GRAPE & WINE ROADSHOW

Clare Valley Seminar

Wednesday, 25th September, 2013

Welcome and introduction / overview of the AWRI
Con Simos

Issues for discussion at today's Interactive session
Con Simos

Terroir – separating fact from fiction
Peter Dry

Does soil and vine nutrient status affect wine quality?
Marcel Essling

Morning Tea

GRAPE & WINE ROADSHOW

Clare Valley Seminar

Wednesday, 25th September, 2013

It's getting hotter – what does this mean for our vineyard management strategies?
Peter Dry

Tannin from grape to wine: new insights on a complex system
Keren Bindon

Managing stuck fermentations and rescue procedures
Paul Henschke

Lunch

GRAPE & WINE ROADSHOW

Clare Valley Seminar

Wednesday, 25th September, 2013

Interactive session
Con Simos

Using the timing of MLF inoculation to optimise your winemaking
Peter Costello

Afternoon Tea

GRAPE & WINE ROADSHOW

Clare Valley Seminar

Wednesday, 25th September, 2013

Health, nutrition and other warning labels
Creina Stockley

The origin of eucalyptol and minty flavour in red wines
Dimi Capone

Features of the AWRI website and closing comments
Con Simos

A W R I

The Australian Wine Research Institute

TERROIR – SEPARATING FACT FROM FICTION

PETER DRY

Geology = terroir in some circles

The Australian Wine Research Institute

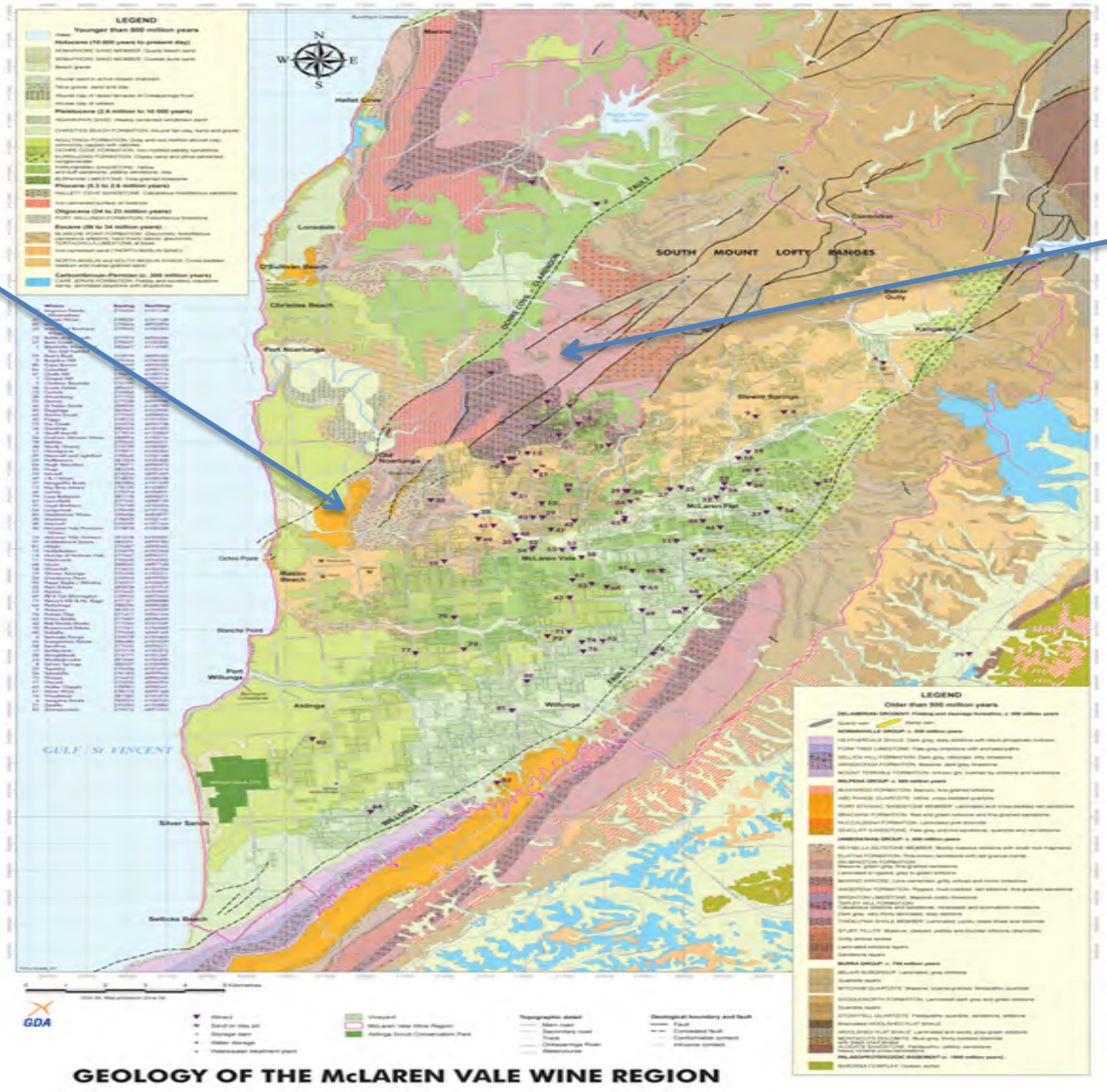
- Geology is being used to map ‘terroir’
- As a marketing tool it is useful for implanting images of terroir distinctiveness

The McLaren Vale geological map

The Australian Wine Research Institute

Wine A

Wine B



Geology = terroir in some circles

The Australian Wine Research Institute

- Geology is being used to map ‘terroir’
- As a marketing tool it is useful for implanting images of terroir distinctiveness
- **But is it the whole terroir story?**

Definition of terroir (OIV)

The Australian Wine Research Institute

- “A terroir is a unique and delimited geographical area for which there is a collective knowledge of the interaction between the **physical** and **biological environment** and **applied viticultural practices**.”

Factors that may influence terroir

The Australian Wine Research Institute

- Climate
- Geology
- Geomorphology
- Soil
- Human influence
  - Selection of sites
  - Practices e.g. irrigation

Interactions are important

The Australian Wine Research Institute

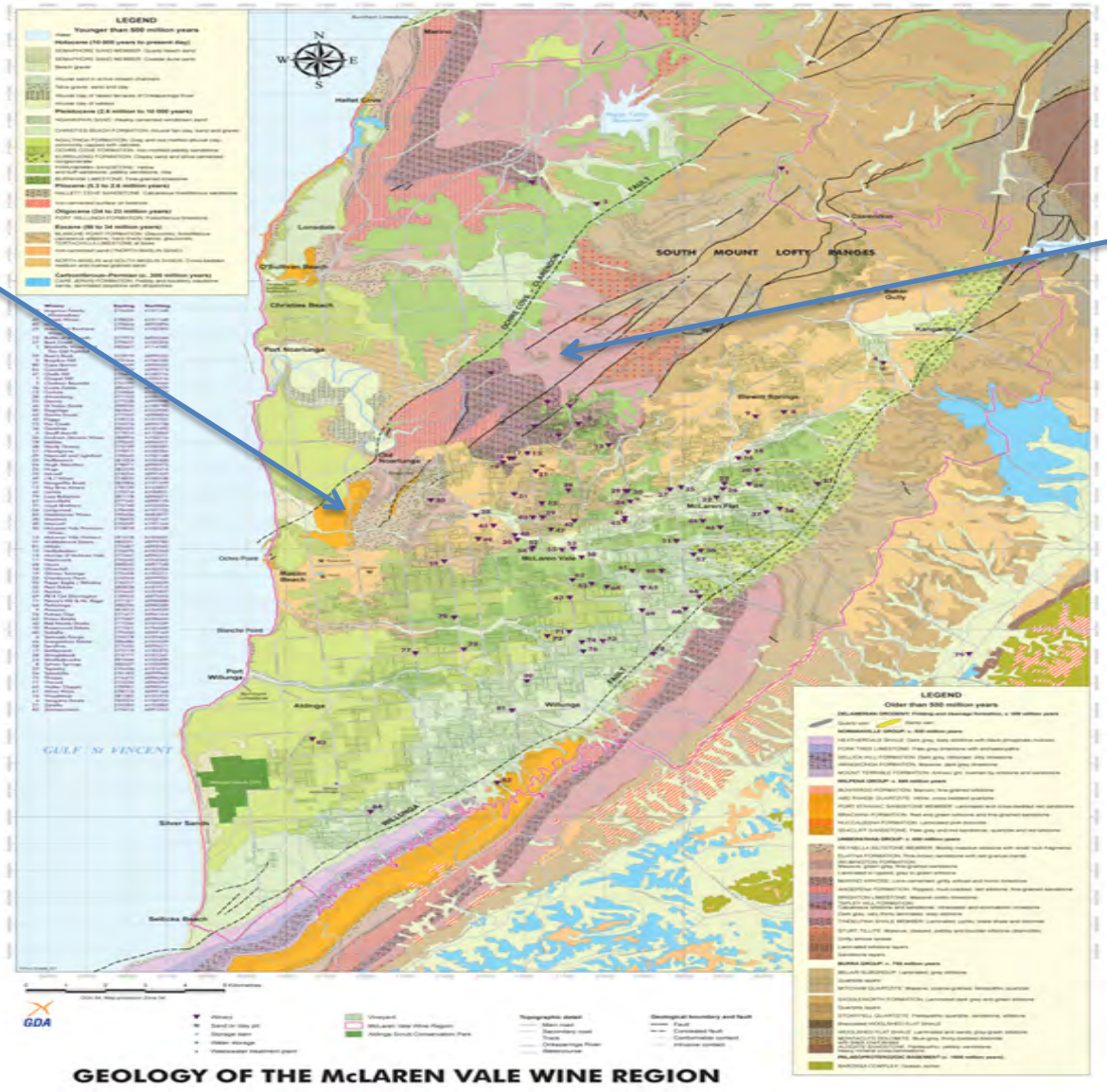
- Therefore, it is pointless to try to explain terroir in terms of a single factor
  - e.g. **climate** or **geology** or **soil** or ……
- But that hasn't stopped some people trying

The McLaren Vale geological map

The Australian Wine Research Institute

Wine A

Wine B



Contribution of each factor to terroir

The Australian Wine Research Institute

Climate

Geology

Soil

Geomorphology

Contribution of each factor to terroir

The Australian Wine Research Institute

Climate

Geology

Soil

Geomorphology

Climate

The Australian Wine Research Institute

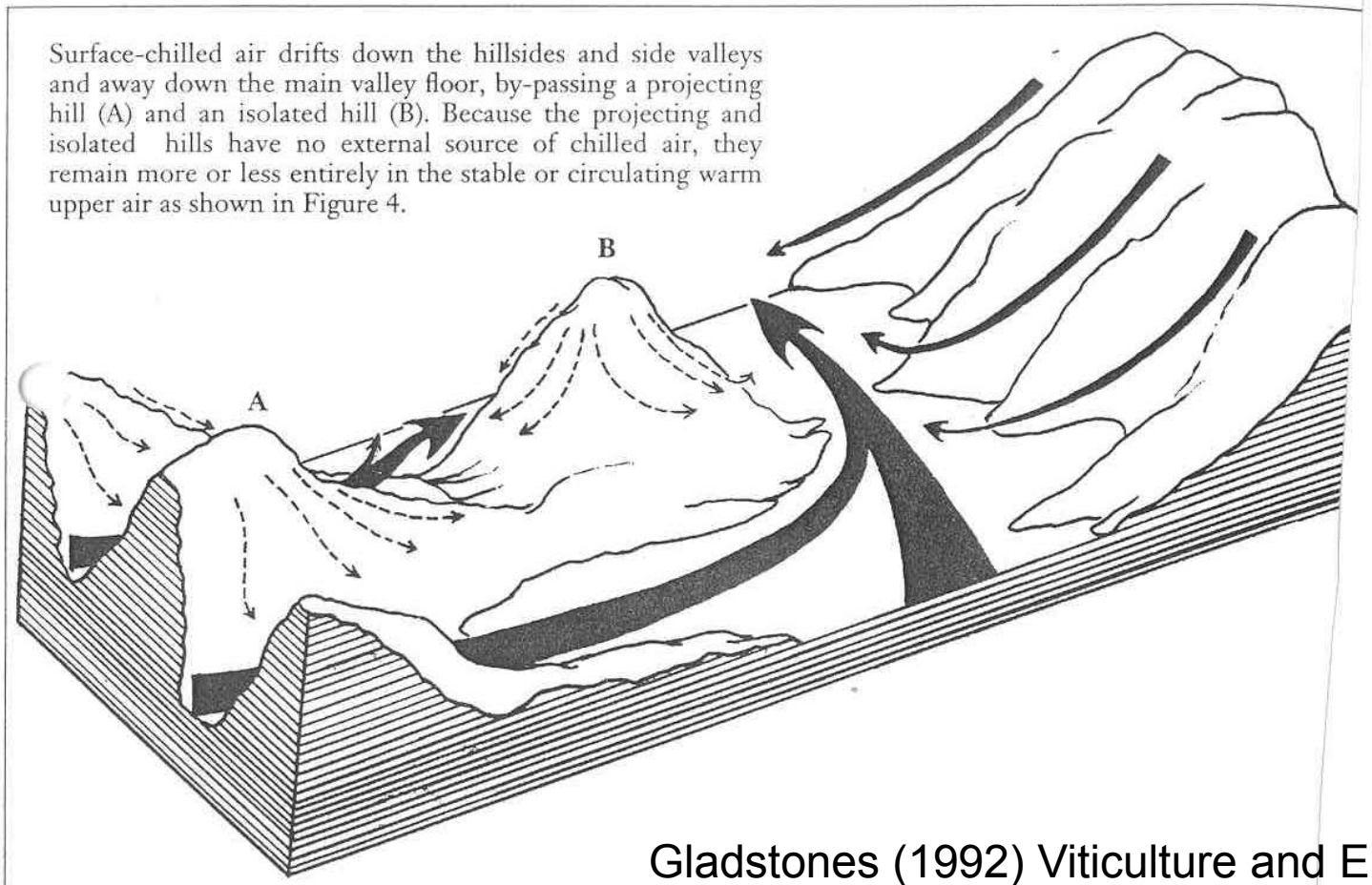
- Macroclimate and mesoclimate have great influence on growth, fruit composition and wine style/quality
  - particularly in regions with complex geomorphology
  - or with maritime influence
- Affected by
  - Altitude
  - Cold air drainage
  - Large water bodies
  - Sea breezes

Mesoclimate = site climate

Mesoclimate effect on air drainage

The Australian Wine Research Institute

Figure 5. Cross section of a valley showing the air drainage of projecting and isolated hills compared with the valley floor and normal valley sides.



Gladstones (1992) Viticulture and Environment

Contribution of each factor to terroir

The Australian Wine Research Institute

Climate

Geology

Soil

Geomorphology

Geology?

The Australian Wine Research Institute

- One particular geology is not necessarily better than another
- High quality wines are produced on a wide variety of geological materials, e.g.

- Schists: Douro, Mosel
- Chalk, limestone etc: Champagne, Chablis, St Emilion, Burgundy, Rioja, Barolo, Coonawarra
- Clay: Napa Valley, parts of Pomerol
- Sand: parts of Margaret River, McLaren Vale, Barossa
- Granite: Beaujolais

Geology?

The Australian Wine Research Institute

- Role is likely to be indirect
- Influence on:
  - soil type
  - root depth
  - geomorphology
    - e.g. slope
  - drainage

Role of geology is often misinterpreted

The Australian Wine Research Institute

- Example: Chablis
  - Best wines said to come from vineyards on Kimmeridgian limestone
  - Lesser wines from Portlandian limestone

Role of geology is often misinterpreted

The Australian Wine Research Institute

Kimmeridgian: all south-facing sunny slopes
Portlandian: all cool and windy plateaux

The influence of geology

The Australian Wine Research Institute

- Is wine from vines grown on ‘old’ rocks better than that from ‘young’ rocks

- Great wines can come from young rocks

  eg Medoc, Chateauneuf-du-Pape and many others

Contribution of each factor to terroir

The Australian Wine Research Institute

Climate

Geology

Soil

Geomorphology

Geomorphology

The Australian Wine Research Institute

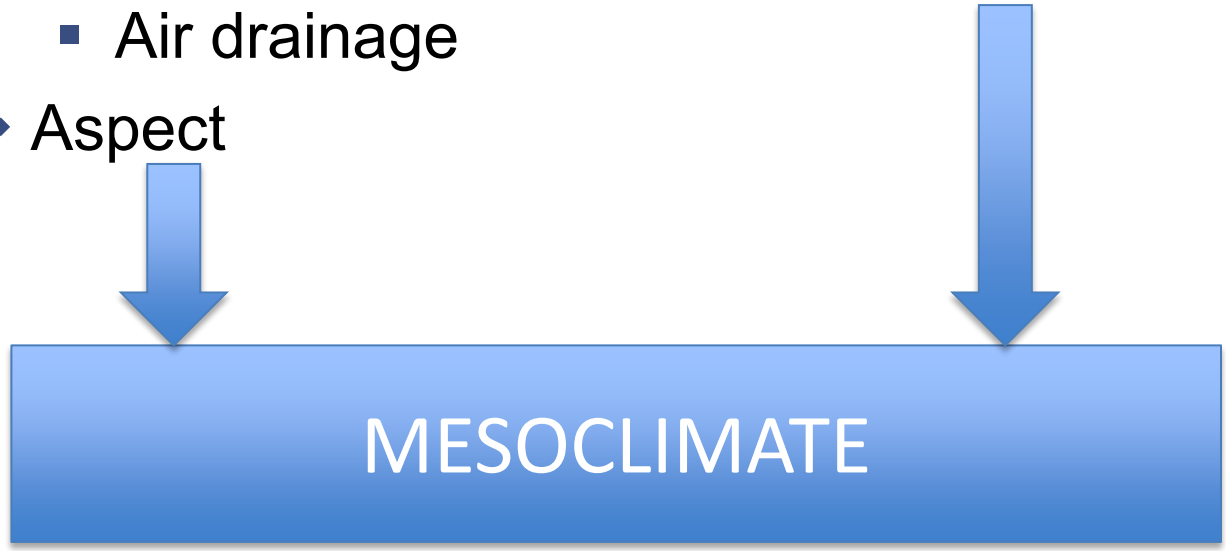
- Influenced by geology
- Because geology influences landform over millions of years doesn't necessarily mean that geology is currently having a direct effect on terroir expression today

Geomorphology

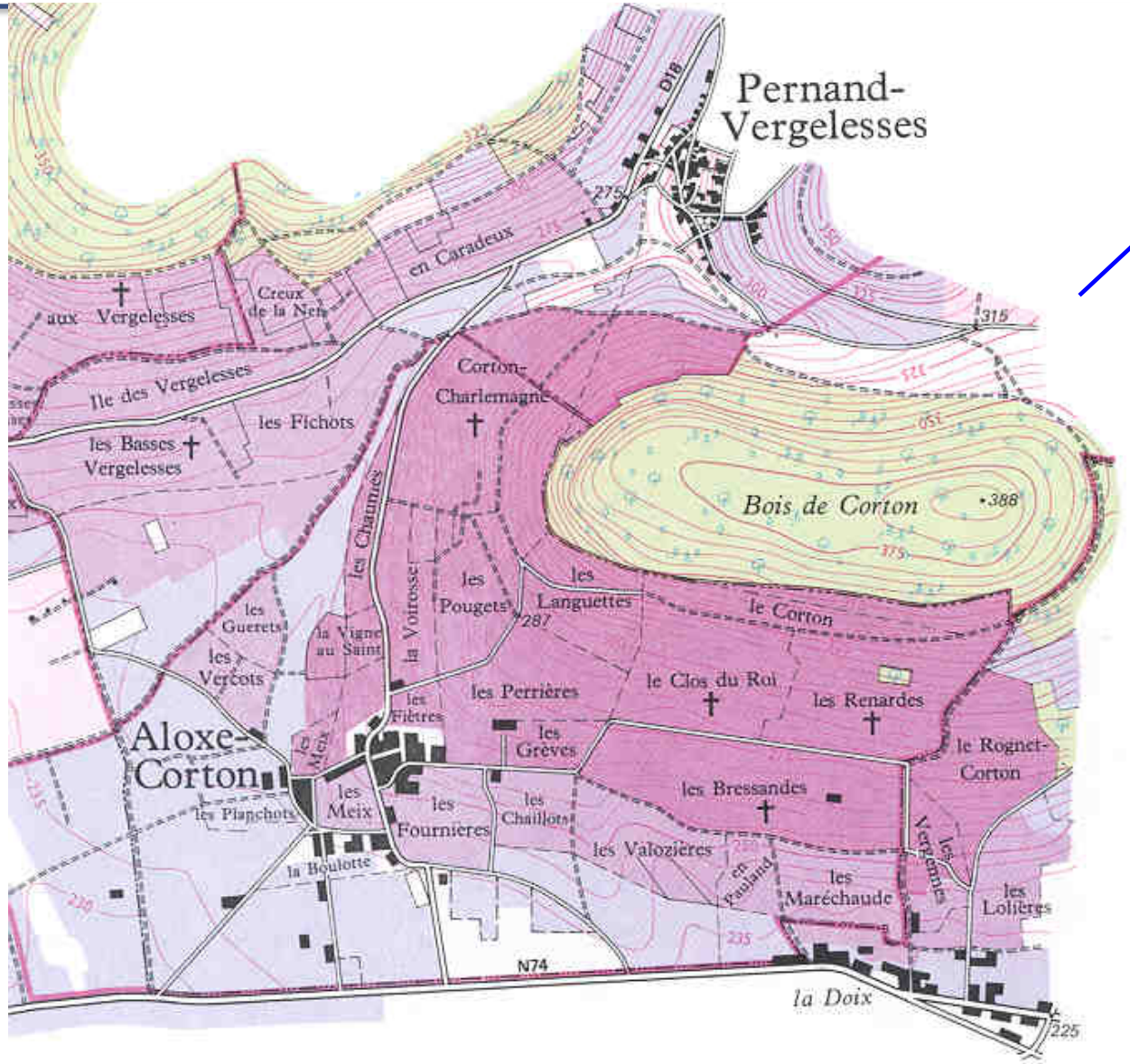
The Australian Wine Research Institute

Indirect effect on terroir via

- Altitude
- Slope
  - Erosion and soil depth
  - Radiation interception and thermal load
  - Air drainage
- Aspect



Corton (Burgundy)


Pernand-
Vergelesses
D18
en Caradeux
Creux
de la Net
aux Vergelesses
Ile des Vergelesses
les Fichots
les Basses
Vergelesses
Corton-
Charlemagne
Bois de Corton
388
les Chaumes
la Voirosse
les
Pougets
les
Languettes
287
le Corton
les
Guerets
les
Vercots
la Vigne
au Saint
les Perrières
le Clos du Roi
les Renardes
les
Fièvres
Aloxe-
Corton
les
Grèves
le Rognet-
Corton
les Bressandes
les Planchots
les
Meix
les
Fournières
les
Chaillots
les Valozières
la Boulotte
en
Paulant
les
Maréchaude
les
Lolières
les
Vergennes
N74
la Doix
225
N

Contribution of each factor to terroir

The Australian Wine Research Institute

Climate

Geology

Soil

Geomorphology

Soil

The Australian Wine Research Institute

- Physical properties such as texture APPEAR TO BE MOST IMPORTANT
  - Likely effect on vine is **indirect**
  - → Waterholding capacity
  - → Cation Exchange Capacity
  - → Root penetration
  - → Rootzone temperature
  - → Susceptibility to waterlogging

Soil

The Australian Wine Research Institute

- What about mineral composition?
  - In popular press, terroir effect often attributed to specific minerals that are alleged to confer typicity to wine

For example

The Australian Wine Research Institute

"...but unlike clay, (the) Kurrajong (Formation) is composed of big chunks of rock stuff, each of which has a **flavour**"

Philip White Drinkster blog May 2013

Source: Fairburn, W. et al. (2010)

Soil

The Australian Wine Research Institute

- Geological minerals are complex chemical compounds that are mainly tasteless
- Vine roots can only take up ions in solution
- Membranes only allow certain ions to be taken up
- Even then not all ions taken up by roots will end up in fruit
- Different ratios of mineral nutrients reach skins, seeds and pulp

And even if a particular mineral ion made it to the fruit

The Australian Wine Research Institute

That mineral ion (tasteless) has to become complexed with an organic aromatic compound

- so that the apparent flavour of the mineral can be expressed

The reality

- Inorganic chemical profile of grape berry bears only distant and indirect relationship with vineyard geochemistry (Maltman 2013)

The reality

The Australian Wine Research Institute

- This disconnect is magnified during vinification
  - Fermentation can remove mineral nutrients such as Cu, Zn, while adding others e.g. Al, Ca, Fe
  - Fining removes more - and others added if betonite etc used
  - Stabilisation and ageing can add Cu, Fe etc whereas others removed along with tartrate precipitation

Therefore, proportions of minerals in wine bear **little relationship** with geological minerals in vineyard.

