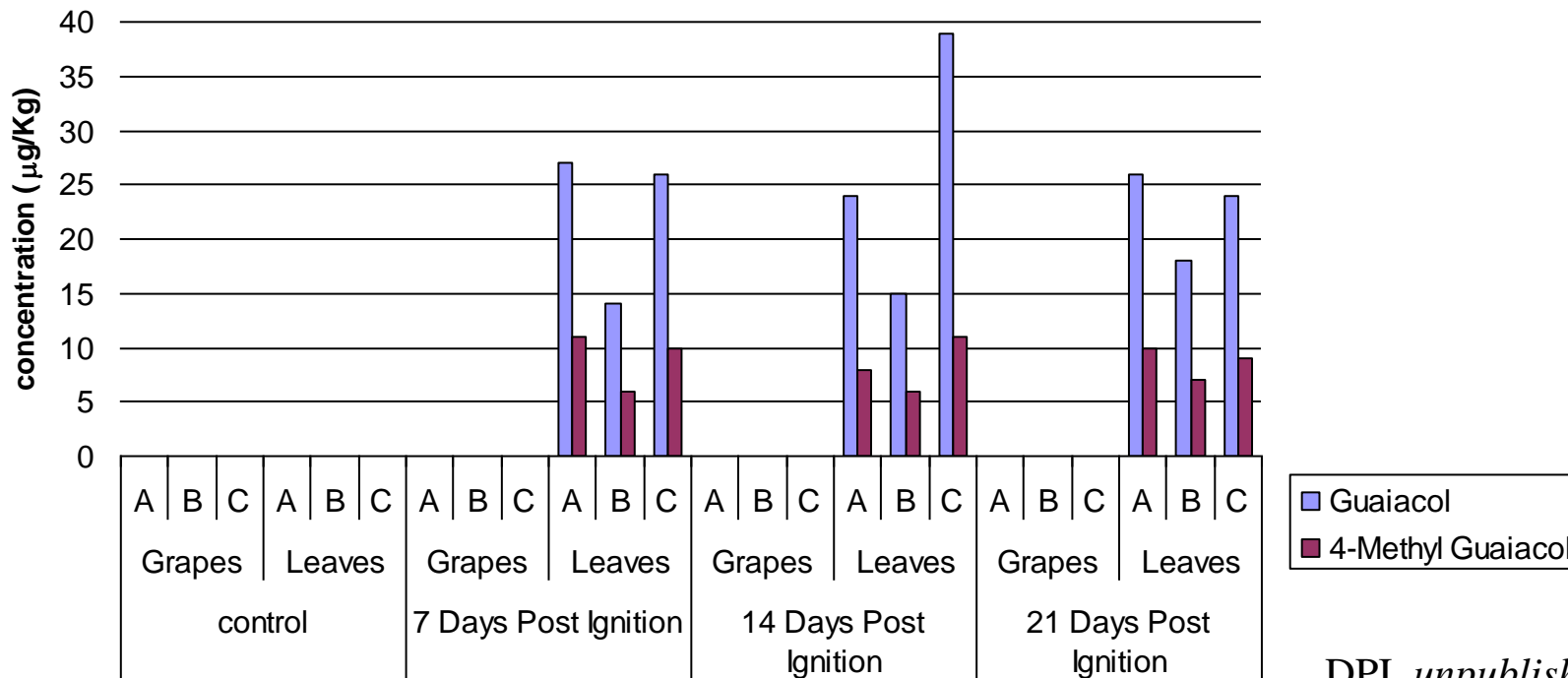
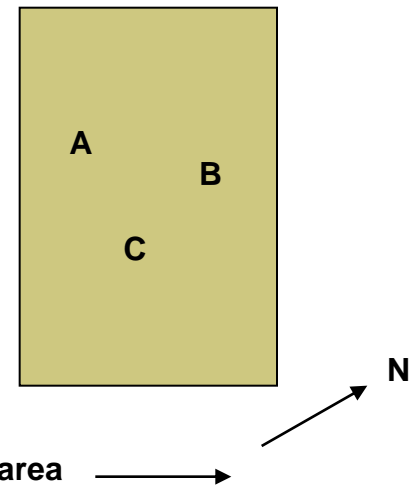




# 2008 Prescribed Burns

## Grape and Leaf Analysis

Cabernet Sauvignon  
King Valley, Victoria



DPI, unpublished results

# ***Leaves & Shoot Feeding Experiments***

- 1% and 2% aqueous mix of guaiacol standard
- Vines 'fed' guaiacol through leaves and decapitated shoots
- Guaiacol level 30 – 50 times higher than control
- Demonstrates transportation between leaves and shoots into berries

Whiting, J and Kristic, M, *DPI Report*, 2007

# ***Smoke and Smoke-Water Spray***

- Applied to separate grapevine components
  - ie bunches only, leaves only
- Analysed for guaiacol and 4-methyl guaiacol
- Free forms were *not detected*
- Acid hydrolyses
  - ↑ levels leaves of smoke & smoke water applications
  - ↑ levels in smoked bunches
  - Not detected in bunches sprayed with smoke water

Kennison, K. *GWRDC Report, 2009*

# ***Stable Isotope Tracer Techniques***

- Used to identify and quantify guaiacol conjugates present in leaves and grapes exposed to guaiacol
- Showed that leaves take up guaiacols
  - only trace quantities are translocated to berries
  - rate of translocation was slow.
- Demonstrates biotransformation of guaiacol into its glycosides