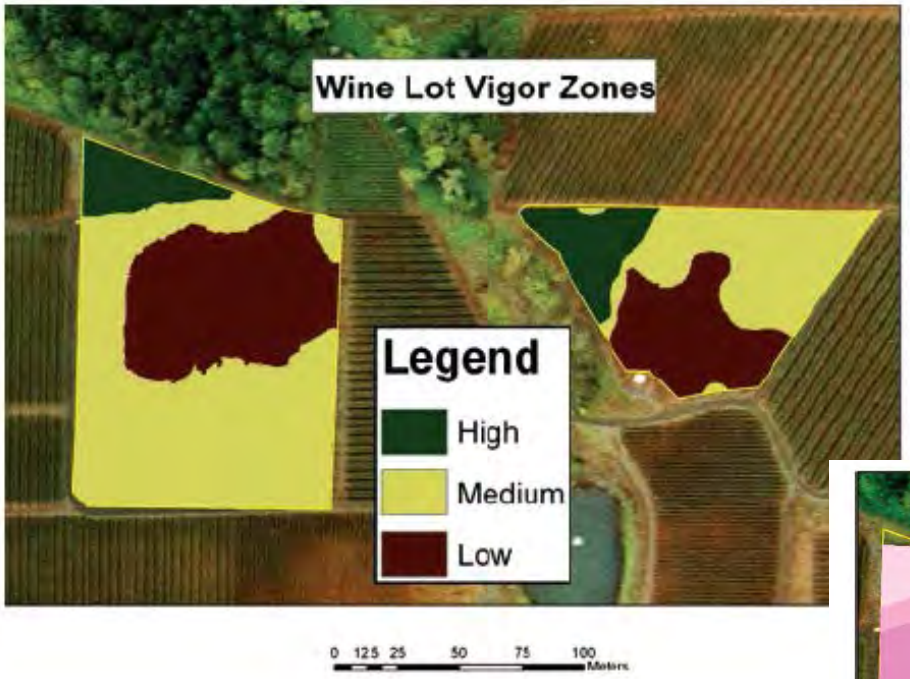
The reality

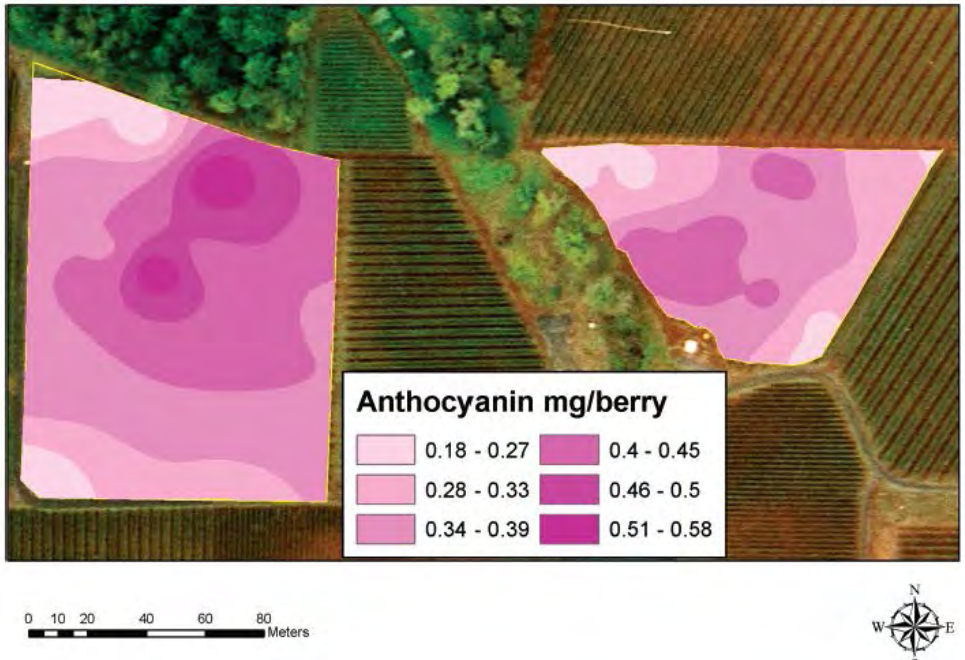
- Many studies → no correlation between wine quality and soil content of any nutritive element **with exception of N**
- **MORE ON THIS IN THE NEXT PRESENTATION**

Using vineyard mapping to understand terroir effects

The Australian Wine Research Institute

Pinot Noir, Oregon



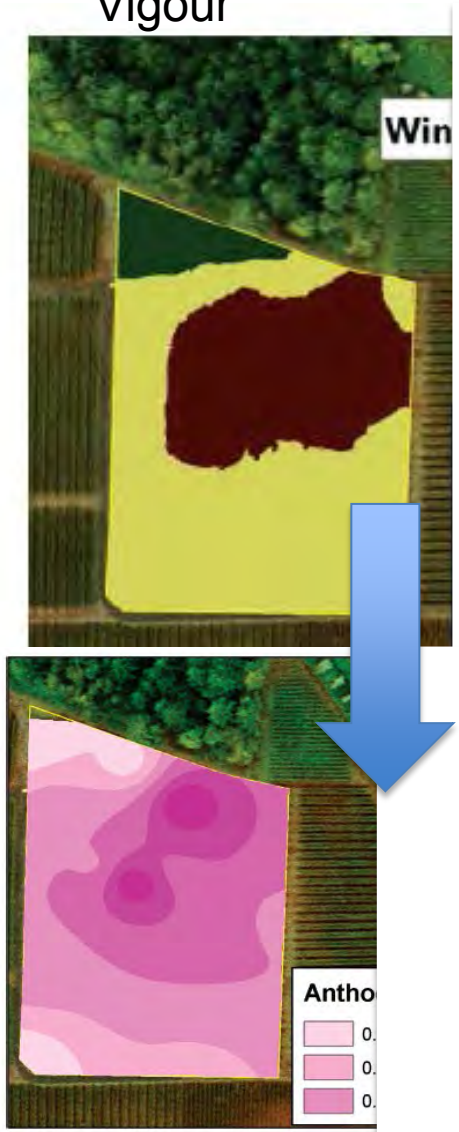


Cortell, J.et al. (2005) J Agric Food Chem 53, 5798-5808

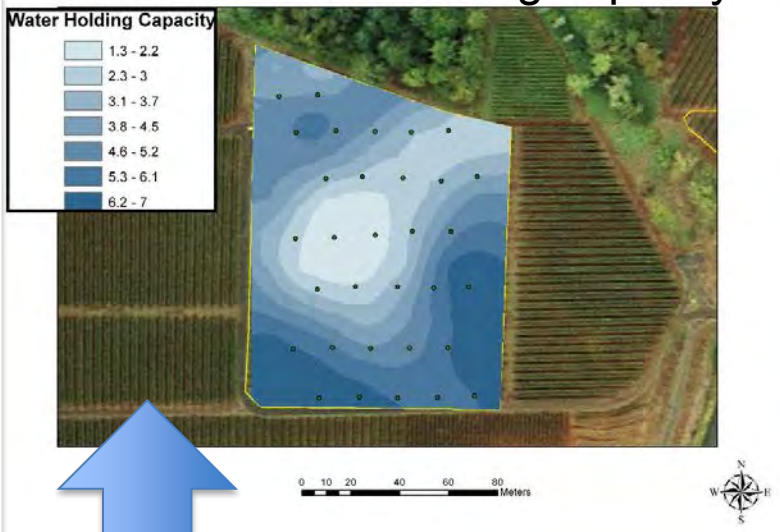
Using vineyard mapping to understand terroir effects

The Australian Wine Research Institute

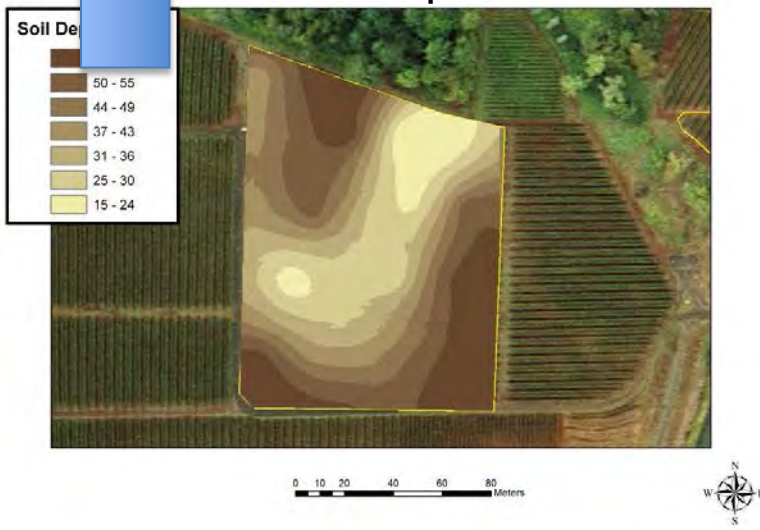
Vigour



Calculated water holding capacity



Soil depth



Coonawarra

The Australian Wine Research Institute

Coonwarra: why does red soil → better wine than black?

The Australian Wine Research Institute

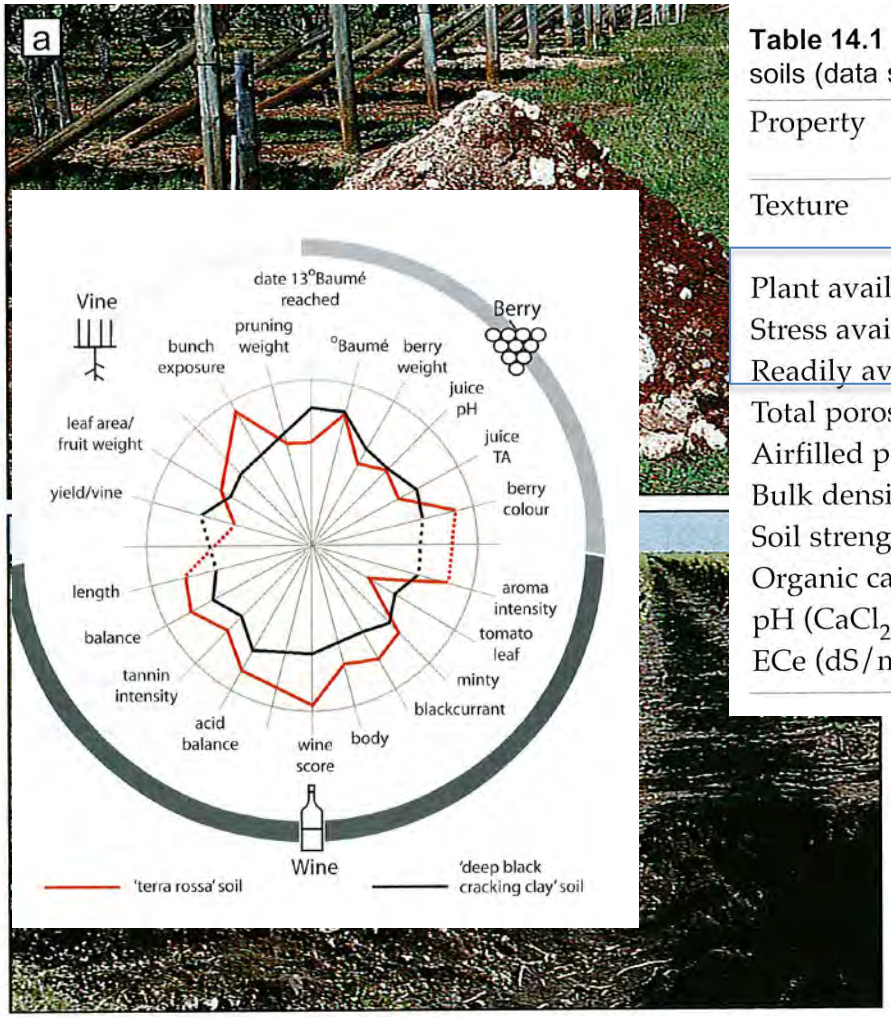


Figure 14.4 (a) The 'terra rossa' soil and (b) the 'deep black cracking clay' soil (photographs P.G. Iland).

Table 14.1 Properties of the terra rossa and the deep black cracking clay soils (data sourced from Proffitt et al. 2000).

Property	Terra rossa soil	Black cracking clay soil
Texture	Clay loam/ loamy clay	Medium clay/ heavy clay
Plant available water (mm)	63	96
Stress available water (mm)	41	64
Readily available water (mm)	25	40
Total porosity (%)	52	49
Airfilled porosity @ 10kPa (%)	19	11
Bulk density (g/cm^3)	1.3	1.4
Soil strength @ 10kPa (MPa)	1.7	2.9
Organic carbon (%)	1.6	1.6
pH ($CaCl_2$)	7.1	6.6
ECe (dS/m)	1.5	0.6

Source of figures: Iland et al. (2011) The Grapevine

Summary

The Australian Wine Research Institute

- Terroir: many interacting factors
  - Invalid to focus on just one factor such as geology
- Soil/geology do matter in terroir expression
- But not necessarily in a direct way
  - physical properties of soil are very important
    - **Particularly soil water status**
  - And influence on geomorphology etc

Summary

The Australian Wine Research Institute

- ‘Minerality’ as a sensory descriptor of wine is unlikely to be related to soil nutrient status
  - N is the only soil nutrient that seems to have a significant impact on wine quality
- Soil and rocks and a presumed direct association with flavour
  - No evidence (yet) to support a direct link

Is it OK to use ‘minerality’ in a metaphorical sense?

The Australian Wine Research Institute

- Yes - so long as we do it in same way as truffles, cats pee, sweaty saddle, cigar box, chocolate ....

- “*the problem with wielding these metaphors is that if I describe a wine as slatey - whose vine is growing in slate – the metaphor is quickly gobbled up by the literal image and the trusting reader assumes a direct line of transmission*”

Andrew Jefford Decanter Blog June 2013

Further reading

The Australian Wine Research Institute

Maltman, A. Minerality in wine: a geological perspective
(as submitted to Journal of Wine Sc)
http://cadair.aber.ac.uk/dspace/handle/2160/1270

A W R I

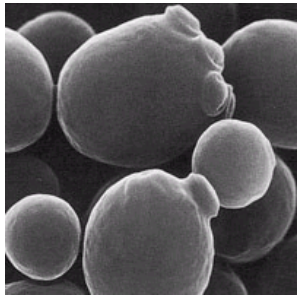
The Australian Wine Research Institute

Does soil and vine nutrient status affect wine quality?

Is there a direct link between soil nutrient status and wine 'minerality'?

Marcel Essling

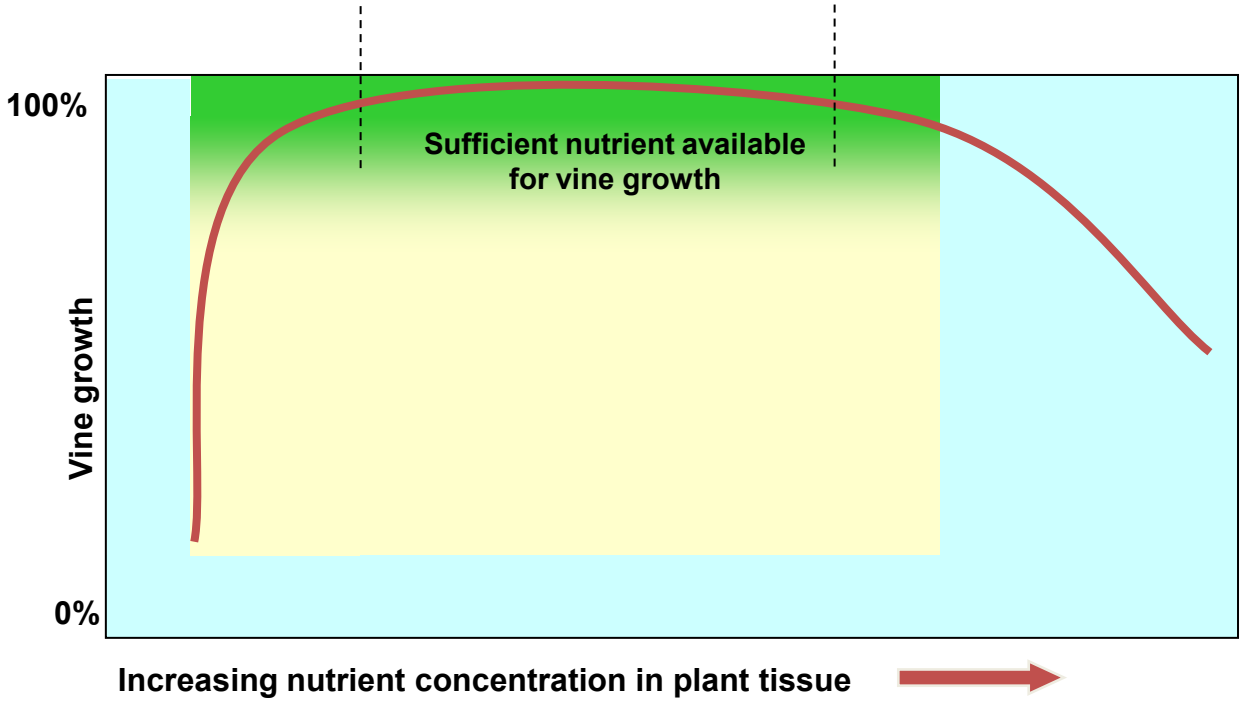
Prepared by Peter Dry



Does soil nutrient status affect wine aroma and flavour?

The Australian Wine Research Institute

- Wine quality is not easily manipulated by fertiliser practices.
- Many studies – no correlation between wine quality and soil content of any nutritive element with exception of N (and salt)



Response to N: summary

The Australian Wine Research Institute

Red wine quality: negatively correlated with vine N

- particularly when water not limiting

❖ Low soil N best for red wine quality

White wine: moderate soil N best for quality

❖ Low N → decreased aromatic precursors and increased tannin

❖ High N → increased Botrytis

NITROGEN

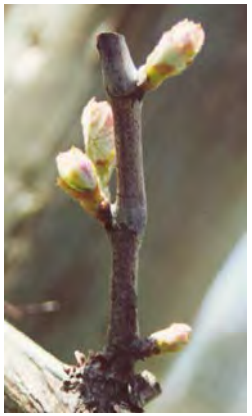
The Australian Wine Research Institute

- Of all mineral nutrients, N has greatest effect on growth, yield and fruit composition
  - ↑ soil N → ↑ photosynthesis → ↑ sugar
- As for water, excess N can have negative effect
  - e.g. increased canopy size

NITROGEN

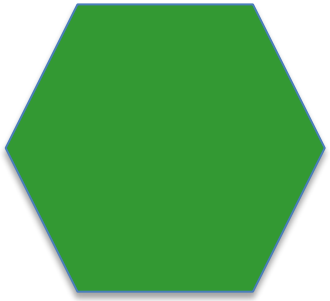
The Australian Wine Research Institute

- Demand for N greatest from budburst to flowering
  - But most uptake from soil after flowering
  - Overwintering reserves thus very important
- Storage reserves are lowest at flowering
  - Therefore plant is vulnerable to deficiency if insufficient N in soil after flowering



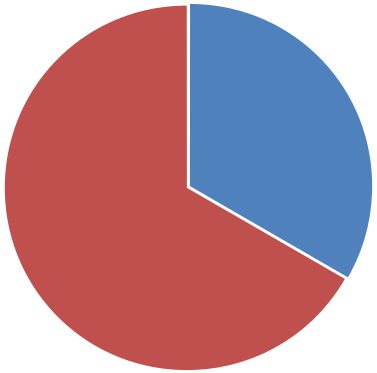
Total berry NITROGEN

The Australian Wine Research Institute



LEAVES

Post -veraison N (as amino acids)



FRUIT

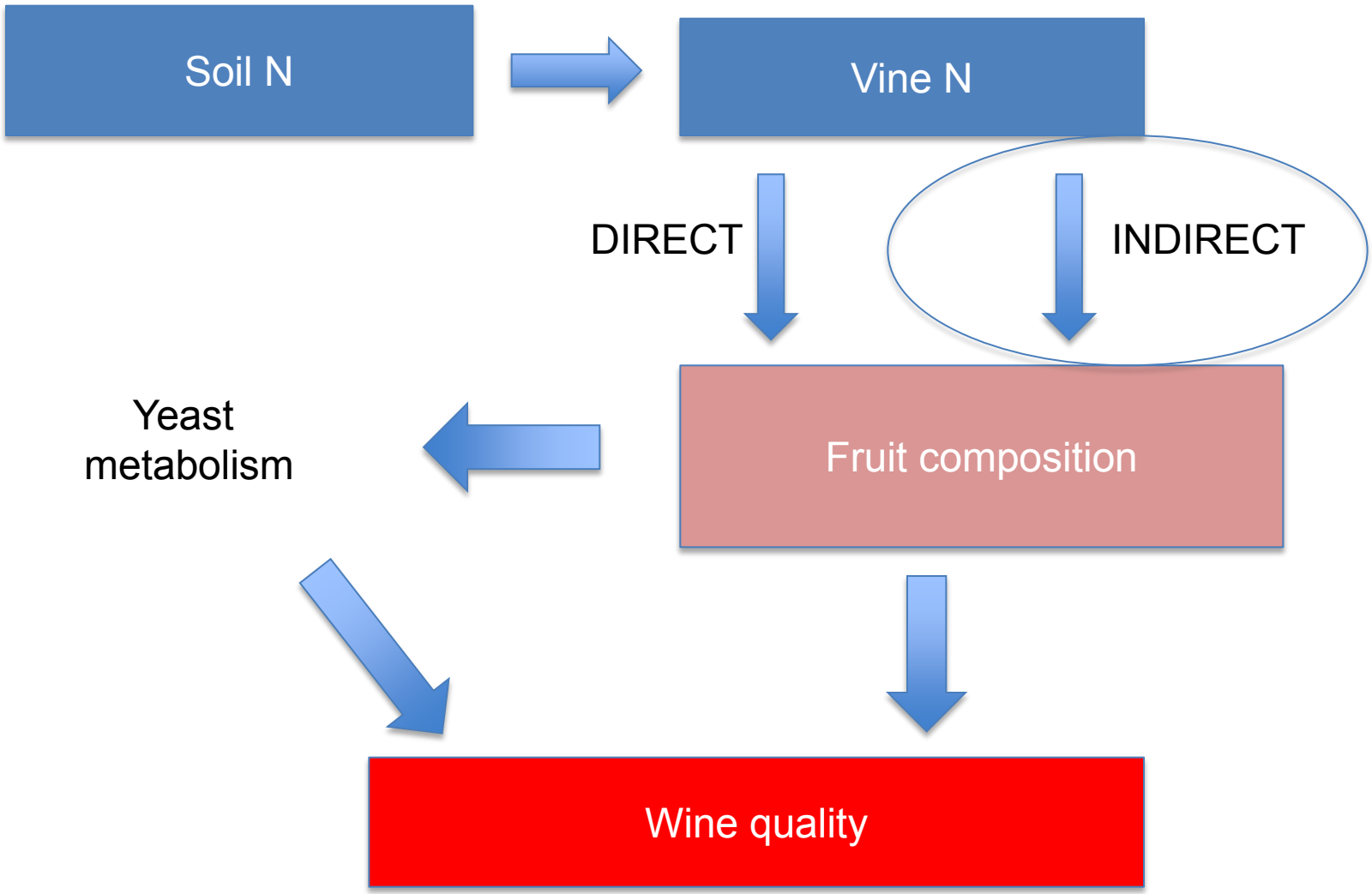
What is effect of N fertilisation on vine performance?

The Australian Wine Research Institute

- Deficit to marginal status (based on tissue analysis)
  - N fert. generally has a positive effect
- Adequate to high status (based on tissue analysis)
  - N fert. may have negative effect
    - Disrupt balance
    - Increases vegetative growth
    - Increases shading
    - Decreases net photosynthesis
    - Assimilates diverted from fruit to shoots

Nitrogen effect on fruit composition and wine quality

The Australian Wine Research Institute



N impact on wine quality: Indirect effect

The Australian Wine Research Institute

- Excess → ↑ vegetative growth ↑ canopy density
  - More bunch zone shading → fruit composition
    - e.g. increased methoxypyrazine concentration in Cab Sauv in response to N fertilization

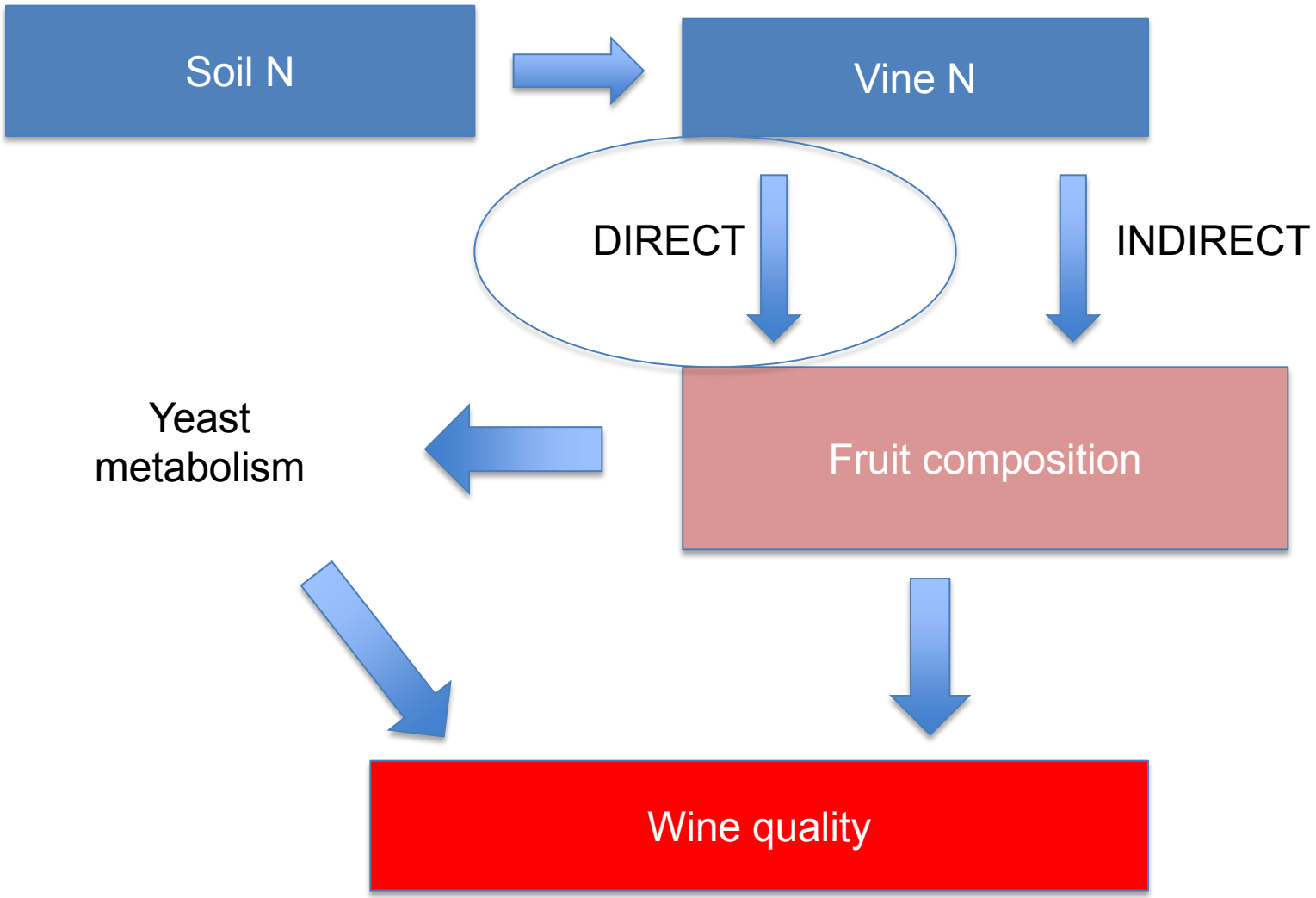
N impact on wine quality: Indirect effect

The Australian Wine Research Institute

- Excess → ↑ vegetative growth ↑ canopy density
  - More bunch zone shading → fruit composition
    - generally decreased monoterpenes in response to N fert.
  - **More disease**
  - **Growing tips compete with fruit for assimilate**

Nitrogen effect on fruit composition and wine quality

The Australian Wine Research Institute



N impact on wine quality: Direct effect

The Australian Wine Research Institute

- Nitrate uptake → reprogramming of gene expression
- High nitrate suppresses genes involved in phenolic production
  - Delayed accumulation of phenolics and flavonols
- Low N at flowering stimulated sugar and phenolics
- High nitrate → ↑ organic acid production
  ↑ amino acid

Overall effect is decreased phenolics

N impact on wine quality: Direct effect?