Hayasaka. Y, *et al. J. Agric. Food Chem.* **2010**, 58, 2076



# Vine Canopy Leaf Area Correlations

Negatively correlated with concentration of phenols in wine

- If the primary mode of uptake is through leaves, expect to see positive relationship
- Suggests direct uptake from berries
- Denser canopy could have shielding effect
  - protecting berries from particulate matter

Kelly, D. *et al.* *Food Chemistry*, in press

# 2012 Experimental Smoking

## Custom Built Smoker





# 2012 Experimental Smoking

Shiraz

DPI Irymple, Victoria



Chamber fully enclosed over vine

# Smoking: Bunches vs Vine

Trays of harvested grapes

Grapes still on the vine

Control grapes



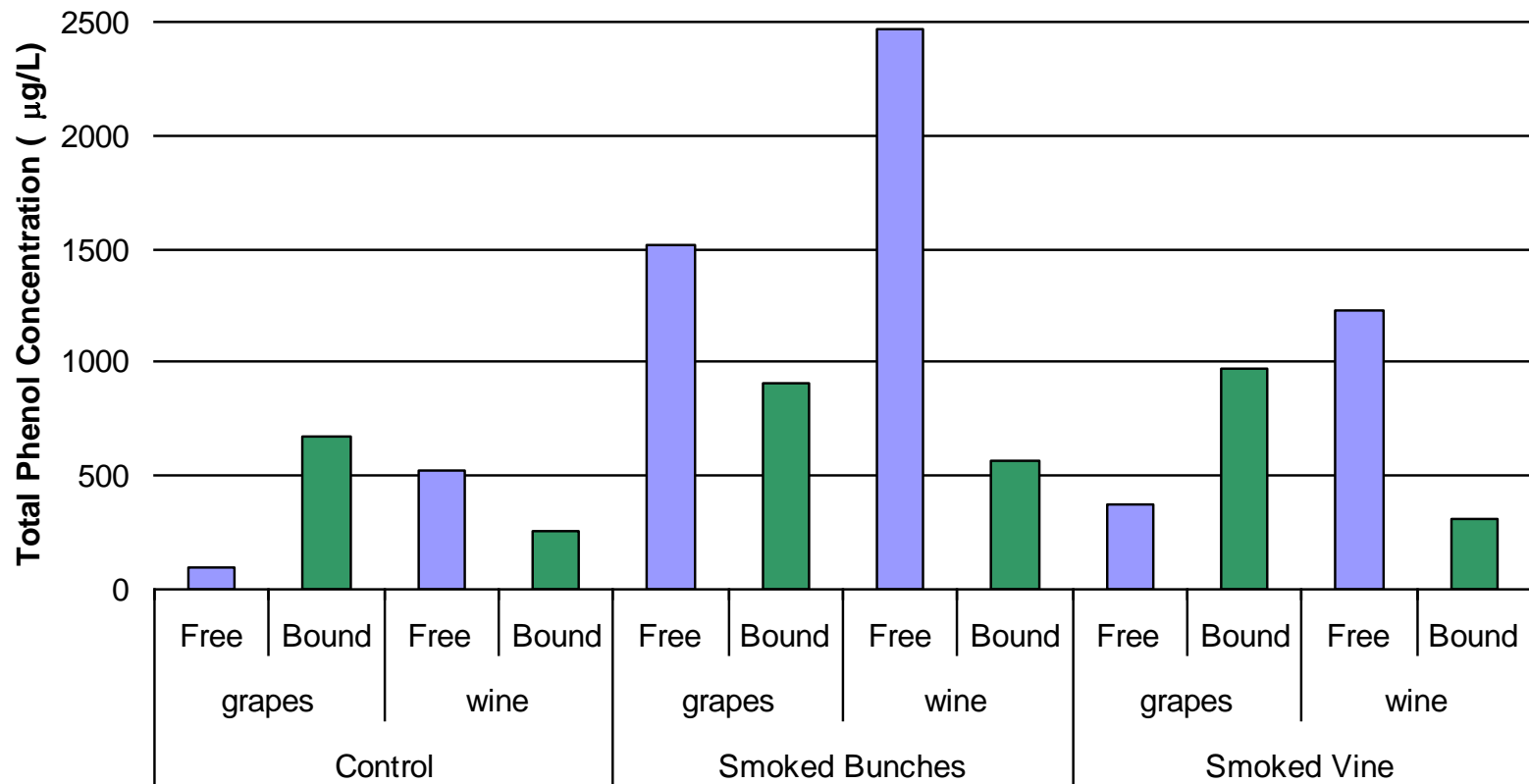
1 hour  
barley straw  
smoker 330 – 650 °C  
chamber 30 – 31 °C  
outside: 25 °C



# Total Phenol Concentrations

GC-MS analysis for 22 free and bound smoke taint compounds

Acid Hydrolysis for bound analytes



# ***Future Work***

Irrigation treatments,

Test absorption through roots

## ***Management Options***

Anti-transpirants - protect against leaf entry

Leaf Removal

Modify irrigation treatments - prevent entry & translocation

Hand harvesting vs machine

# Smoke Taint Team

## Mildura

- Dr Mark Downey, Director
- Dr Nicole Cain, Research Scientist
- Mr Peter Rogers, Experimental Winemaker
- Mr Fred Hancock, Senior Technical Officer
- Mr Joel Beloy, Technician

## Melbourne

- Dr Craige Trenerry, Senior Research Scientist
- Dr David Allen, Senior Analytical Chemist
- Mr Tim Plozza, Analytical Chemist
- Ms Kristen Pitt, Project Support Officer
- Mr Subhash Sharma, Spatial Information Scientist

## Rutherglen

- Mr Ricky James, Extension Specialist