The Australian Wine Research Institute

Impact on organic acids:

- Increased N fertilisation
  - Often no change in malic and tartaric acids
  - Some studies found higher acid, lower pH (with significant yield increase). Keller 2001
  - Increased TA Christensen 1994

N fertilisation and grape anthocyanins

The Australian Wine Research Institute

- Response to N fertilisation depends on starting point
  - Less than adequate level:
    - may increase anthocyanins
  - Adequate or more:
    - may decrease anthocyanins
  - High N → lowest colour density in wine
  - Low N → highest total anthocyanins and phenolics

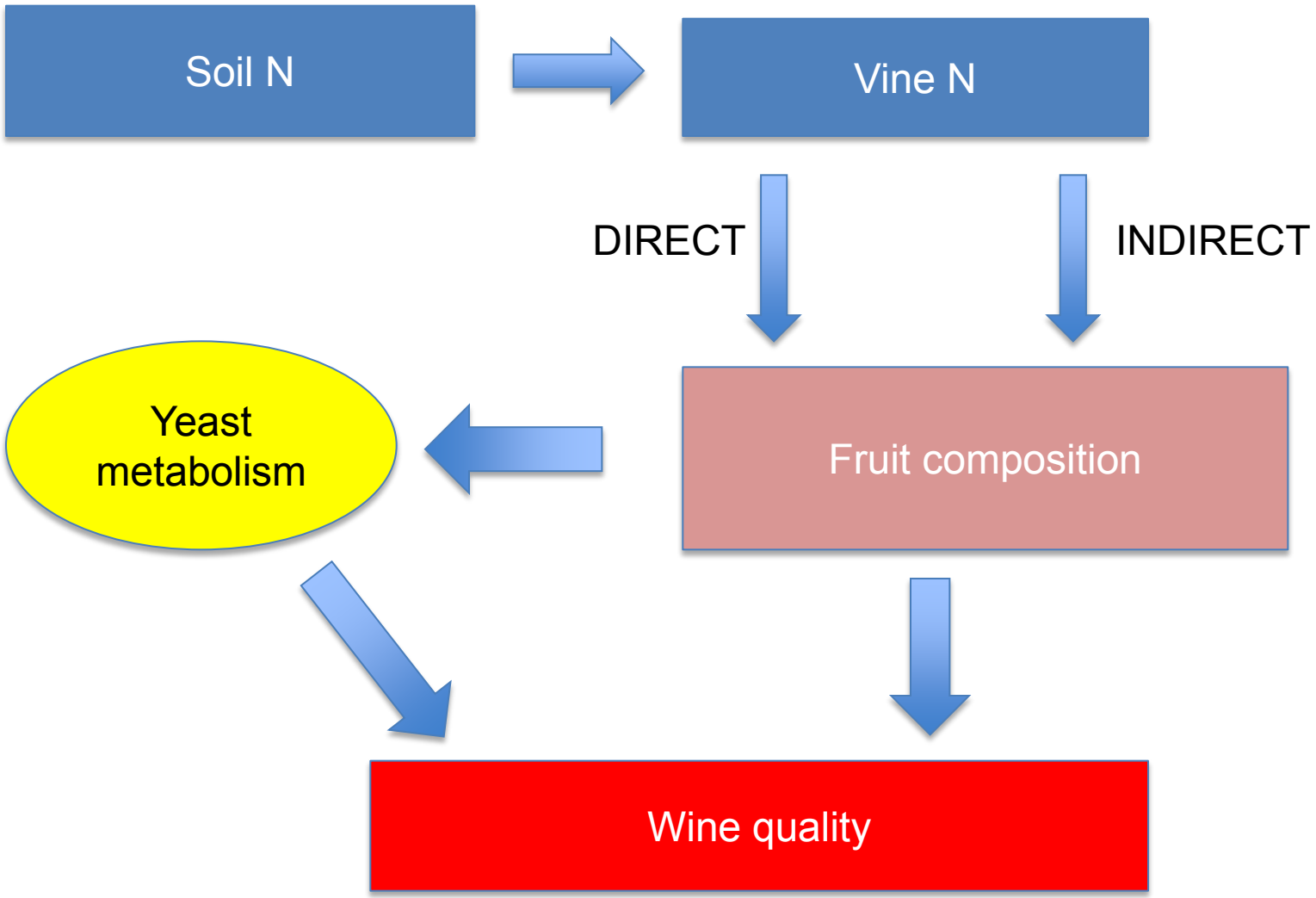
N impact on wine quality

The Australian Wine Research Institute

- Can the negative effect of shading caused by high N be overcome by leaf removal in bunch zone etc?
  - Not necessarily – high N and low flavonol make berries more susceptible to sunburn
- Or hedging?
  - This may waste resources because removes young leaves and retains old inefficient leaves
  - Also diversion of assimilates away from fruit

Nitrogen effect on fruit composition and wine quality

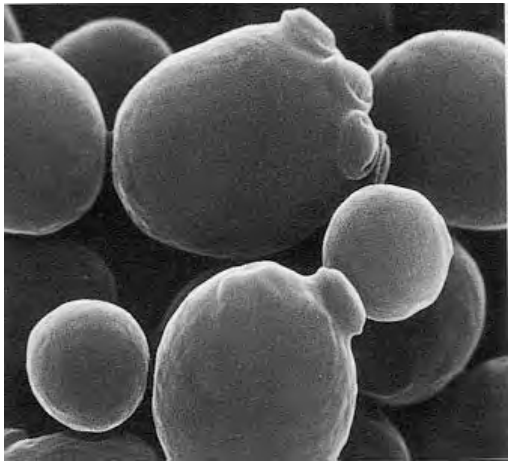
The Australian Wine Research Institute



N and fermentation

The Australian Wine Research Institute

Nitrogen affects



- Yeast growth
- Metabolic activity
  - Fermentation rate
  - Flavour active compounds (fermentation bouquet)

Grape nitrogen: effect on yeast

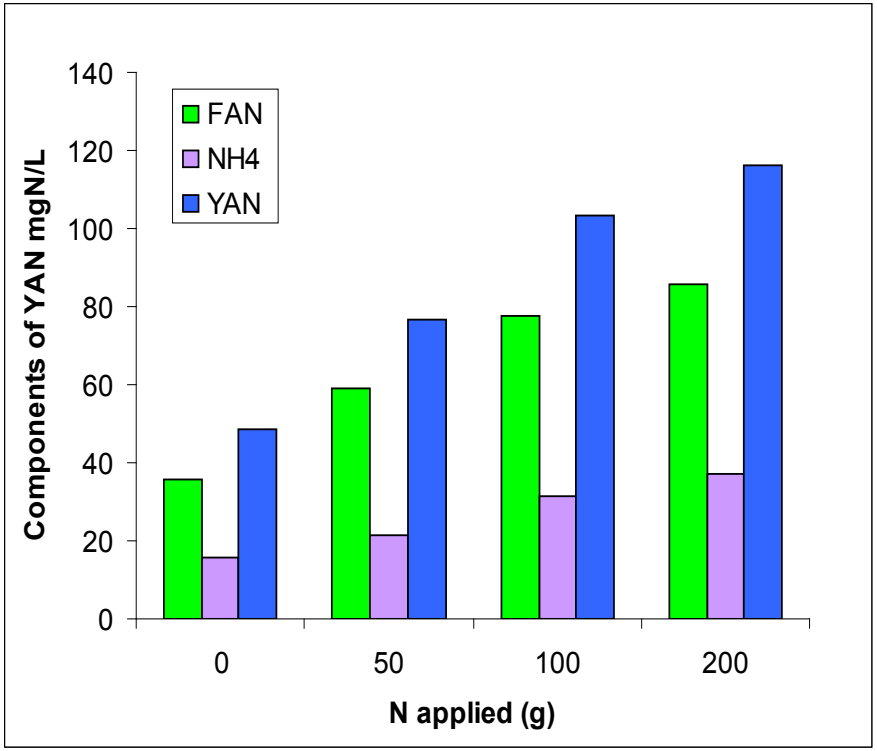
The Australian Wine Research Institute

- Total Nitrogen in juice is mainly
  - Ammonium
  - Free Amino Acids
- Yeast assimilable N (YAN)

  = free amino N (FAN) + ammonium N (NH_4+)
- Yeast will use ammonium N initially, then most assimilable amino acids
- If YAN too low → stuck or slow ferments
- Low N → lower total amino acids (and more proline)
- High N → higher total amino acids (and more arginine)

Does N fertilization affect YAN in grapes?

The Australian Wine Research Institute



Grape N that yeast can use

Fermentation and sensory

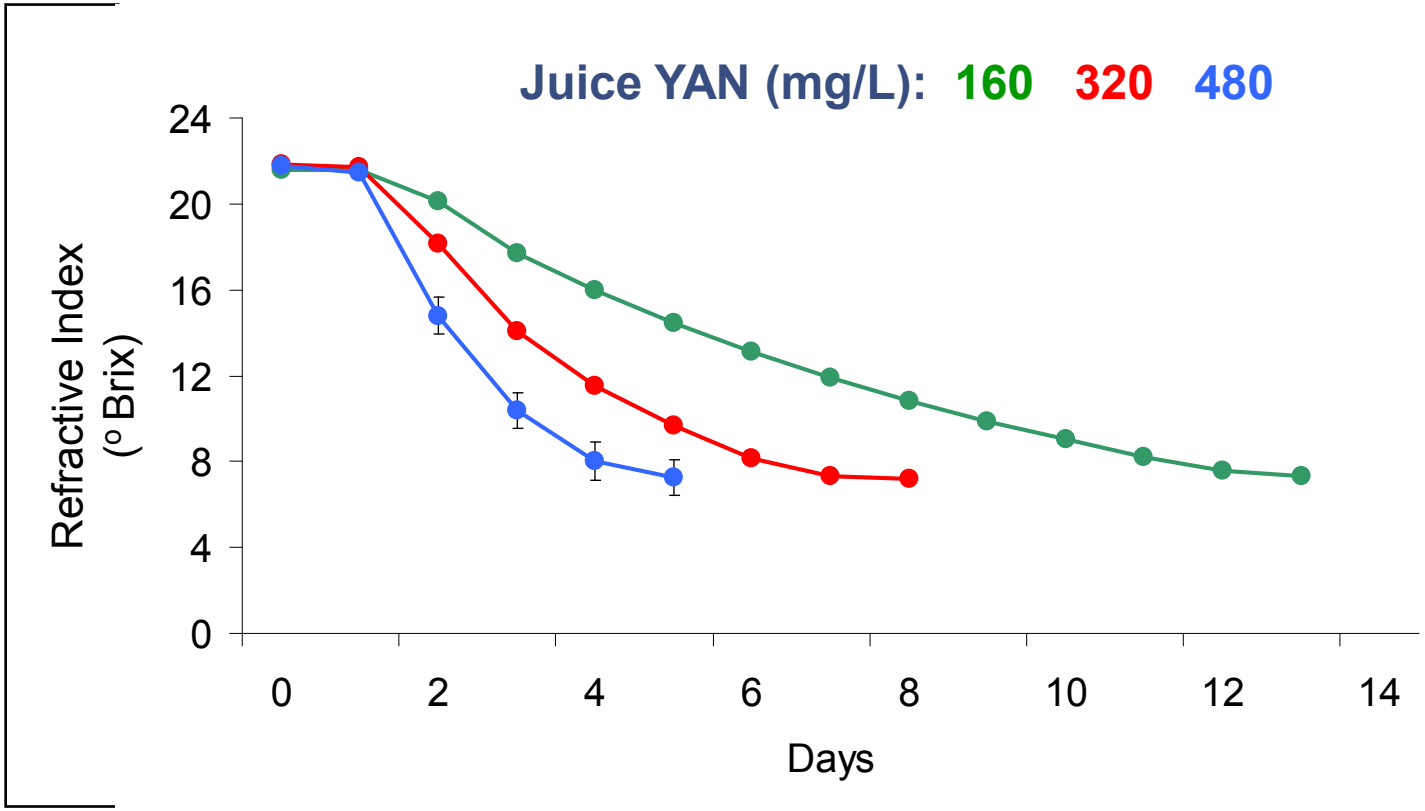
The Australian Wine Research Institute

AWRI fermentation study

- Filtered Chardonnay juice
- Low N (YAN = 160 mg/L)
- High N demand yeast (AWRI 796)
- Wine analysis and descriptive sensory analysis

Effect of Juice N on Fermentation

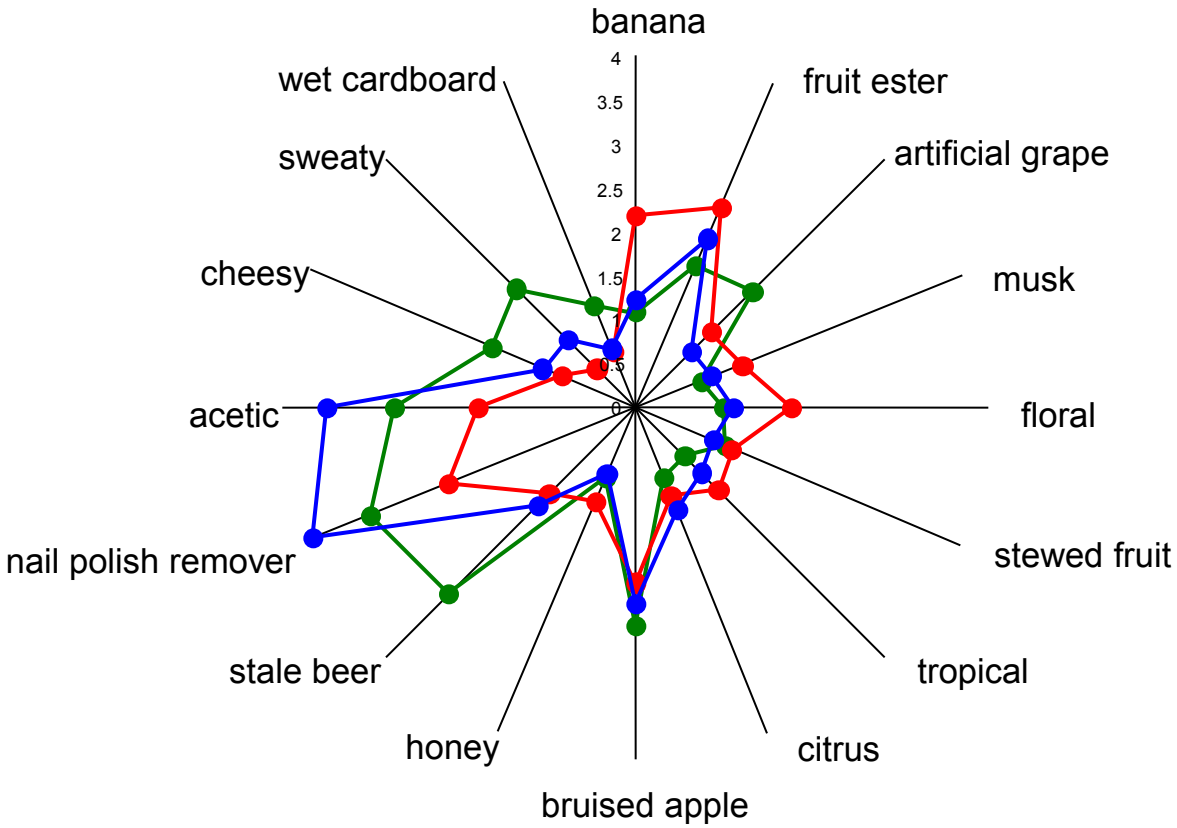
The Australian Wine Research Institute



Juice YAN affects: i) yeast growth,
ii) fermentation, and
iii) fermentation duration

Effect of juice N concentration on wine aroma profile

The Australian Wine Research Institute



Low & High N: Negative effects
Moderate N: Positive effects

Juice YAN (mg/L): **160** **320** **480**

NITROGEN

The Australian Wine Research Institute

- Increased PR proteins with increased plant N
  - → haze and increased need for bentonite fining

Potassium

The Australian Wine Research Institute

- No evidence for direct effect of soil K on wine quality
  - Except K deficiency may impair sugar accumulation
- K fertilisation effect on juice K concentration?
  - No consistent results
- Factors such as rootstock type, irrigation, canopy management etc much more influential than K status of soil
  - Reduced irrigation → reduced juice K concn
  - Shoot trimming → increased leaf blade K concn

Potassium

The Australian Wine Research Institute

- High K in juice
  - → decreased concentration of free acids ??partic. tartaric (and ↑ pH)
  - → may decrease rate of degradation of malic acid
  - Reduced colour intensity
  - Lack of acidity in flavour
  - Poor wine stability

What factors determine how much K ends up in juice?

Impact of K movement from leaves to fruit

The Australian Wine Research Institute

EXPOSED CANOPY
Less potassium moves from leaves to the berries

Shading→ ↑ K in leaves at veraison
→ ↑ K in berries at maturity
Therefore more K in wine, higher pH

SHADED CANOPY

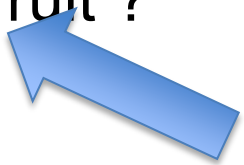
More potassium moves from leaves to the berries

Potassium: rootstock effect

The Australian Wine Research Institute

- Direct or indirect effect?

- Direct
  - Rootstock type affects:
    a) uptake by roots √
    b) transport from roots to shoots √
    c) transport from leaves to fruit ?
- Indirect
  - Rootstock type affects shoot vigour, canopy shading



Mg and Ca

The Australian Wine Research Institute

- Mg deficiency may decrease export of sugar and amino acids to fruit
- No direct effect of Ca
  - High Ca soils usually well drained so may be indirect effect
- High soil Mg or Ca may decrease K uptake by roots → lower juice/wine pH
  - Therefore high soil pH (associated with high soil Ca) may be coupled with low wine pH

Take home messages

The Australian Wine Research Institute

- Minerality of wine is unlikely to be related to soil nutrient status
- N is the only soil nutrient that has a significant impact on wine quality
- N has both direct and indirect effects on fruit composition and wine quality
- Only use N fertiliser to correct a deficiency or to maintain adequate levels (timing is important)
- Measure must YAN before fermentation

The AWRI is a member of the Wine Innovation Cluster and is supported by Australia's grapegrowers and winemakers through their investment agency, the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

A W R I

The Australian Wine Research Institute

It's getting hotter, what does this mean for our vineyard management strategies?

Peter Dry

Developed by Peter Dry
& modified by Mardi Longbottom

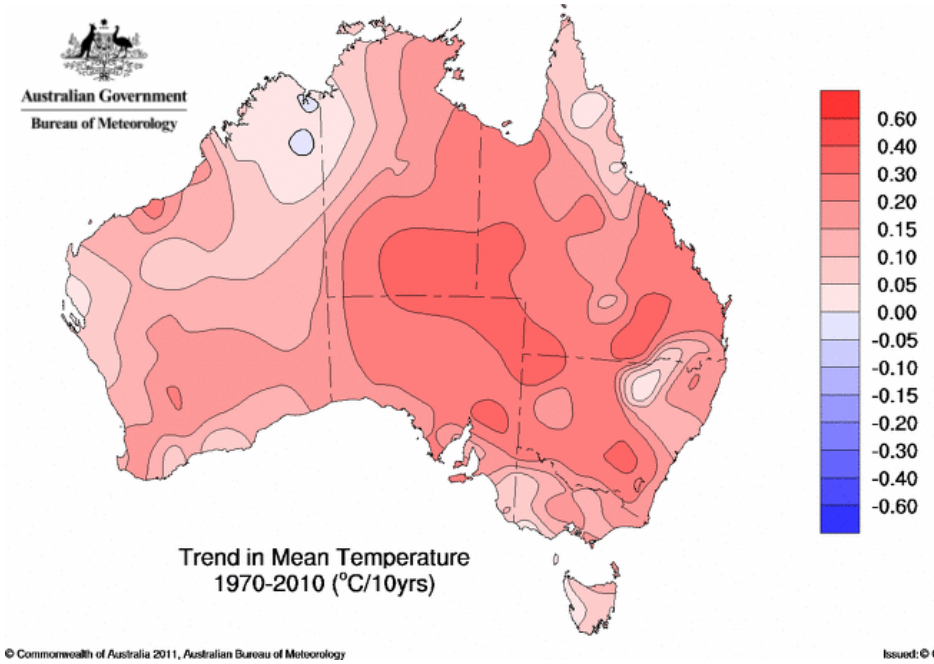
It's getting hotter, what does this mean for our vineyard management strategies?

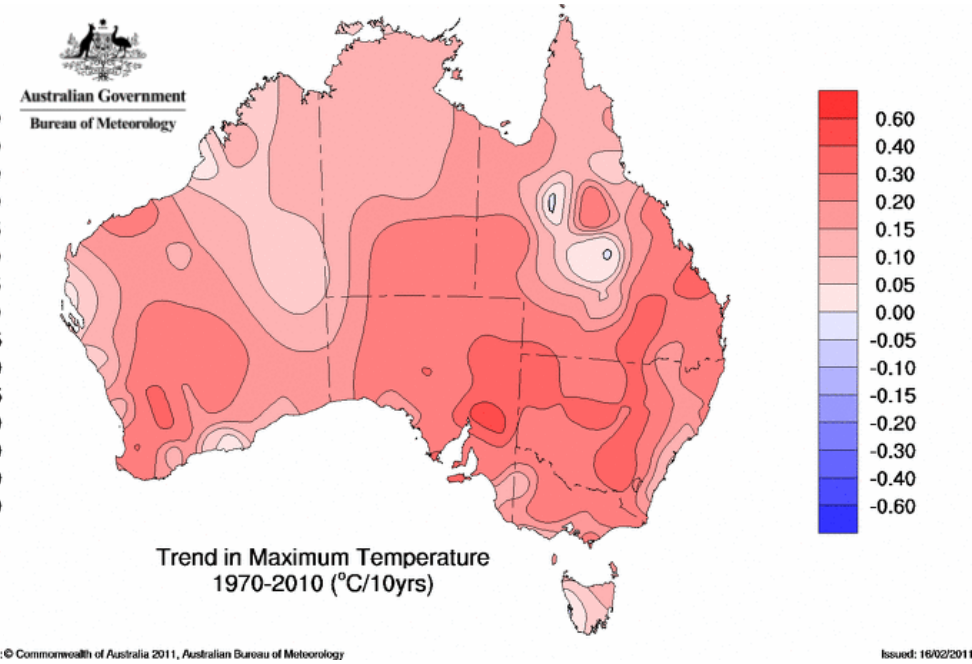
The Australian Wine Research Institute

1. Changes in grapevine phenology & physiology – what does this mean for grape ripening?
2. How do grapes get hot?
3. Management strategies to protect bunches

Climate change

The Australian Wine Research Institute





Climate change forecasts include:

↑ temperature

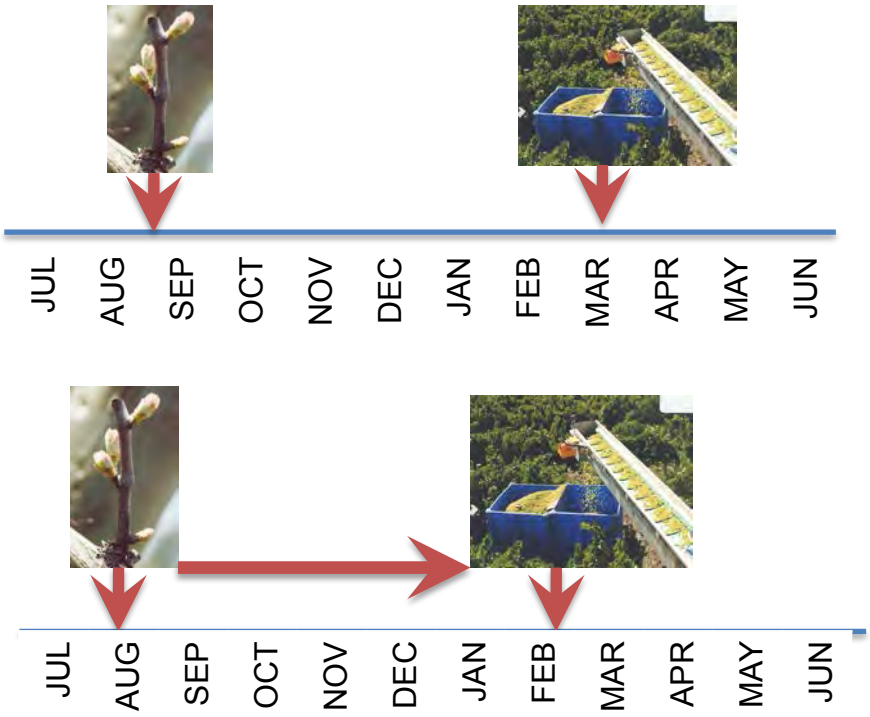
→ changes in phenology

→ changes in physiology

Phenological changes

The Australian Wine Research Institute

- Early budburst
- Early harvest
- Compression of the growing season



Physiological changes

The Australian Wine Research Institute

↑ demand for water

- ↓ vigour
- ↑ basal leaf defoliation
- ↓ natural protection of bunches (↑ exposure)

Grape composition – the critical period

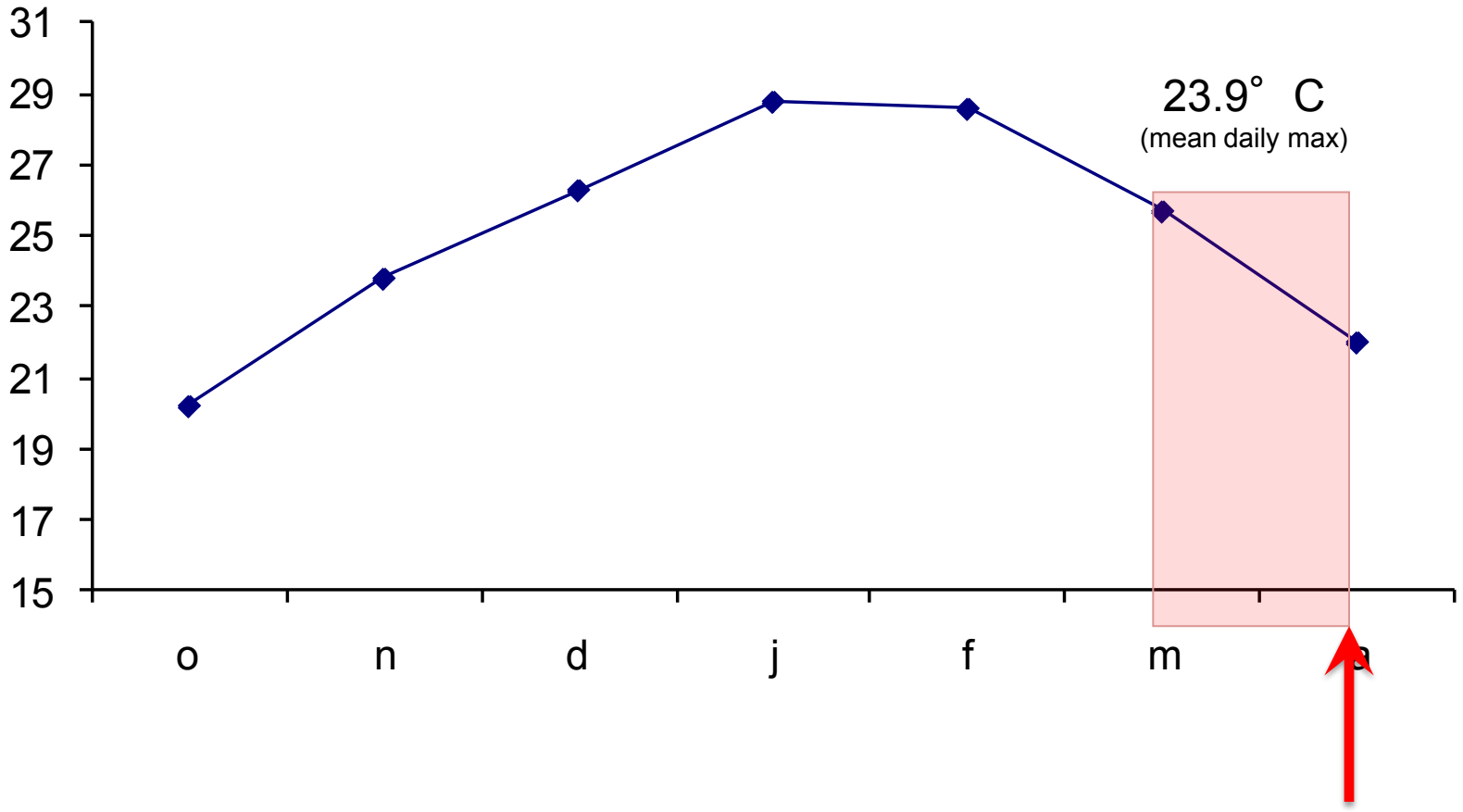
The Australian Wine Research Institute

Temperature in month prior to harvest (= ripening month) is particularly critical for determination of final wine quality

So, what will happen to ripening month temperature in a warming climate?

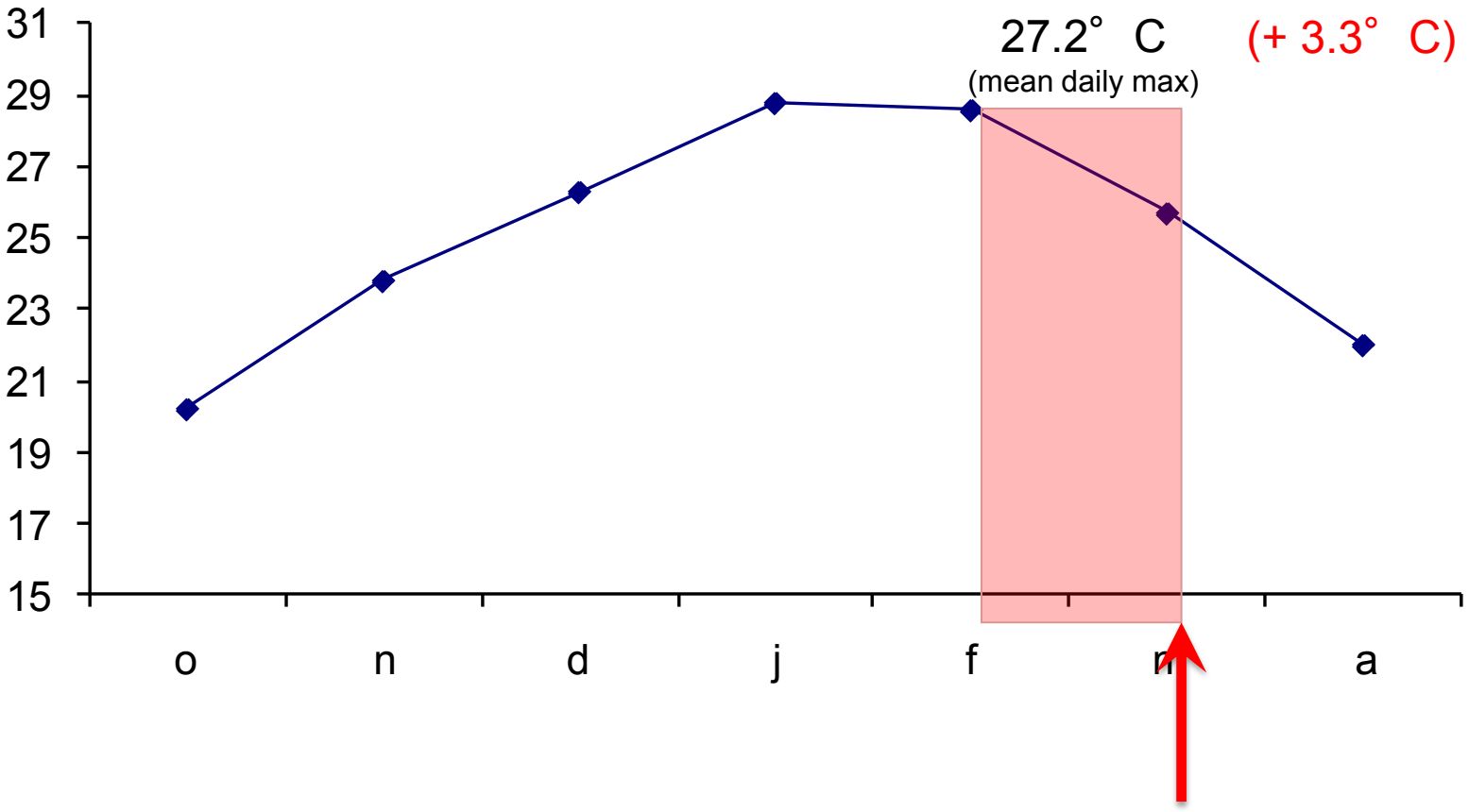
Example: Coonawarra Cabernet Sauvignon

The Australian Wine Research Institute



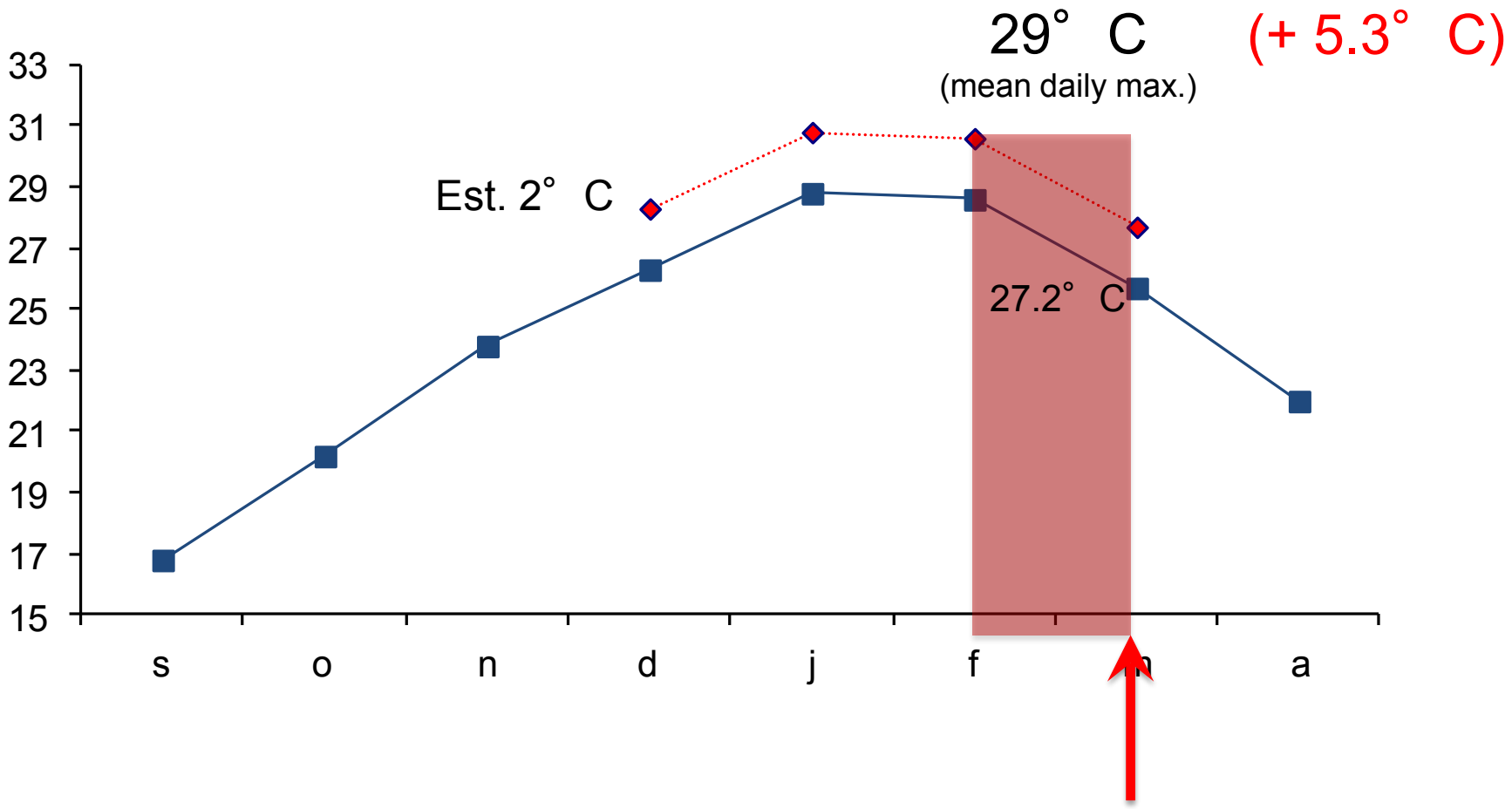
Example: Coonawarra Cabernet Sauvignon

The Australian Wine Research Institute



Example: Coonawarra Cabernet Sauvignon

The Australian Wine Research Institute



Influence of climate change on temperature during ripening period

The Australian Wine Research Institute

The ‘double whammy’ effect

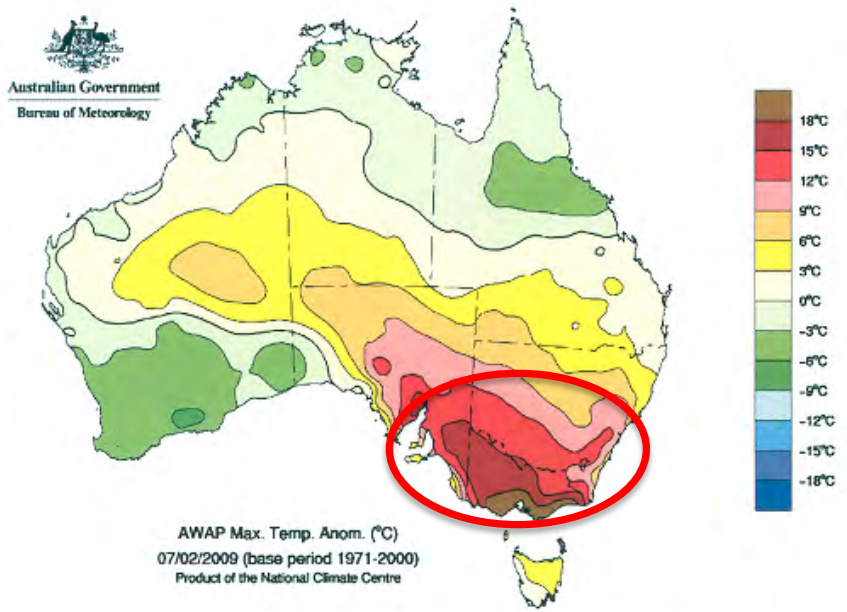
= earlier harvest + higher temperature

Extreme heat

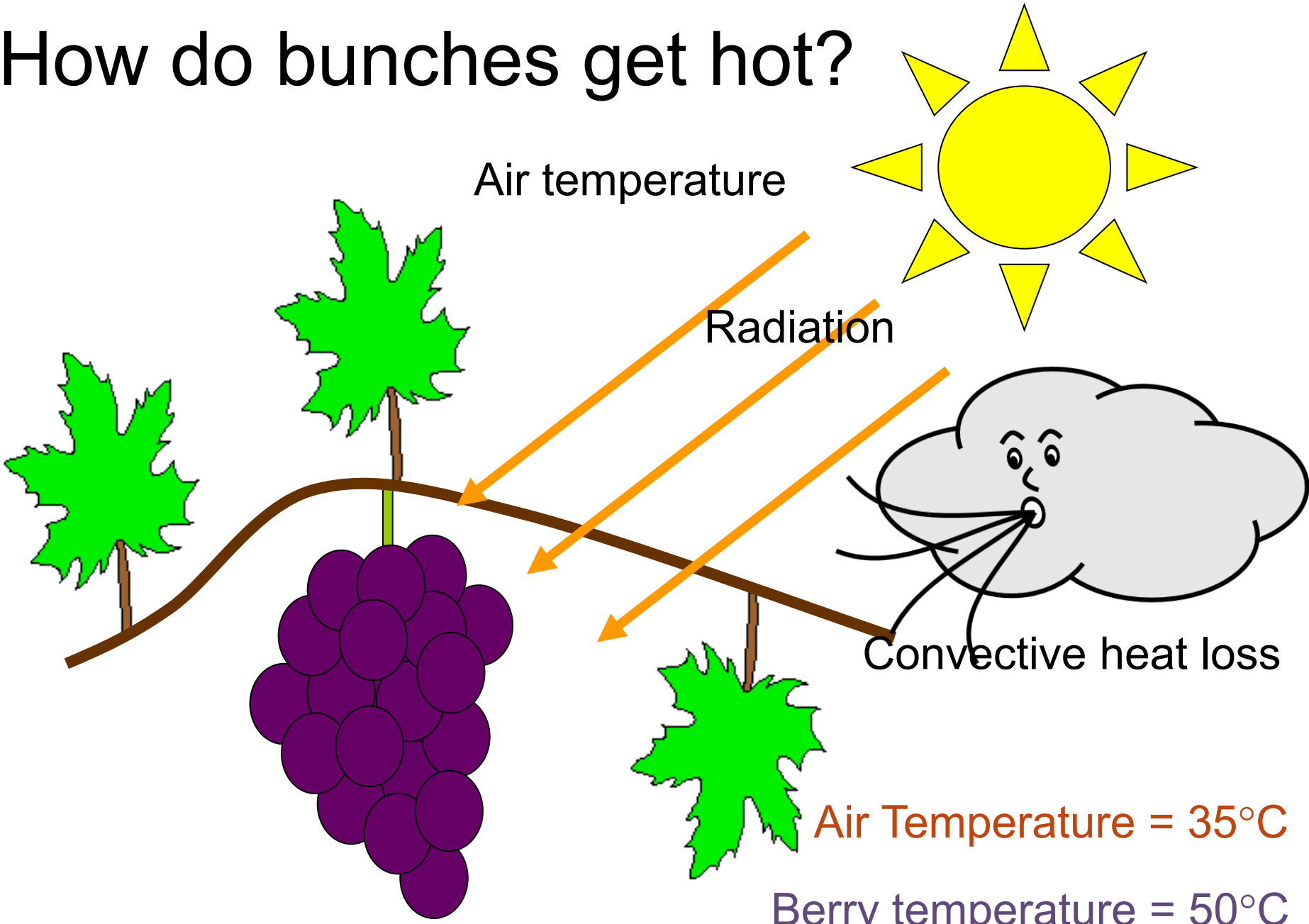
The Australian Wine Research Institute

In 2007-08 and 2008-09: SE Australia experienced severe heat waves post-veraison

- e.g. Mildura 12 days > 40°C in Jan/Feb 2009
- >70% Australian wine production area affected



How do bunches get hot?



Effects of bunch overexposure

The Australian Wine Research Institute

Overexposure → losses in both productivity and wine quality

Physical damage

- sunburn browning = skin injury
- ↑ bitterness
- invasion by 2° bunch rots

'Chemical' damage

- may occur in the absence of any physical symptoms

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

↓ bunch exposure

↑ cooling

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

1. Aim = minimise exposure
   - Considerations for new / redeveloped vineyards

In established vineyards:

- Pruning
- Nutrition
- Irrigation

} increase shoot vigour and promote canopy development

- Canopy management
- Artificial shading
- Vineyard floor management
- Chemical sprays

} minimise bunch exposure to radiation, particularly in the afternoon

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

2. Aim = decrease vine and bunch temperature
   - Irrigation
   - Sprinkler cooling
   - Artificial shading

New vineyards: Row orientation

The Australian Wine Research Institute

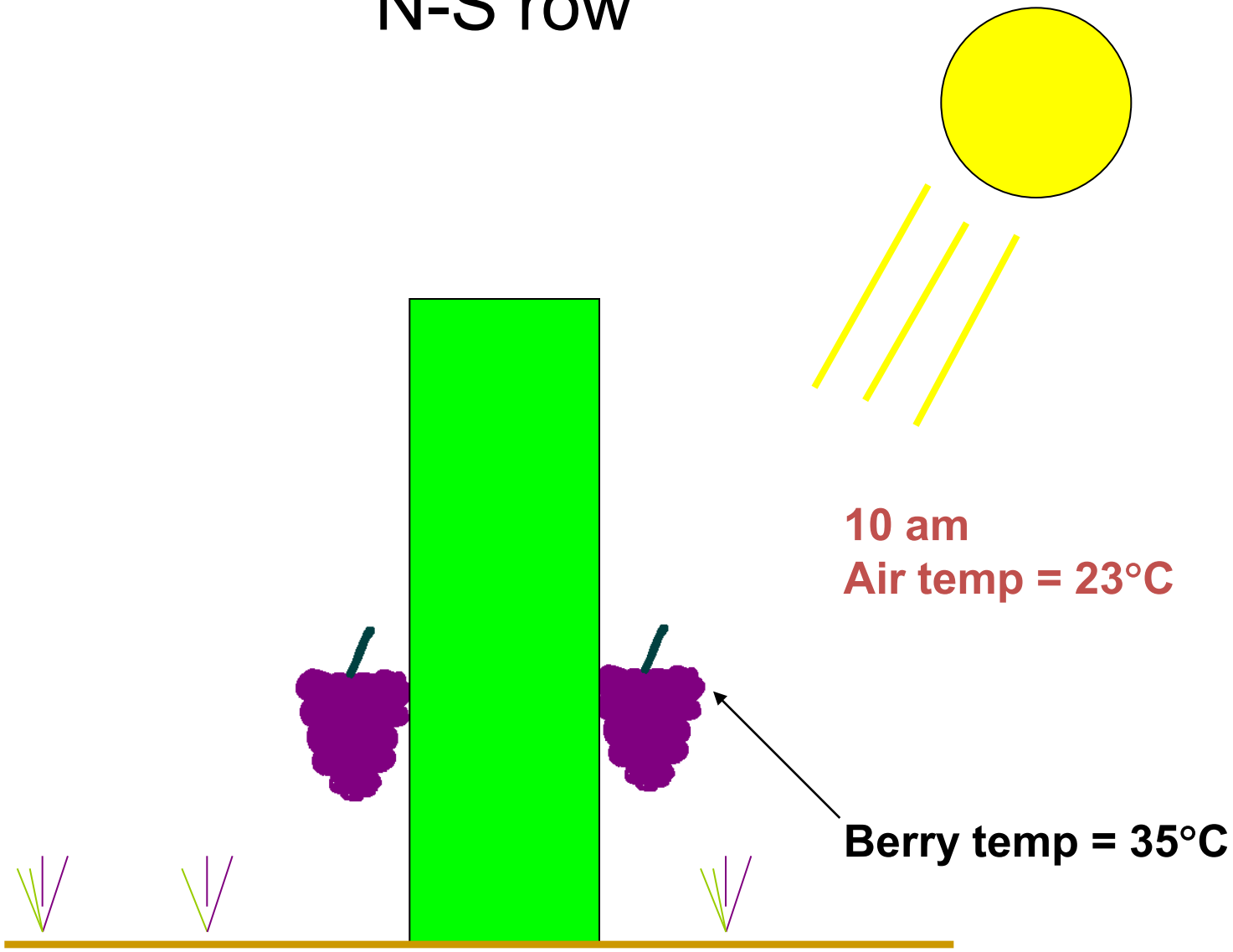
North-South rows are common in Australia:

BUT thermal properties of bunches on W side are very different to those on E side

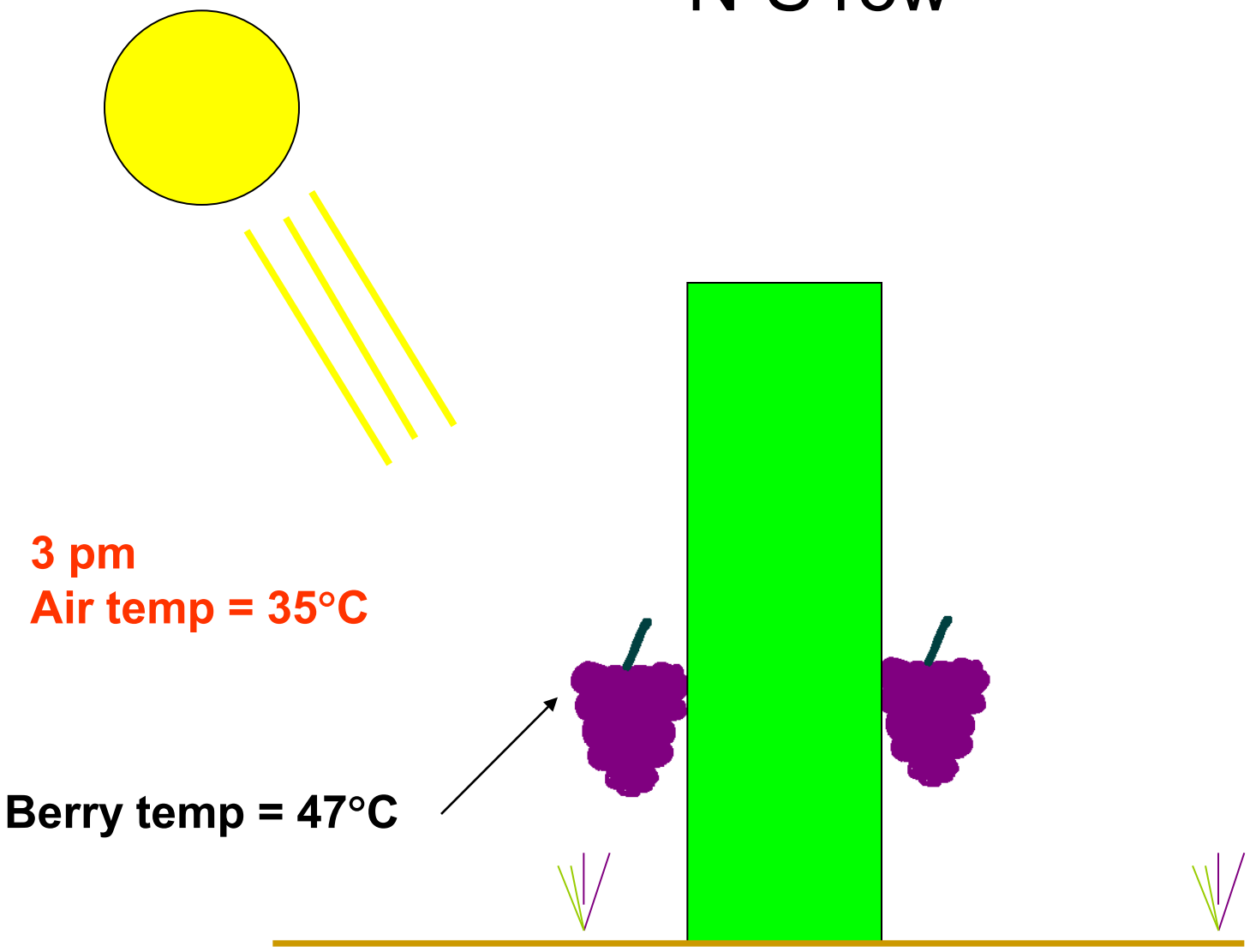
In warm to hot and sunny climates, the choice of row orientation should be determined by other considerations

e.g. protection of bunches from over-exposure

N-S row



N-S row



New vineyards: Row orientation

The Australian Wine Research Institute

In 2009: most bunch damage on N-S rows, particularly with VSP

In the same cool climate vineyard:

- 40% bunch damage on N-S rows,
- only 10% on E-W (Webb et al. 2009)

Row orientation:

The Australian Wine Research Institute

Recommendations:

On heat-prone sites protect bunches during the hottest part of the day

- Consider **E-W or NW-SE*** row orientation for VSP and other trellis systems with vertical canopy face

*NE-SW in northern hemisphere

New vineyards: consider alternative varieties

The Australian Wine Research Institute

Established vineyards: Pruning

The Australian Wine Research Institute

Aim: to achieve balance between yield and vegetative growth

- overcropping will be at the expense of protection by leaves later in the season

Nutrition

The Australian Wine Research Institute

Ensure adequate nutrition:

- post harvest for strong growth in spring
- early season
- ID & rectify any deficiencies that may restrict growth or cause defoliation

Irrigation management

The Australian Wine Research Institute

Aims:

- Develop strong canopy early in the season
  - Keep in mind potential ↑ demand for water later in the season
- Maintain a good canopy cover until late in the season

Irrigation management

The Australian Wine Research Institute

In 2007 to 2009 most bunch damage occurred where water was limited prior to heatwaves due to:

- drought or
- 'severe' deficit irrigation

Negative effects of high temperature event (40-45° C) are more severe for water-stressed vines than well-watered controls (Edwards et al. 2011)

Irrigation management

The Australian Wine Research Institute

Irrigation affects the vineyard microclimate

Transpirational cooling is ***critical***

- Active transpiration must occur ***prior*** to heat event

  (Edwards et al. 2011)

Considerations:

- Need good water supply
  - particularly from set to veraison
  - and during heat waves

Irrigation management

The Australian Wine Research Institute

Recommendations:

- Apply adequate irrigation pre-veraison to achieve good canopy cover
- If heat event forecast, cease deficit irrigation, apply irrigation to refill soil profile

These require good water supply & appropriate infrastructure

Canopy management: training system

The Australian Wine Research Institute

In 2009 vineyards with sprawling, non-positioned canopies had least heat damage (Webb et al.)

- VSP trellis had most heat damage

  Particularly in cool regions (with a high proportion of VSP trellis) and bunchzone leaf removal

Canopy management: training system

The Australian Wine Research Institute

What do you do if you have VSP and north-south rows in sunny climate?

Canopy management: training system

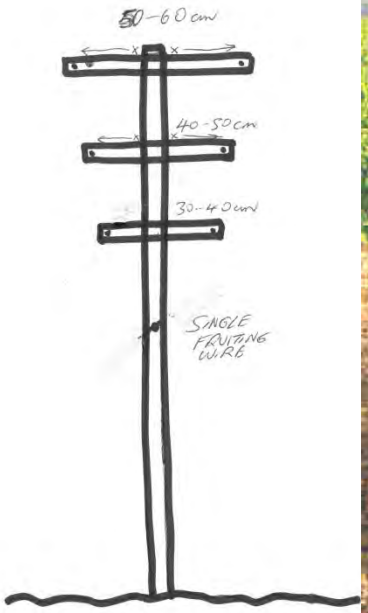
The Australian Wine Research Institute

Full lift on both W and E sides of N-S row

Foliage wire lift to first position only on W side: both wires lifted on E side

Canopy management: training system

The Australian Wine Research Institute



V-VSP trellis
(Rahn 2007)

N-S row; single fruiting wire with
T foliage wires offset to west (Lodi, CA)

Canopy management: bunchzone leaf removal

The Australian Wine Research Institute

- Either avoid altogether
- Or if necessary, do only on E side of N-S rows

W side

Artificial shading

The Australian Wine Research Institute

Applicable to winegrape vineyards?

Tablegrape vineyard near Mildura

Vineyard floor management

The Australian Wine Research Institute

In 2009 vineyards with bare soil had most heat damage (Webb et al.)

Recommendation:

Permanent sward

Mown sward thrown undervine

Chemical sprays

The Australian Wine Research Institute

‘sun protection agents’ or ‘sunscreens’

- particle film technology (PFT) products based on:
  - processed and refined kaolin (Surround®, Screen®)
  - calcium carbonate crystals (Parasol®)

applied as a foliar/bunch spray claimed:

- reduce visible radiation, reflect UV and infrared
- Australian research: reduced leaf temperature, no effect on yield, increased juice sugar and acids

Seek clarification from winery regarding their use

Conclusions

The Australian Wine Research Institute

- Excessive bunch exposure has implications for grape composition and wine quality
- Maintain bunches with some degree of shading
- The degree of bunch exposure can be manipulated in both existing and new vineyards
- New technologies such as particle film and anti-transpirants may be considered
- Many existing winegrape varieties are adaptable

  BUT alternative varieties can offer greater heat and drought tolerance

Acknowledgements

The Australian Wine Research Institute

This work is supported by Australia's grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

Australian Government

Grape and Wine Research and Development Corporation

A W R I

The Australian Wine Research Institute

TANNIN FROM GRAPE TO WINE

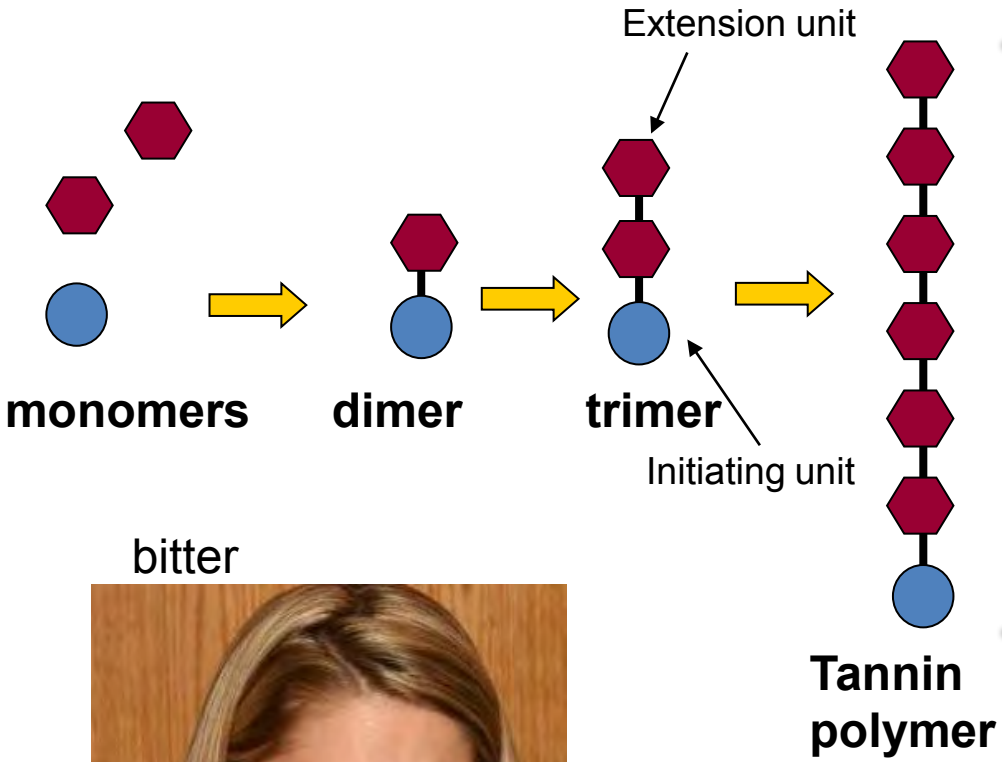
New insights on a complex system

Dr Keren Bindon

The Australian Wine Research Institute

Tannin 101

The Australian Wine Research Institute



mDP = average units

mDP α molecular mass

bitter

Low mDP

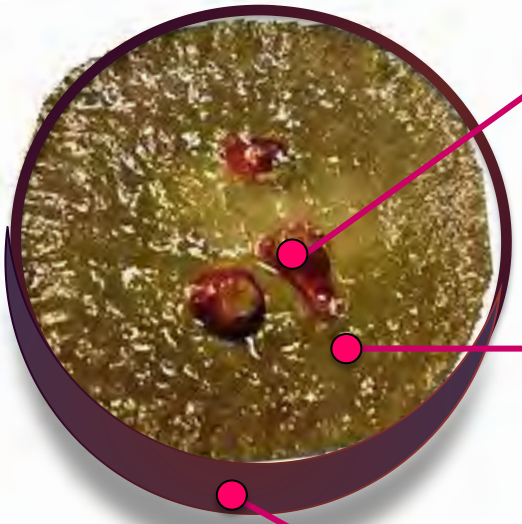
More tannin

High mDP

astringent

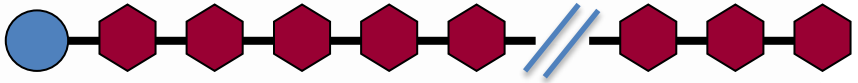
Tannin composition within the berry

The Australian Wine Research Institute



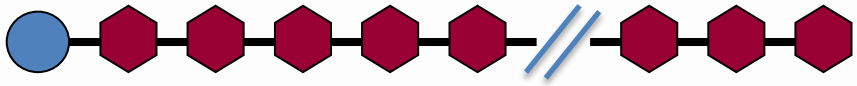
Seed:

- mDP: 3-5 units
- molecular mass = 3000 g/mol



Flesh:

- mDP: 14-37 units
- molecular mass = 6000 g/mol

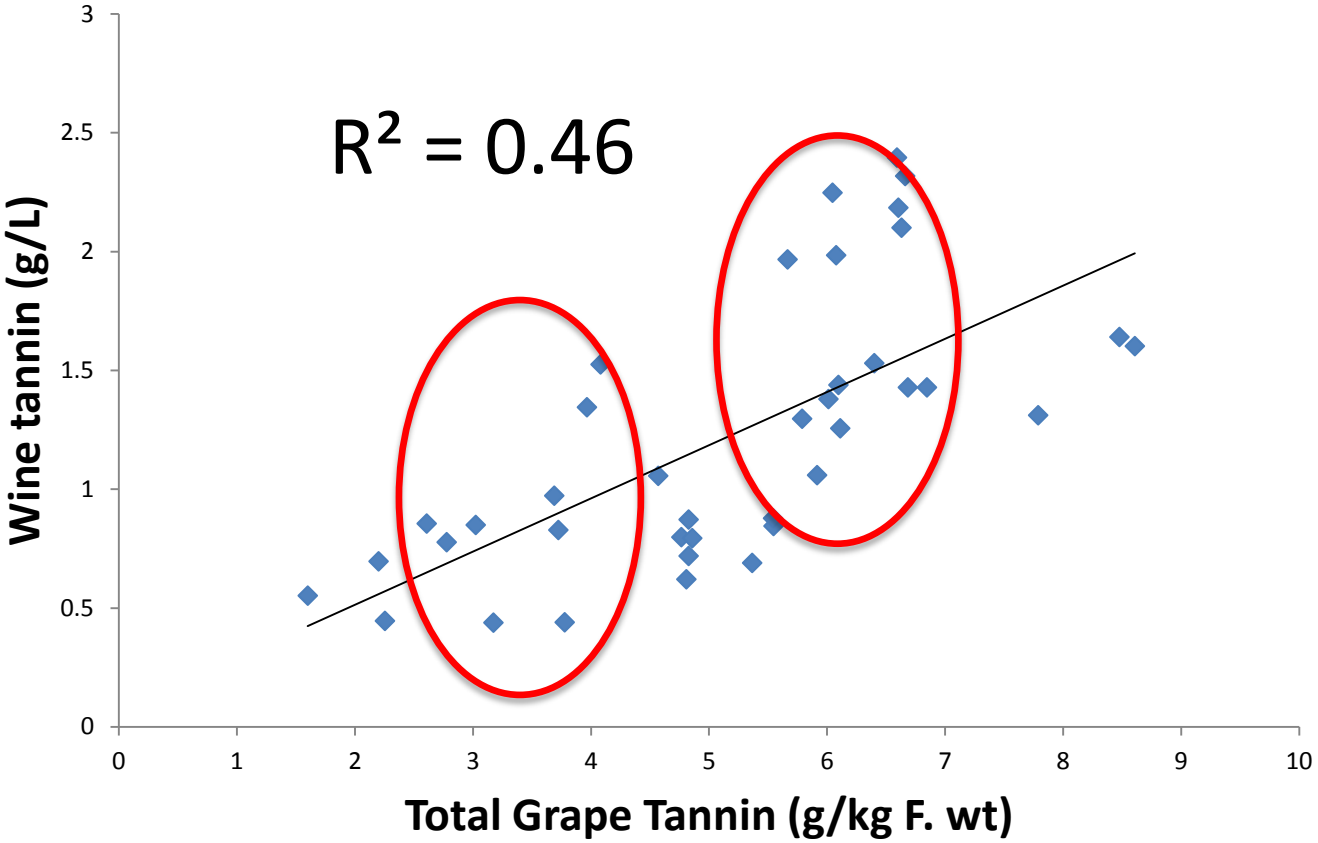


Skin:

- mDP: 17-37 units
- molecular mass = 8500 g/mol

In search of a grape to wine correlation

The Australian Wine Research Institute



A poor correlation is often found between total grape tannin and wine tannin

Points to differences in tannin extractability

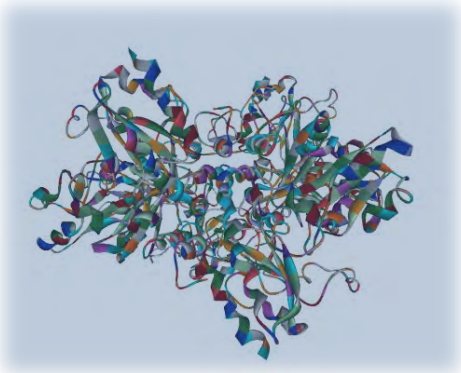
Techniques which enhance tannin extraction

The Australian Wine Research Institute

Flash detente, thermovinification, microwave

Extended maceration

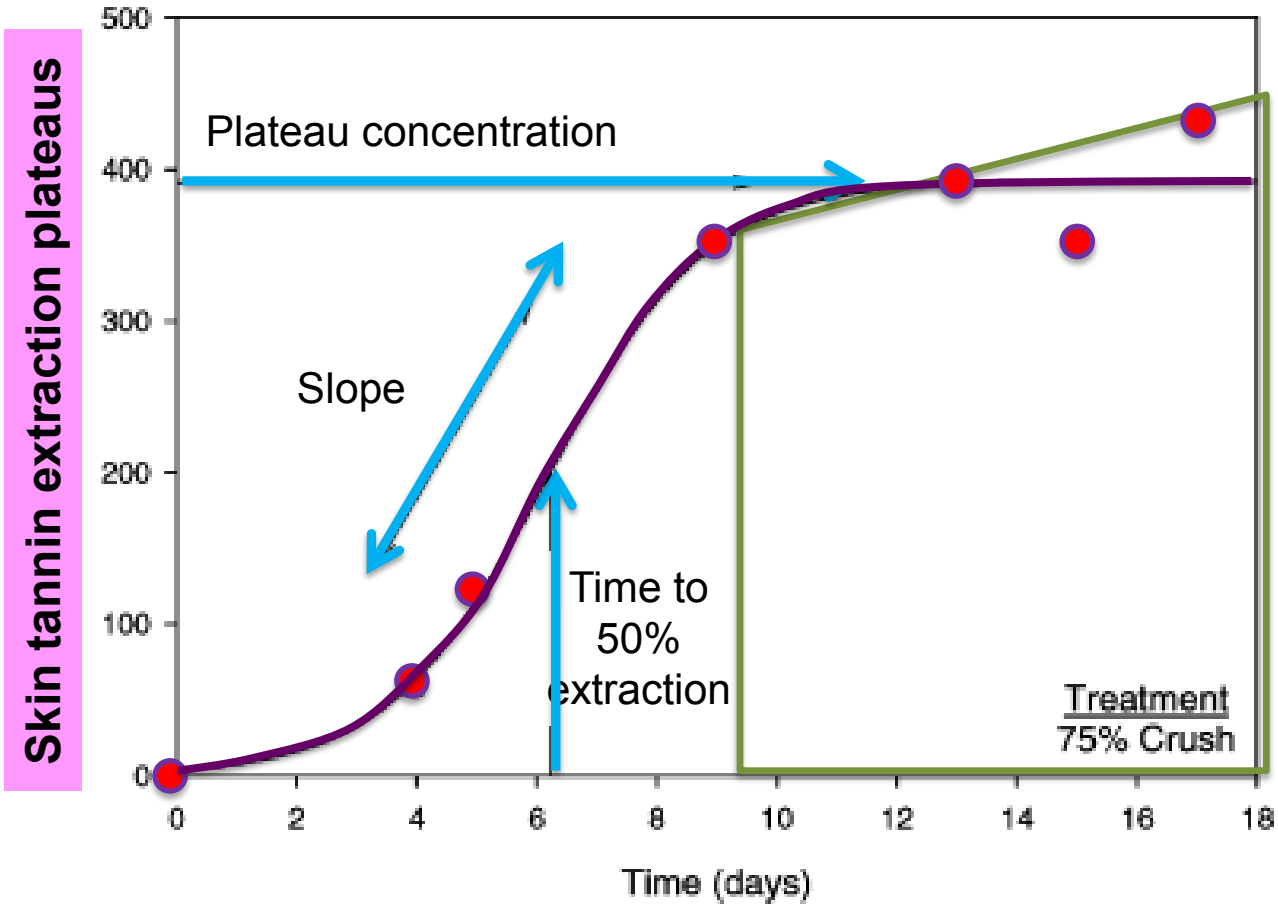
Macerating Enzymes



Cap blending

Maceration: whole-berry vs crushed ferments

The Australian Wine Research Institute

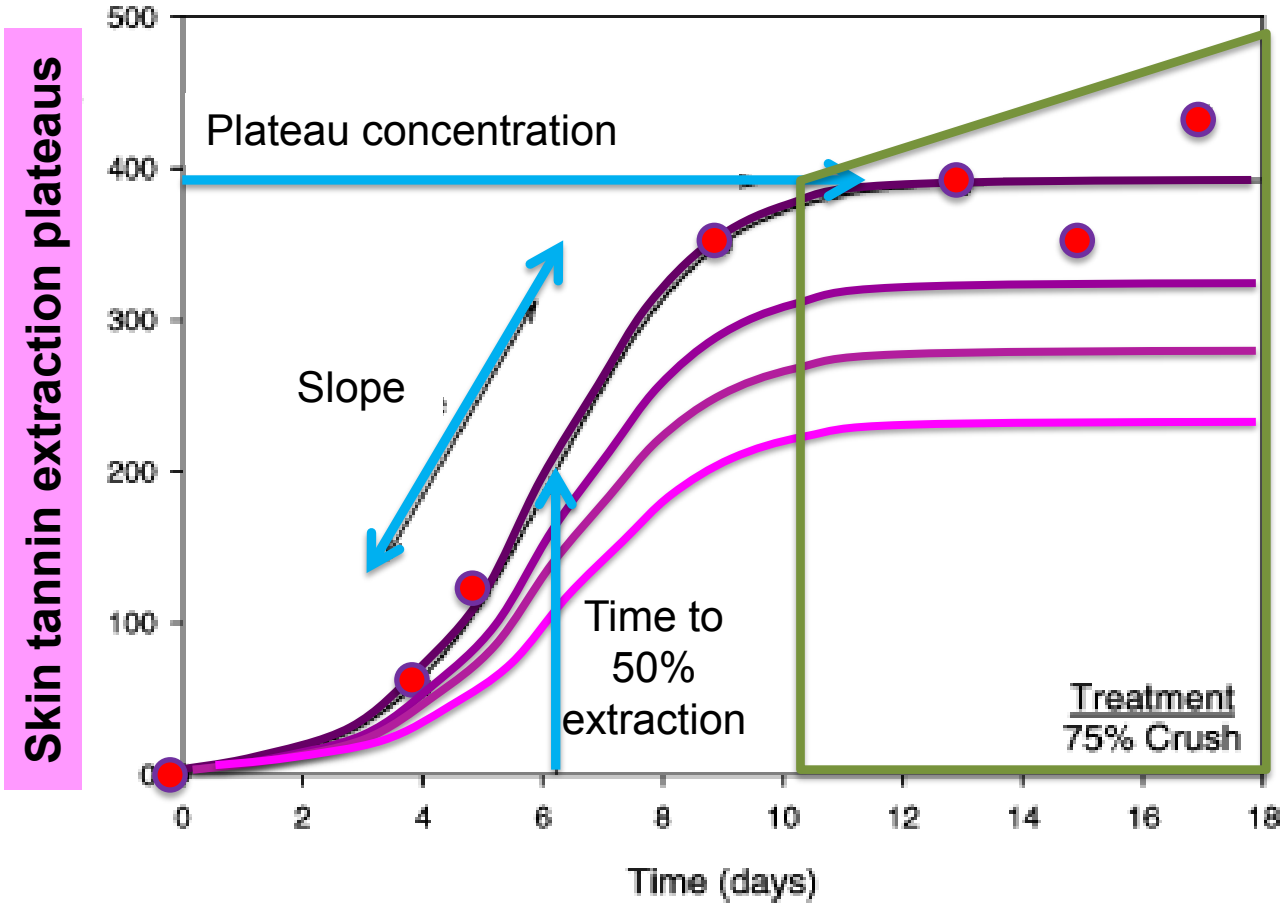


Seed tannin extraction increases late and continues

Cerpa-Calderon & Kennedy 2008, J. Agric. Food Chem., 56, 19, 9006-9014

Maceration: whole-berry vs crushed ferments

The Australian Wine Research Institute



Degree of berry crushing shortens time to 50% skin tannin extraction

Increased height of skin tannin plateau

Increases seed tannin extraction late in ferment

Cerpa-Calderon & Kennedy 2008, J. Agric. Food Chem., 56, 19, 9006-9014

Extended maceration

The Australian Wine Research Institute

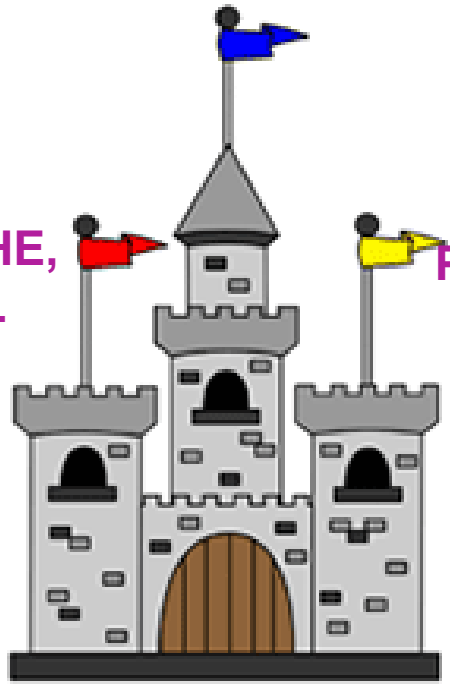
- The effects of extended maceration on tannin concentration depend on
  - Extractable grape tannin concentration
  - Concentration increases are invariably from seed extraction

Standard winemaking

SHIRAZ, 2000 mg/L

GRENACHE, 50 mg/L

PINOT NOIR, 30 mg/L

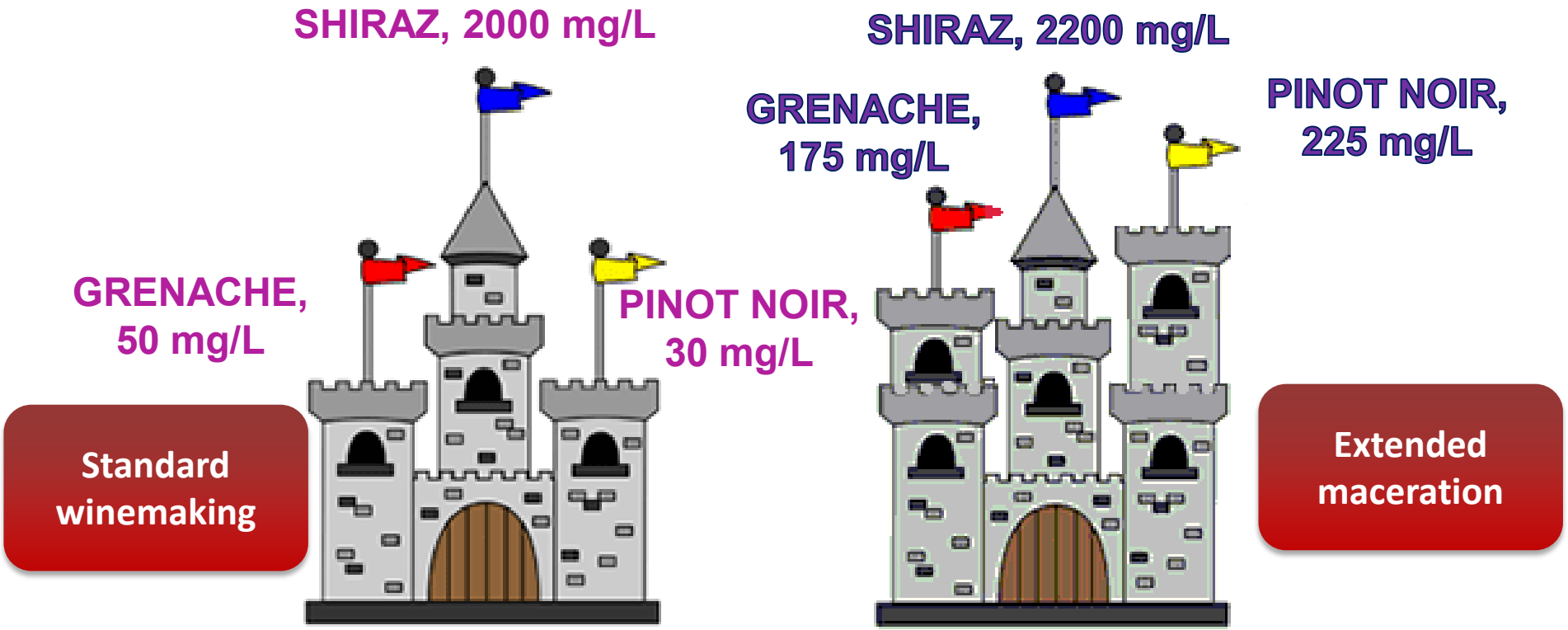


Joscelyne, V., 2009, PhD Thesis, University of Adelaide

Extended maceration

The Australian Wine Research Institute

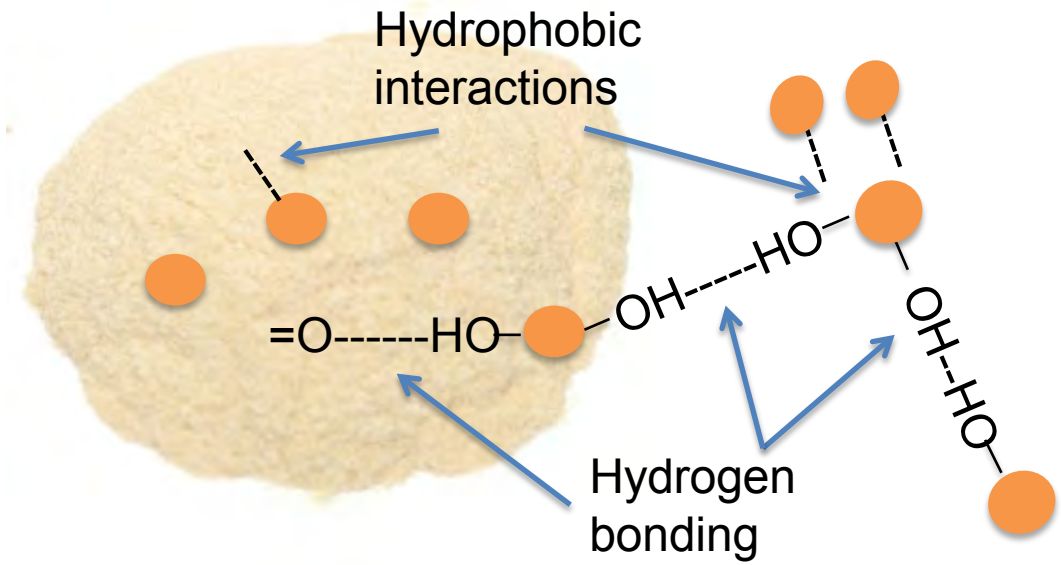
- Shiraz has high grape tannin, no effect of extended maceration on tannin concentration in wine
- Grenache and Pinot noir have low grape tannin, extended maceration increases wine tannin concentration significantly, but from seed extraction



Joscelyne, V., 2009, PhD Thesis, University of Adelaide

The adsorption properties of tannin

The Australian Wine Research Institute



Binding of tannins to cell walls:

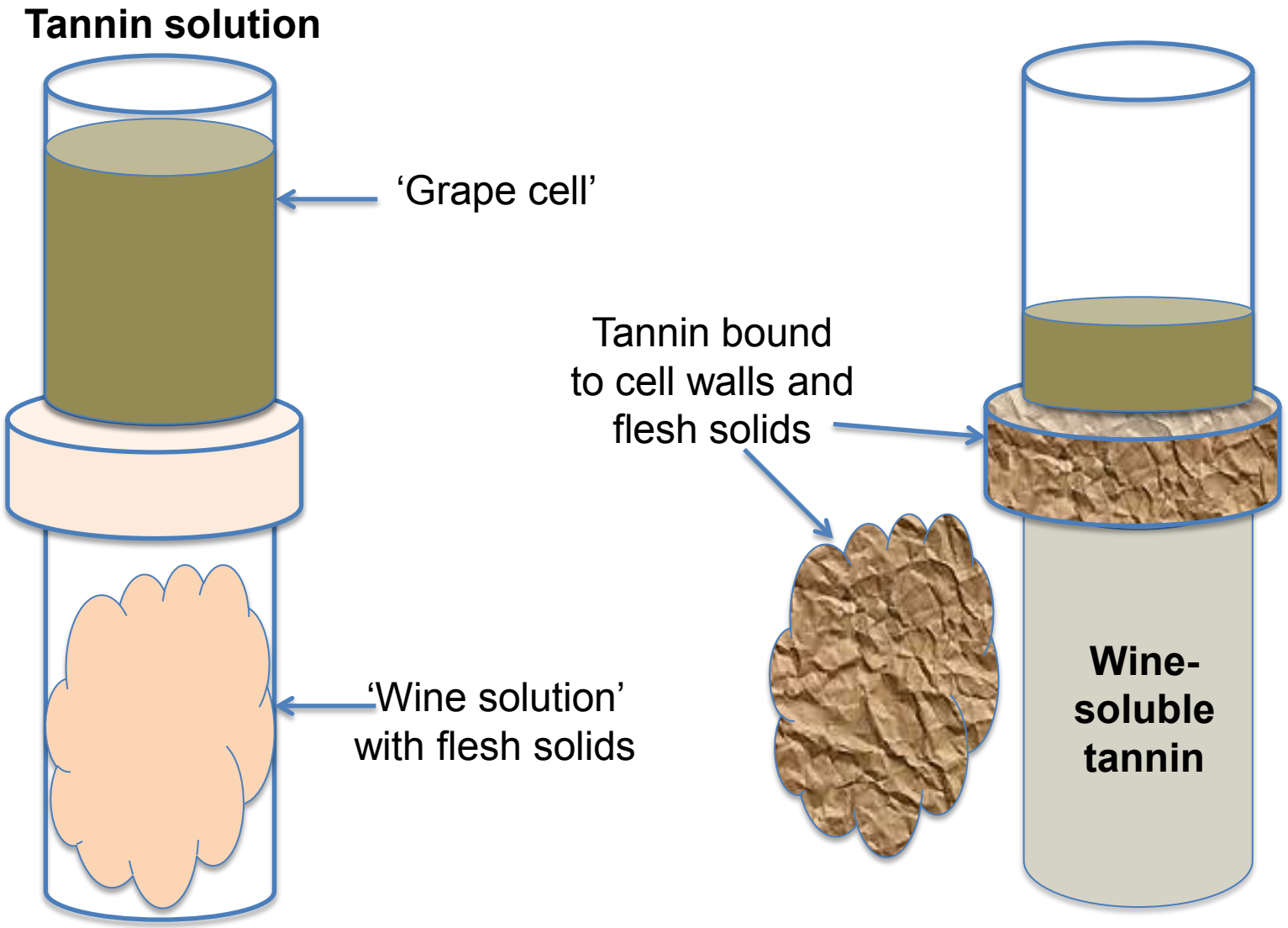
- Non-covalently by hydrogen bonding and hydrophobic interaction
- Secondary tannin-tannin bonding

Cell wall structure and porosity:

- Tannin can be sequestered in pores through multilayer formation (hydrophobic)

Model of tannin extraction to wine

The Australian Wine Research Institute



Strength of tannin binding

The Australian Wine Research Institute

SKIN TANNIN

Large molecular mass

Strong binding

Not extractable

Intermediate molecular mass

Weak binding

Very extractable

SEED TANNIN

Intermediate molecular mass

Strong binding

Not extractable

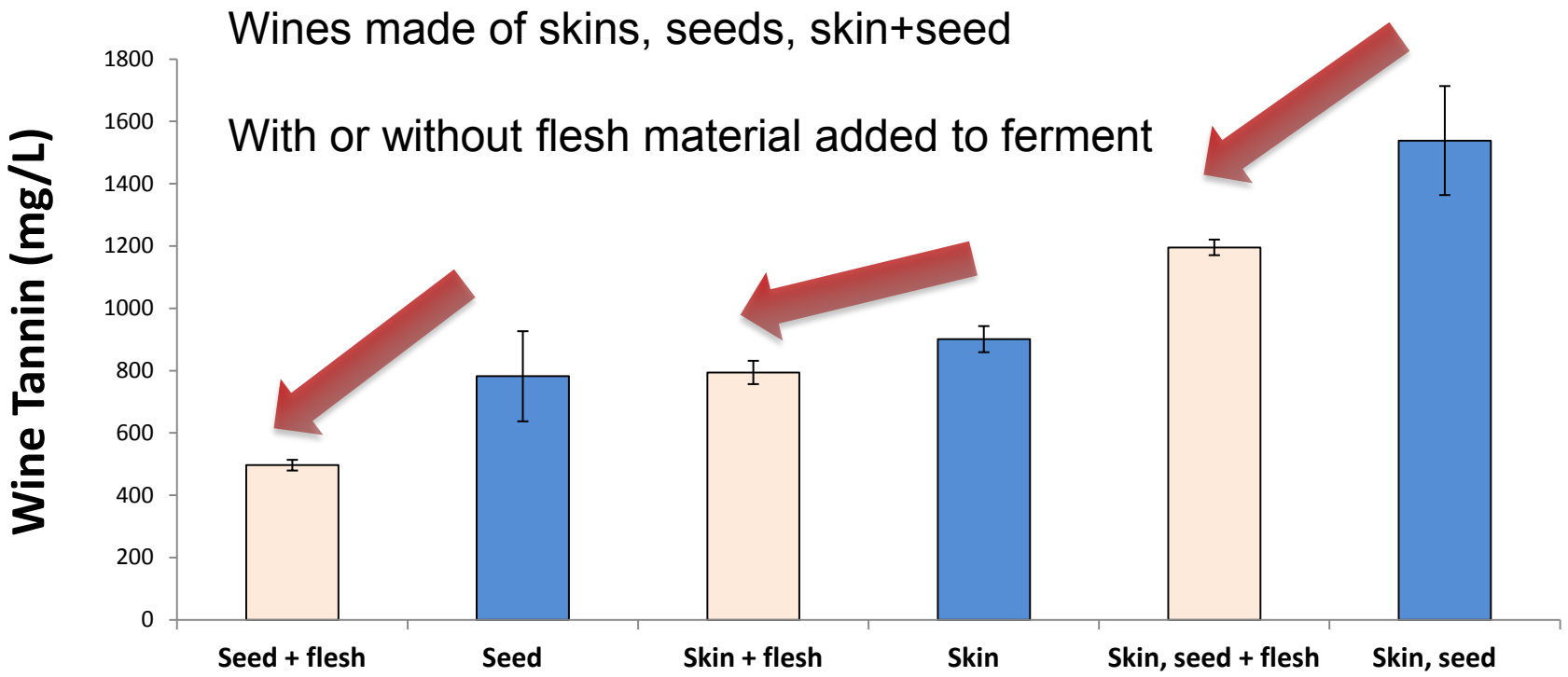
Low molecular mass

Intermediate binding

Poorly extractable

Ferments of grape components

The Australian Wine Research Institute



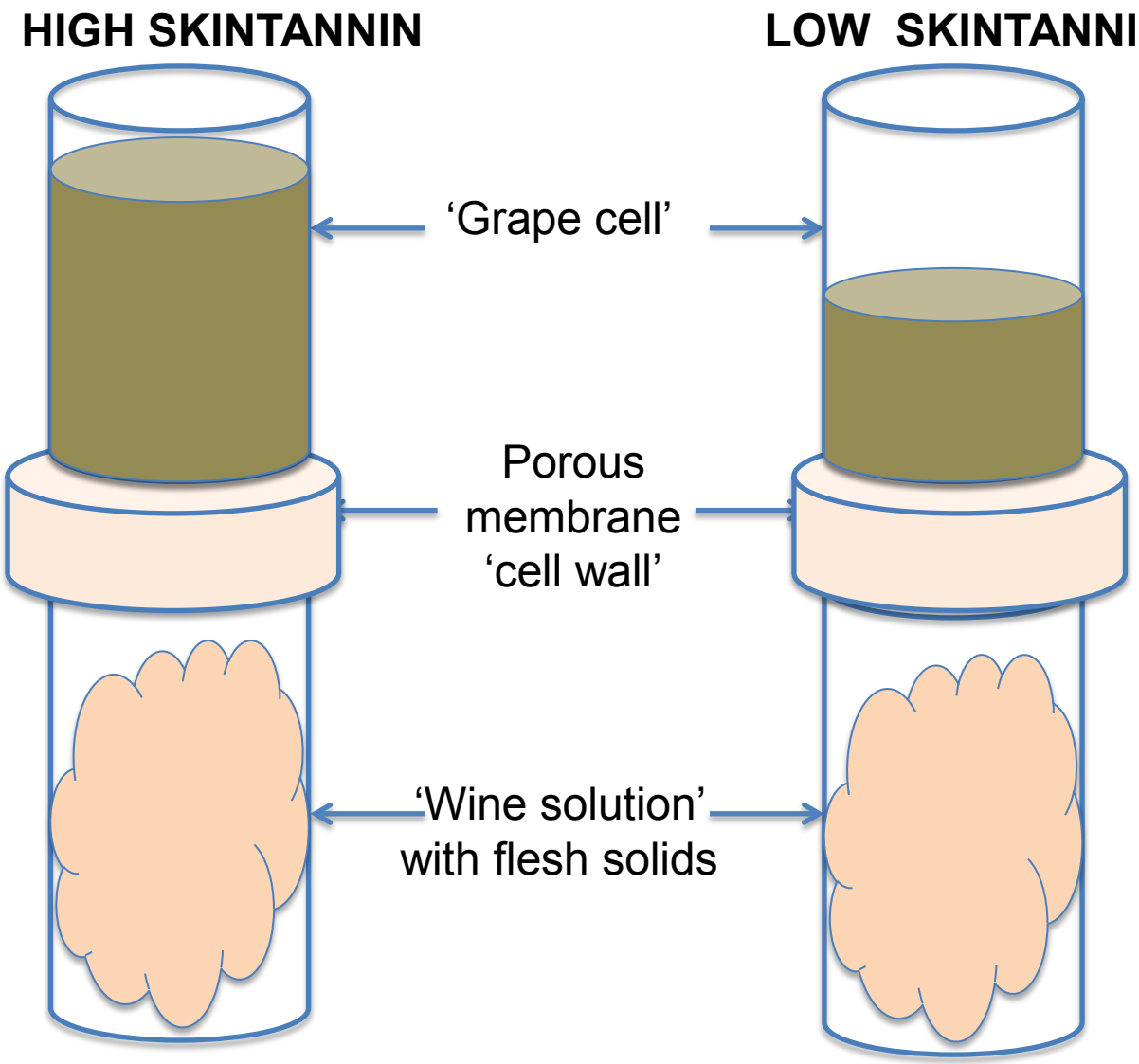
mDP
Wine = 4.5
Grape = 6.3

mDP
Wine = 11.6
Grape = 19.9

mDP
Wine = 8.8

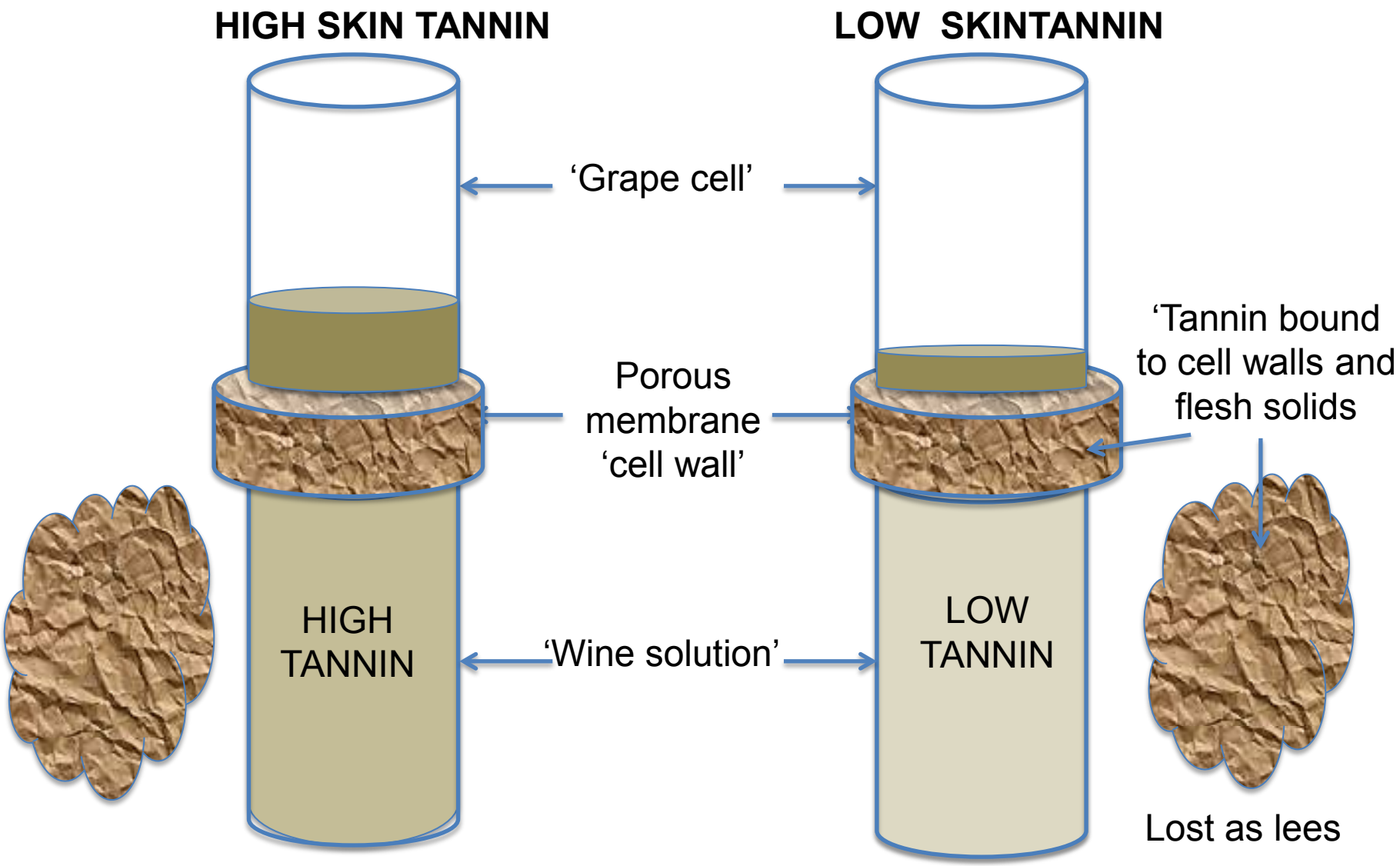
Model of extraction of high and low skin tannin grapes

The Australian Wine Research Institute



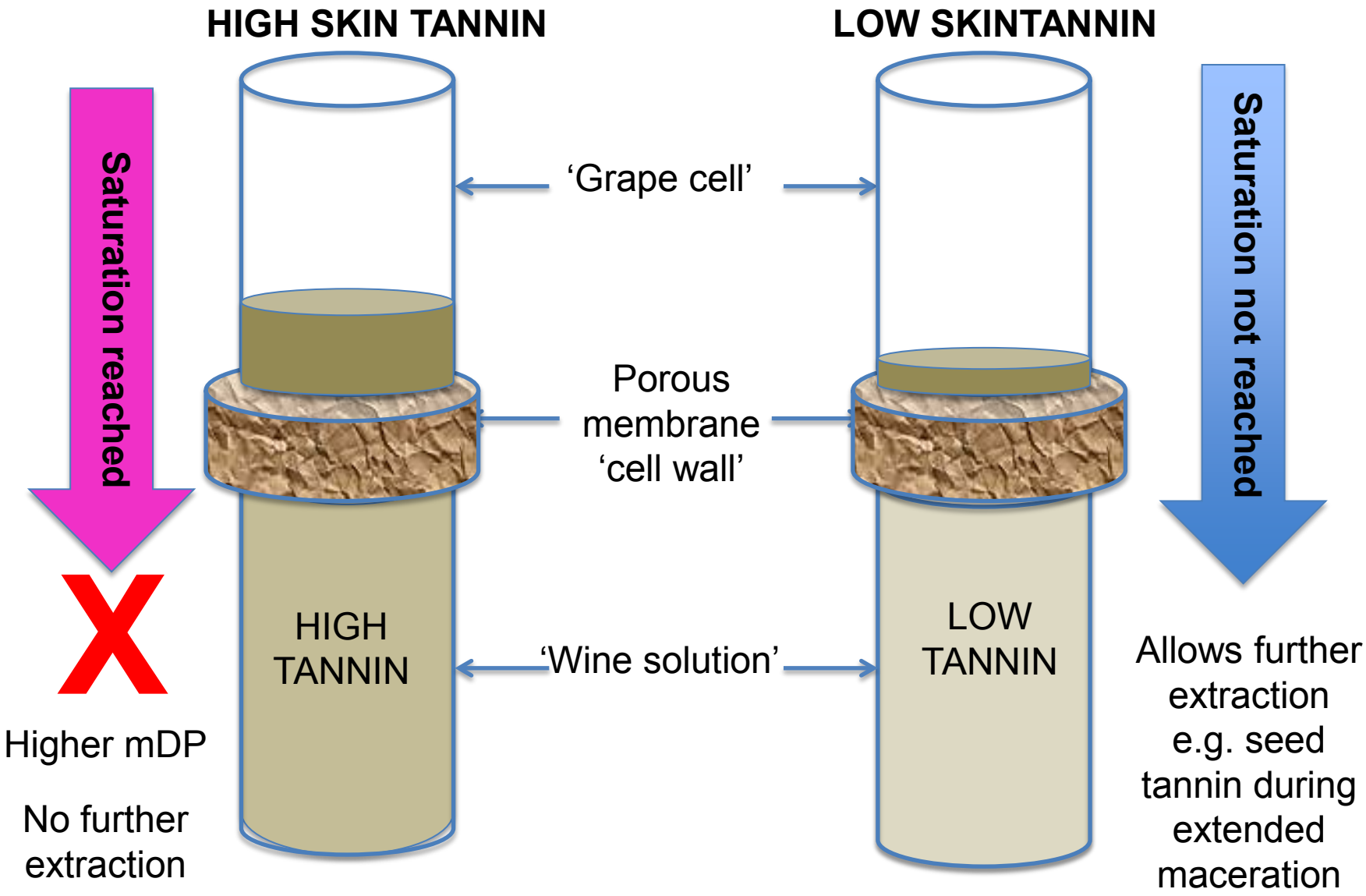
Model of extraction of high and low tannin grapes

The Australian Wine Research Institute



Model of extraction of high and low tannin grapes

The Australian Wine Research Institute



NO, I THINK IT'S BEST WHERE IT WAS.....

The role of anthocyanin: skin tannin

The Australian Wine Research Institute

Total skin tannin = similar content

Extractable tannin lower for mutant
52% extracted versus 12%

Add 750 mg/L anthocyanin = 33%
Add 1500 mg/L anthocyanin = 48%

Cabernet Sauvignon

Colour enhances skin tannin extraction

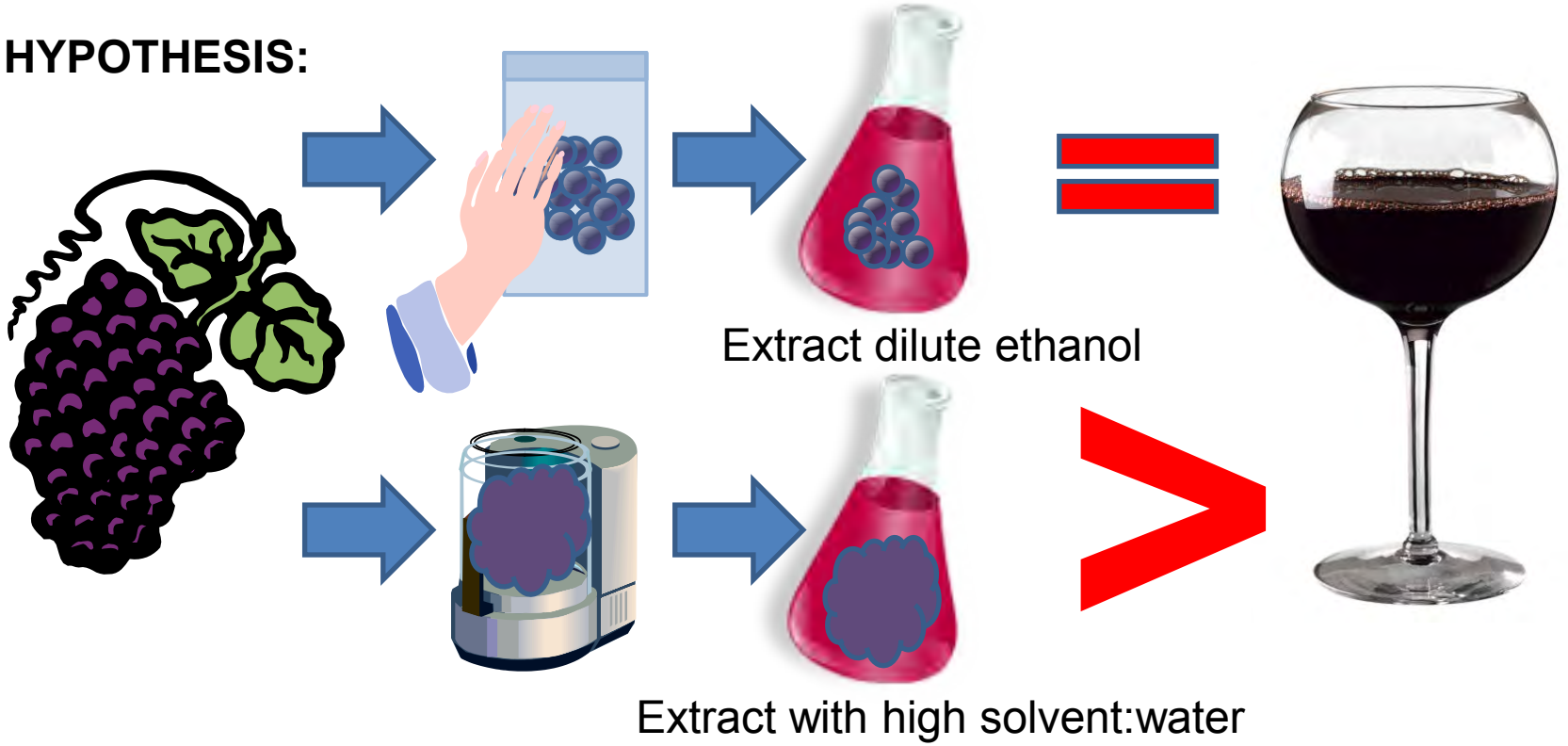
White Cabernet S. mutant

Can we measure tannin extractability?

The Australian Wine Research Institute

- Whole grape extracts, crushed berries in acidified 15% ethanol
- Harsh grape extractions (50% ethanol) following homogenisation

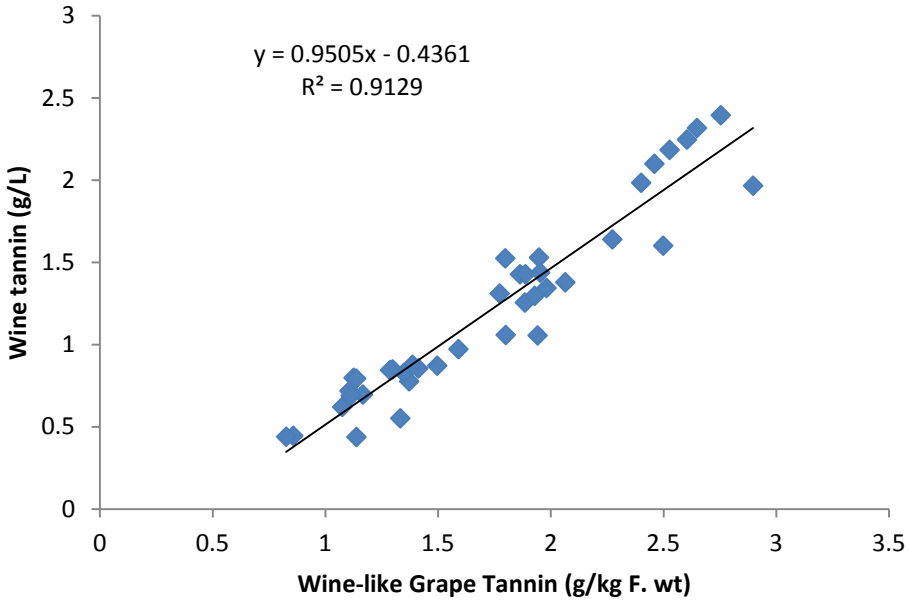
HYPOTHESIS:

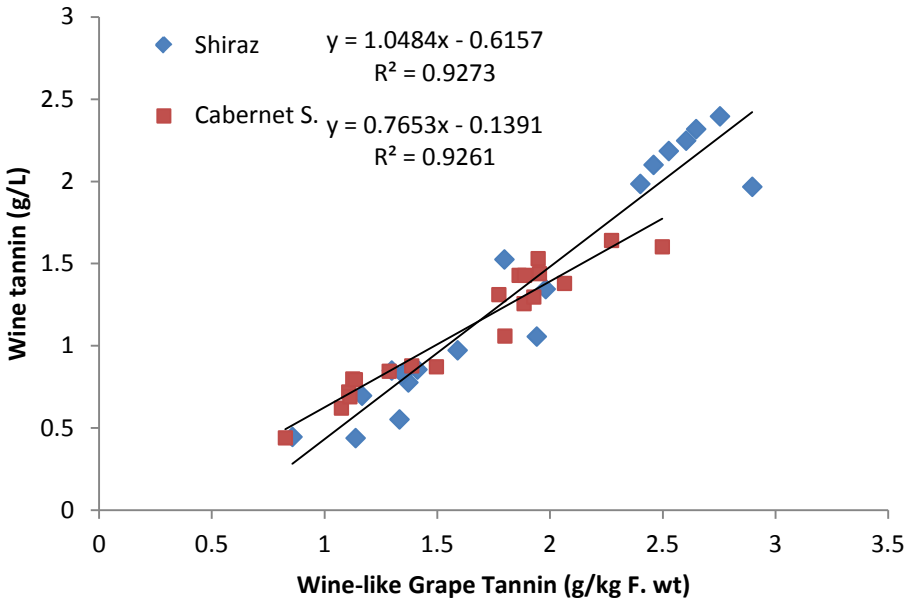


Putting it to the test: grape to wine 2013

The Australian Wine Research Institute

- A strong relationship was found for wine-like extractions and wine tannin
- Small differences were found between cultivars
- Main differences in concentration were driven by:
  - skin tannin extraction
  - tannin mDP (increase with greater extraction)

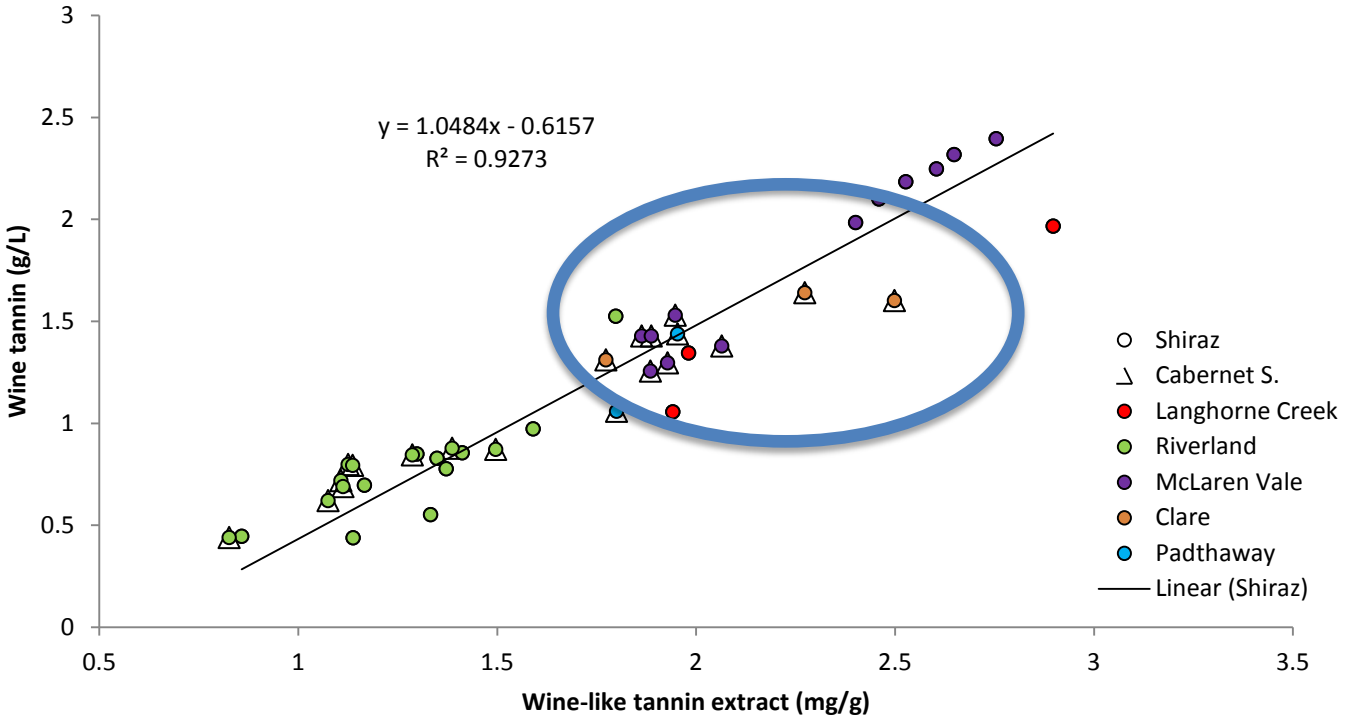




Regionality

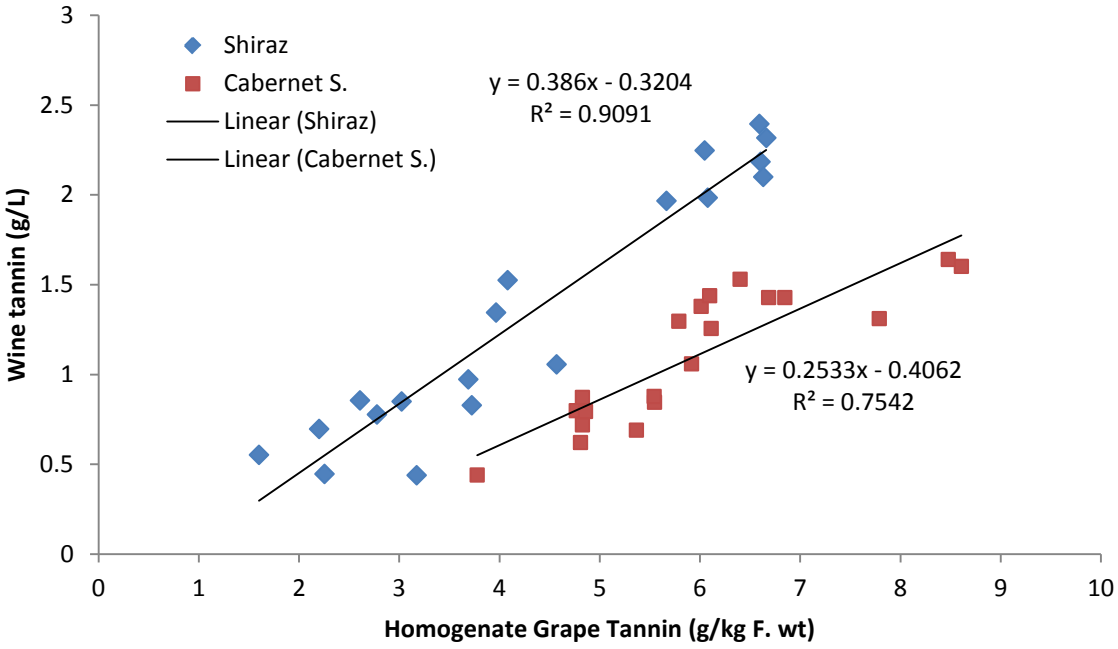
The Australian Wine Research Institute

- Large differences were found between regions
- Riverland = lowest; McLaren Vale = highest, Clare = mid to high
- Highest tannin grapes/wines were also the ‘ripest’ samples



Extraction method

The Australian Wine Research Institute



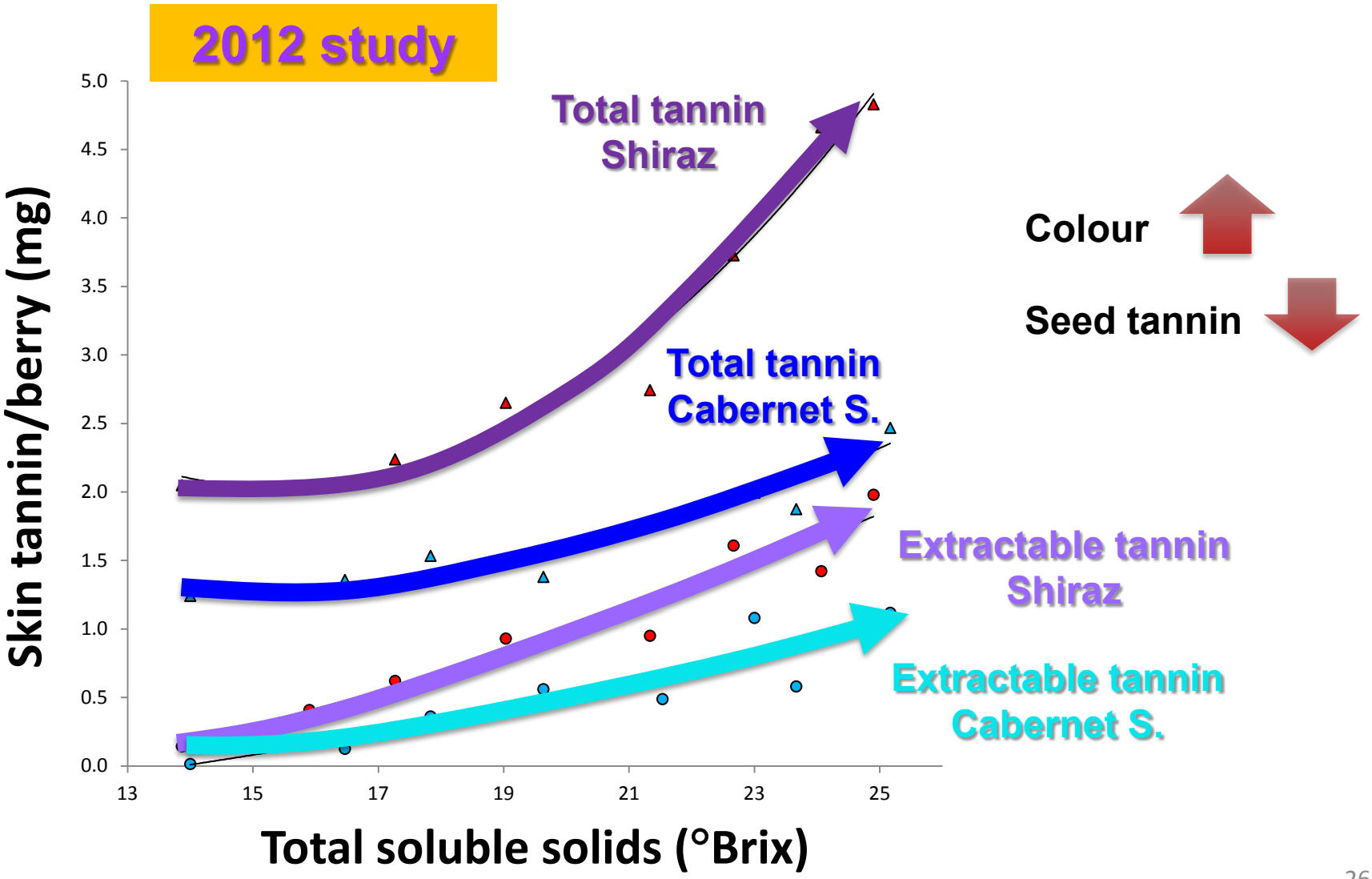
- Useful measure for industry as this method is available via AWRI's tannin portal or commercial service

- Correlation for homogenate extracts was not clear-cut

- By cultivar, homogenate extract tannin was strongly related to wine tannin

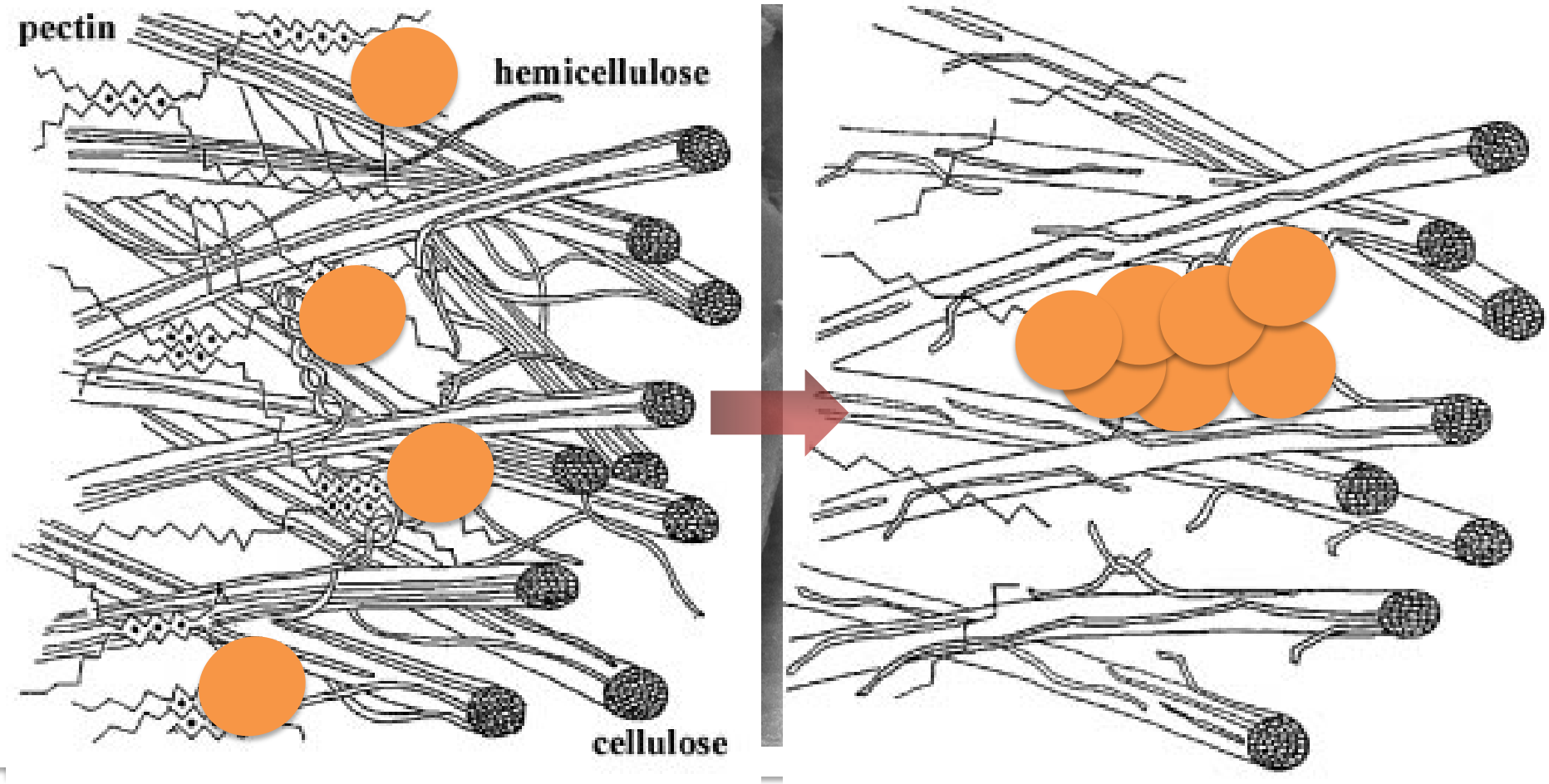
How can this be applied during vintage?

The Australian Wine Research Institute



Tannin-cell wall interactions in ripening skins

The Australian Wine Research Institute

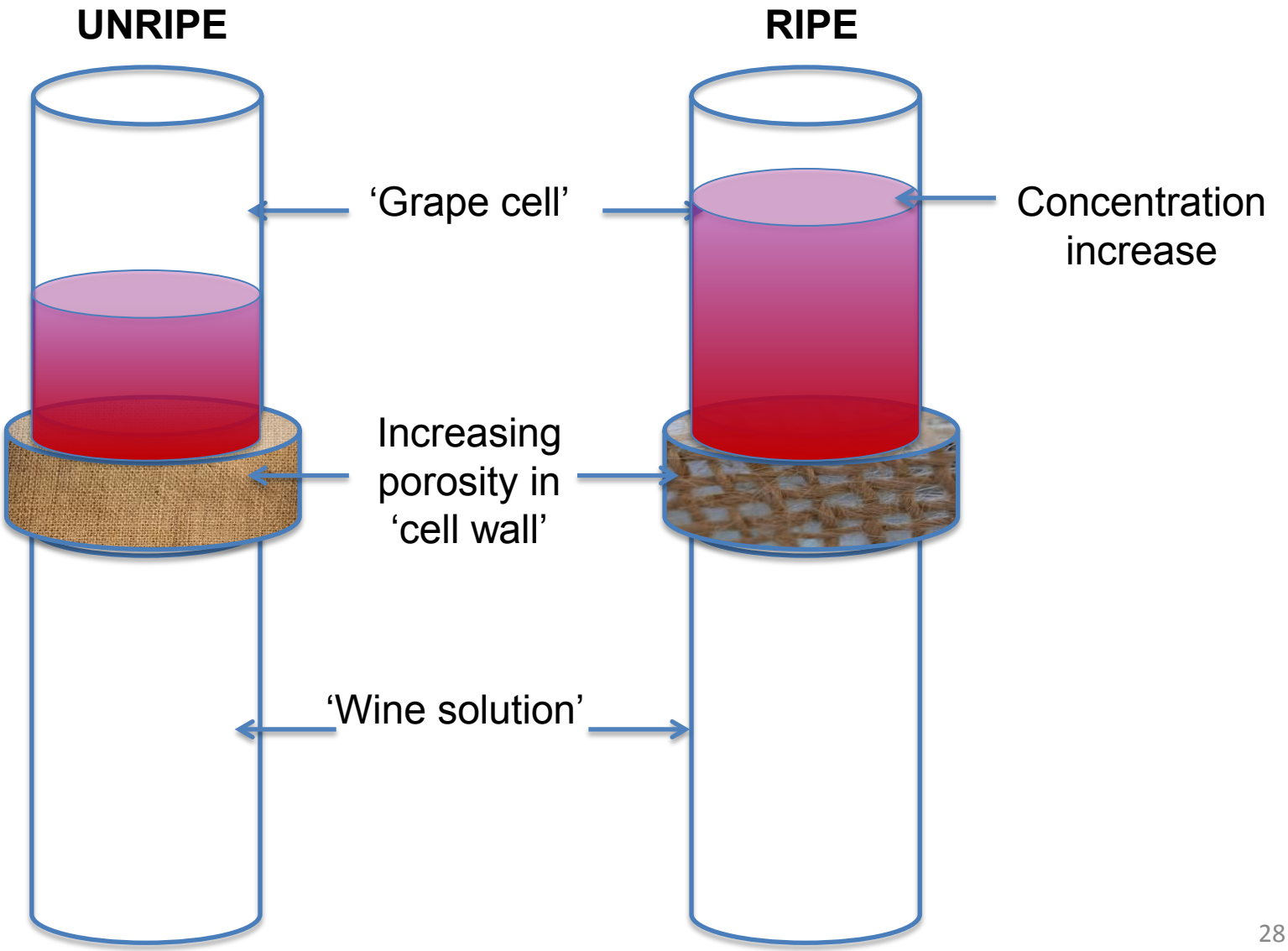


Immature cell wall rich in pectins = tannin binds strongly to the surface

Mature cell wall with greater porosity = larger tannins bound in pores

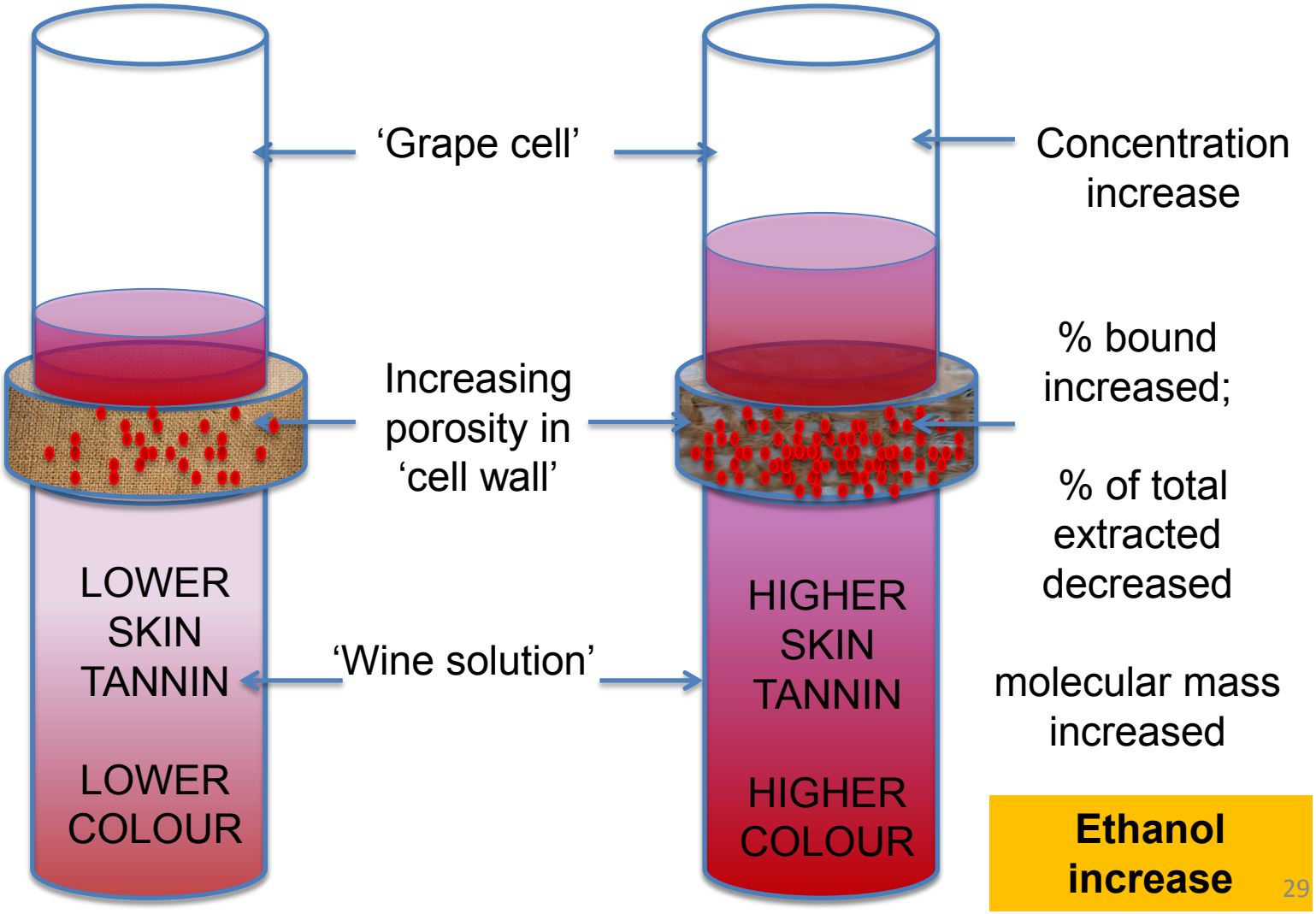
Model of tannin extraction in ripening skins

The Australian Wine Research Institute



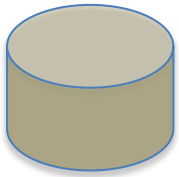
Model of tannin extraction in ripening skins

The Australian Wine Research Institute

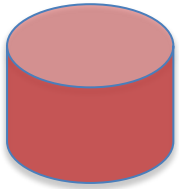


Take home messages

The Australian Wine Research Institute



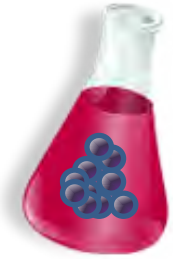
Tannin concentration and molecular mass
Ratio of skin tannin to seed tannin
Skin tannin increases with ripening



Anthocyanin binds to cell walls
BUT, facilitates the extraction of tannin

Cell wall porosity increases with ripening
Can cause net tannin extraction to decrease

Flesh solids to tannin ratio;
Enzymes can break flesh cell walls down



Wine-like extracts can predict grape-extractable tannin
Homogenate extracts* are a useful indicator by variety
*Available by AWRI's commercial service/tannin portal

Acknowledgements:

The Australian Wine Research Institute

AWRI

- Paul Smith
- Jim Kennedy
- Stella Kassara
- Gemma West
- Christina Linke
- Fiona Brooks

INDUSTRY PARTNERS

- Pernod Ricard/Orlando Wyndham Australia
- Nathan Scarlett, Pete Bissell (Rathbone Wine Group)

GWRDC
GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

COLLABORATORS

- Tony Bacic, Uni Melbourne
- Mike McCarthy, Matthew Ayers, SARDI
- Lynette Waterhouse, Adelaide Microscopy
- Hadi Madani, Phillip Pendleton, UniSA

A W R I

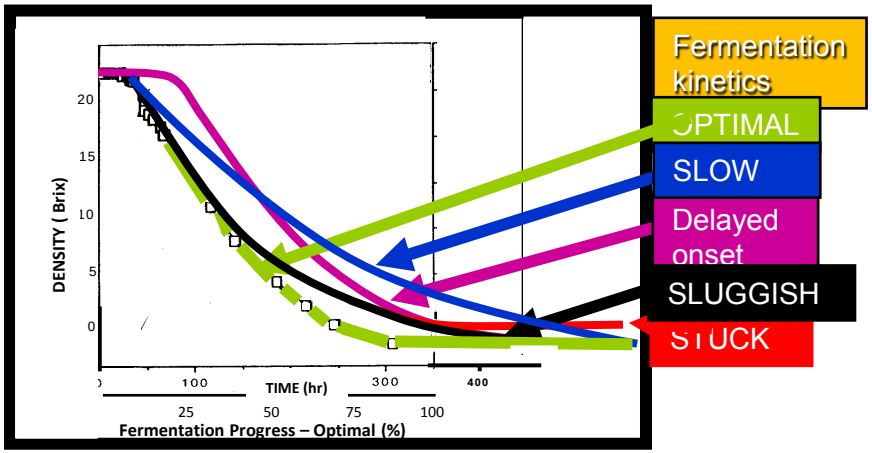
The Australian Wine Research Institute

Managing Stuck Fermentations and Rescue Procedures

Paul Henschke, and

AWRI Industry Development & Support team

- Con Simos
- Adrian Coulter
- Geoff Cowey
- Matt Holdstock



The problem of sub-optimal fermentation

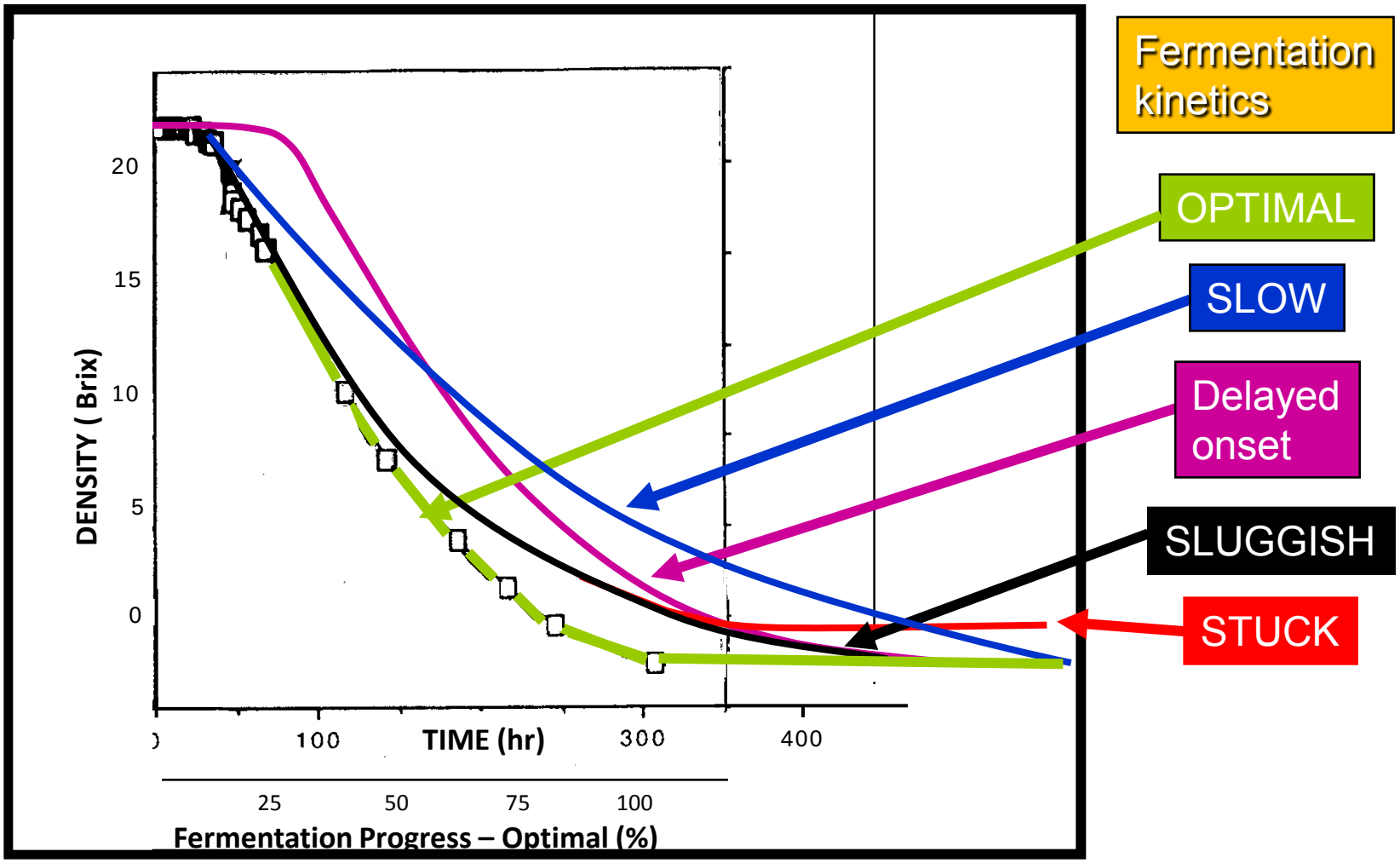
The Australian Wine Research Institute

- A common seasonal problem, but exacerbated by hot weather
- Affects most wineries at some stage, both in Australia and overseas
- White, red & sparkling wines, in tanks & barrels
- Multifactorial problem, including yeast, nutrients, toxic substances and fermentation conditions/management
- Most (all ?) yeast types are affected, including benchmark EC1118/PDM/Prise de Mousse
- Expensive in resources (time, energy, yeast, tank space) and potential loss of quality

>>> This talk contains practical information on how to reduce the risk and how to rescue a fermentation

Sub-optimal fermentation profile

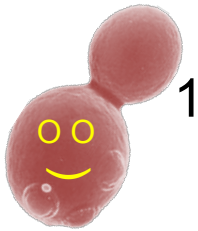
The Australian Wine Research Institute

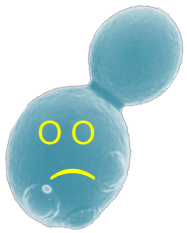


Environmental changes during fermentation - major stresses to which yeast must adapt

The Australian Wine Research Institute

Factor	Grape juice	Wine
Sugar (g/L)	180 – 260	0 – 4
Alcohol (% v/v)	0	10 – 16
Nutrients:		
YAN (mg N/L)	50 – 300	<50
Oxygen (ppm)	0 – 9	0
Conditions	***Nutrient rich***	***Nutrient poor*** ***High conc. toxic products***



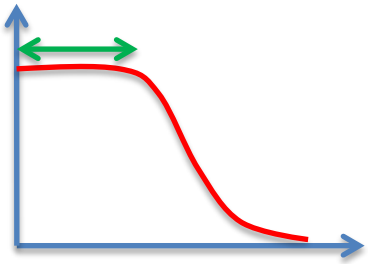


Failure to adapt results in sub-optimal fermentation

Causes of sub-optimal fermentation

The Australian Wine Research Institute

❖ Delayed onset of fermentation



Causes:

- Poor quality starter culture
  - Low viability or low cell count/inoculation rate
  - Poor physiological condition (low metabolic rate)
- High SO_2, resulting in growth inhibition until level of free SO_2 has decreased below a critical point

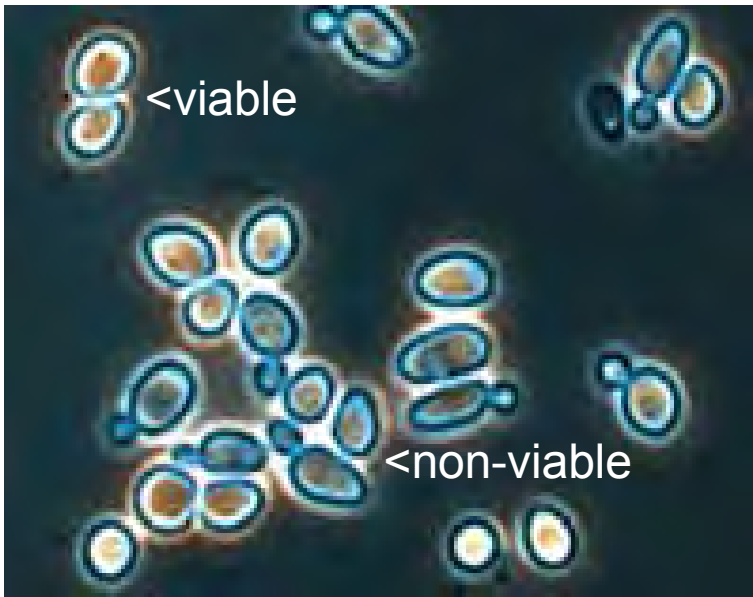
Diagnosis:

- Perform a microscopic cell count before & after treating the sample with vital stain, eg methylene blue (see Iland et al. 2007)
- Viability <75% indicates poor yeast culture or must toxicity, eg SO_2
- Measure must/juice SO_2; should be <10-15 mg/L free SO_2

Vital staining of yeast culture to assess culture health (viability)

The Australian Wine Research Institute

- Methylene blue is a dye that is used to differentiate live and dead yeast cells in a culture.
- Methylene blue is a redox sensitive dye, such that metabolically active cells reduce it to the colourless form; viable cells are highly reductive.
- Dead cells (non-metabolically active) stain blue, ie the oxidised form.
- Population viability is a strong indicator of culture health:
  - Healthy culture typically contains >95-98% viable cells
  - <75% viability indicates toxicity, which can lead to stalled fermentation

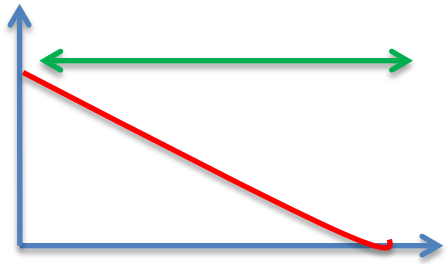


Consult Iland et al (2007): Microbiological analysis of grapes and wine: techniques and concepts

Causes of sub-optimal fermentation

The Australian Wine Research Institute

❖ Slow (continuously) fermentation



Causes:

- Low yeast biomass or cell number
- Low budding index
- Low level of key nutrient, typically YAN, O_2 or lipids

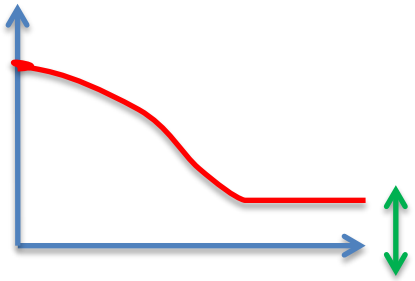
Diagnosis:

- Confirm by microscopic cell count:
  - 0% FP (Fermentation Progress) count should be >1-5x10^6 cells/mL;
  - 35% FP should exceed 50x10^6 cells/mL
- Measure juice/must YAN, should exceed 100-150 mg N/L
- Failure of aeration or grape solids addition to stimulate fermentation suggests deficiency of a key nutrient, eg YAN

Causes of sub-optimal fermentation

The Australian Wine Research Institute

❖ Sluggish & Stuck fermentation



Causes:

- Multifactorial problem

  Interaction between:

  1. yeast strain
  2. juice/must (nutrients, toxic substances) and
  3. fermentation conditions/management (under control of winemaker)

- Most yeast types are affected, including the industry benchmark strains EC1118 / PDM / Prise de Mousse

Diagnosis: complex & the subject of this talk

Sub-optimal fermentation kinetics
Risk Factors – common high risk factors

The Australian Wine Research Institute

Yeast-related factors
- incorrect choice (alcohol stress tolerance)
- poor quality starter culture
  - rehydration / reactivation
  - viability / vitality
- indigenous microflora (esp yeast & LAB)
- unsuccessful inoculation
- temperature stress
- vigour and sedimentation

Nutrient deficiency
- yeast assimilable nitrogen (YAN)
- phytolipids (grape solids – clarification)
- oxygen
- vitamins (thiamin)
- minerals (ie low K+ & pH)

Inhibitors
- high concentration of sugar (high Brix/Be)
- high ethanol
- fatty acids (acetic acid & mid chain length FAs)
- SO_2
- toxic (killer) proteins/other organisms
- residues (pesticides, cleaning agents)

Adapted from Henschke (1997)
ASVO Seminar Procs pp. 30-38,41

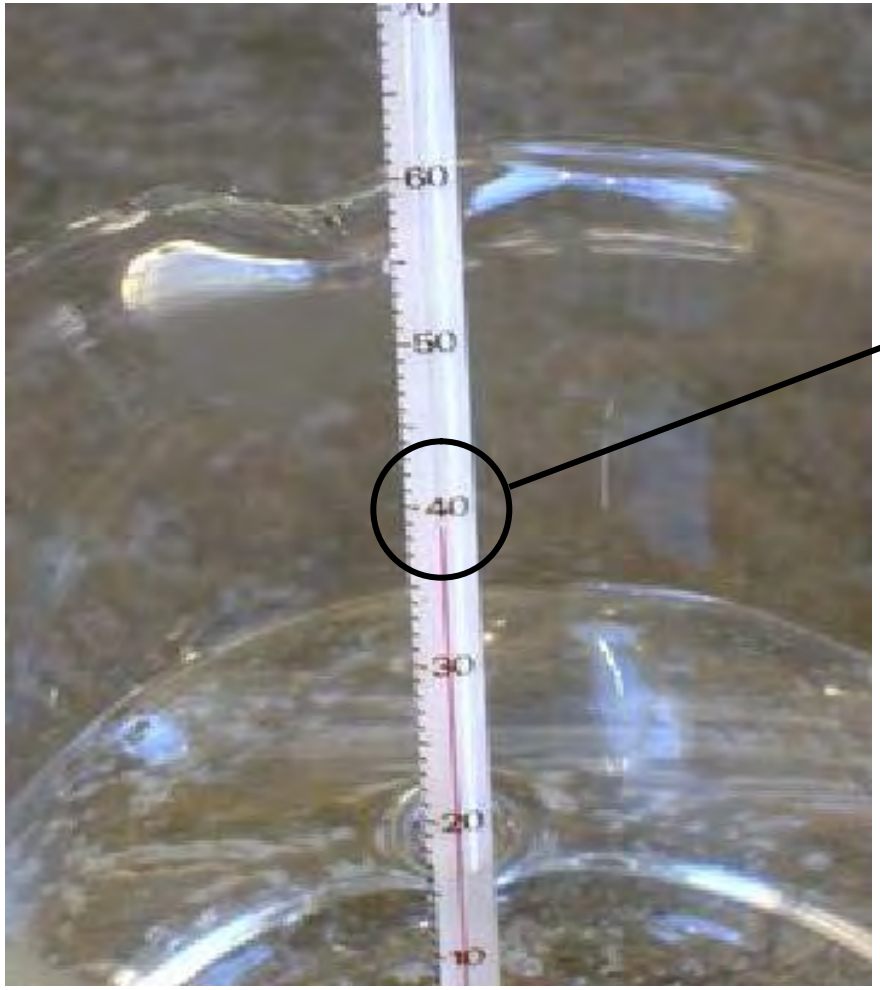
Active Dried Yeast
Rehydration/reactivation risk factors

The Australian Wine Research Institute

- Follow manufacturers instructions precisely
- Rehydration medium
  - Tap/Mineral water/Grape juice or diluted concentrate
  - Consider proprietary 'inactivated yeast' reactivation nutrients rich in sterols for high risk juices
    [ie high sugar (>13 Be), bright (low solids), low YAN (<150 mg/L), to be fermented cold (<15C)]
- Temperature of medium: 38-40 C unless specified
- Ensure yeast is correctly rehydrated
- Use within 30 min of rehydration
- Do not use expired stock

Hydration temperature is very important

The Australian Wine Research Institute



Critical
38 – 40 ° C

Hydration step – prevent ‘dry lumps’ of yeast

The Australian Wine Research Institute

Correct

Incorrect

Active Dried Yeast
Rehydration/reactivation risk factors

The Australian Wine Research Institute

- Add rehydrated yeast to pre-warmed juice (ie after cold settling or cold soak, preferably >15°C
- Step-wise cool reactivated yeast in 5-10°C steps at 5 min intervals by adding appropriate volumes of the juice to be inoculated for high risk juices (ie cold (<15°C), highly clarified, anaerobic, high sugar juice ferments)
- Ensure sufficient time has elapsed after SO_2 addition to must to avoid damaging yeast (<10 ppm SO_2 @ pH3.5) – consider adding a 'sacrificial culture' of about 15–20% of aerated active yeast (containing aldehyde) to the juice in order to bind SO_2 and other potentially inhibiting substances, about 30 min before inoculation

Fermentation Management

The Australian Wine Research Institute

- Add yeast hulls for high risk ferments (detoxification role)
- Allow ~10% of sugar to ferment before cooling
  - It is critical to build-up cell number (growing yeast - v. stress sensitive)
  - Do not cool in greater than 2-4° C increments
- Monitor fermentation progress & temperature daily
  - Spreadsheets provide an efficient record of fermentation data, comparison with similar ferments and early identification of problems
- Look for a steady fermentation rate; compare with previous data of similar ferments and/or previous years data to identify problems
- Cell numbers should reach 70 x 10^6 cells per ml for cellar bright juice ferments (determine with microscope and haemocytometer)
  - Monitor budding % as an indication of yeast growth or problems
  - Expect high % budding during first third stage of fermentation
  - Vital staining (eg methylene blue) is also a useful diagnostic for dead yeast cell estimation – check when fermentation rate becomes slow
  - **Also look for presence of (lactic acid) bacteria, which can adversely affect yeast activity and lead to fermentation arrest**

Optimising yeast inoculation

The Australian Wine Research Institute

Factors affecting yeast implantation

- Pure culture inoculation strategy
  - Maximising the benefits of selected yeast strains

❖ Minimise indigenous yeast population of must (<10^5 cfu/ml)

- Minimise must exposure to moderate-hot temperature, during harvest, transport, juice preparation (enzyme treatment, clarification, etc) which otherwise promotes indigenous yeast & bacteria growth

- Add sufficient SO_2 (50-100 ppm, depending on fruit condition) during machine harvest to limit indigenous microbial growth

- Clarification procedures can lower indigenous microbial growth

- High indigenous yeast count can indicate nutrient depletion – add nutrs.

❖ Recommended Inoculation rates

Under inoculation will compromise ability of culture yeast to dominate

- whites: 5 x 10^6 cells/ml (typically 250 g ADWY per kL juice);
- reds: 5 x 10^6 cells/ml ; lower rates can compromise yeast implantation (typically 200 g ADWY per Tonne must)

Nutritional deficiency risk factors

The Australian Wine Research Institute

- Yeast Assimilable Nitrogen (YAN)
  - A variable proportion of Australian juices/musts have inadequate YAN
  - Measure YAN on a grape maturity sample or juice sample
  - Low YAN (whites <150 mg N/L; reds <100 mg N/L) high risk slow/stuck ferm
  - Adjust with DAP (200 mg N/1g DAP) or proprietary N supplement
- Lipid deficiency (phytosterols and unsaturated fatty acids (UFA))
  - Over clarification removes lipids essential for yeast growth
  - i.e. when <0.1-0.5 v/v juice solids (ie 'cellar bright') or <5 NTU
  - Addition of "fine" settled grape solids highly stimulatory to yeast growth
  - Avoid "hard" settled grape solids, which can impart phenolic coarseness, hotness, bitterness to wine
  - Rehydrate yeast with proprietary inactivated yeast product rich in sterols
- Dissolved Oxygen (dO_2)
  - dO_2 is highly variable in juice/must – ranging 0 – 8 ppm (air-saturated)
  - Aerating fermentations at least once, at the stage when they are most active (during fermentation of 35-50% sugar) is highly beneficial
  - Aerate to give max ~5 ppm oxygen (sparge, pump over, rack-return, etc)
  - Oxygen alleviates yeast REDOX imbalance & stimulates sterol formation

Nutritional deficiency risk factors

The Australian Wine Research Institute

❖ Vitamins

- Vitamin status of Australian musts/juices is unknown
- **Thiamine** - essential for ethanol production by yeast

  - **major losses caused by high SO_2 use and wild yeast growth** (ie during transport or must processing)

- Vitamins (thiamine, niacin, biotin, pantothenate, pyridoxine, inositol) can be added to starter cultures under ANZFA Wine Regulations
- Some proprietary yeast foods provide a useful source of vitamins

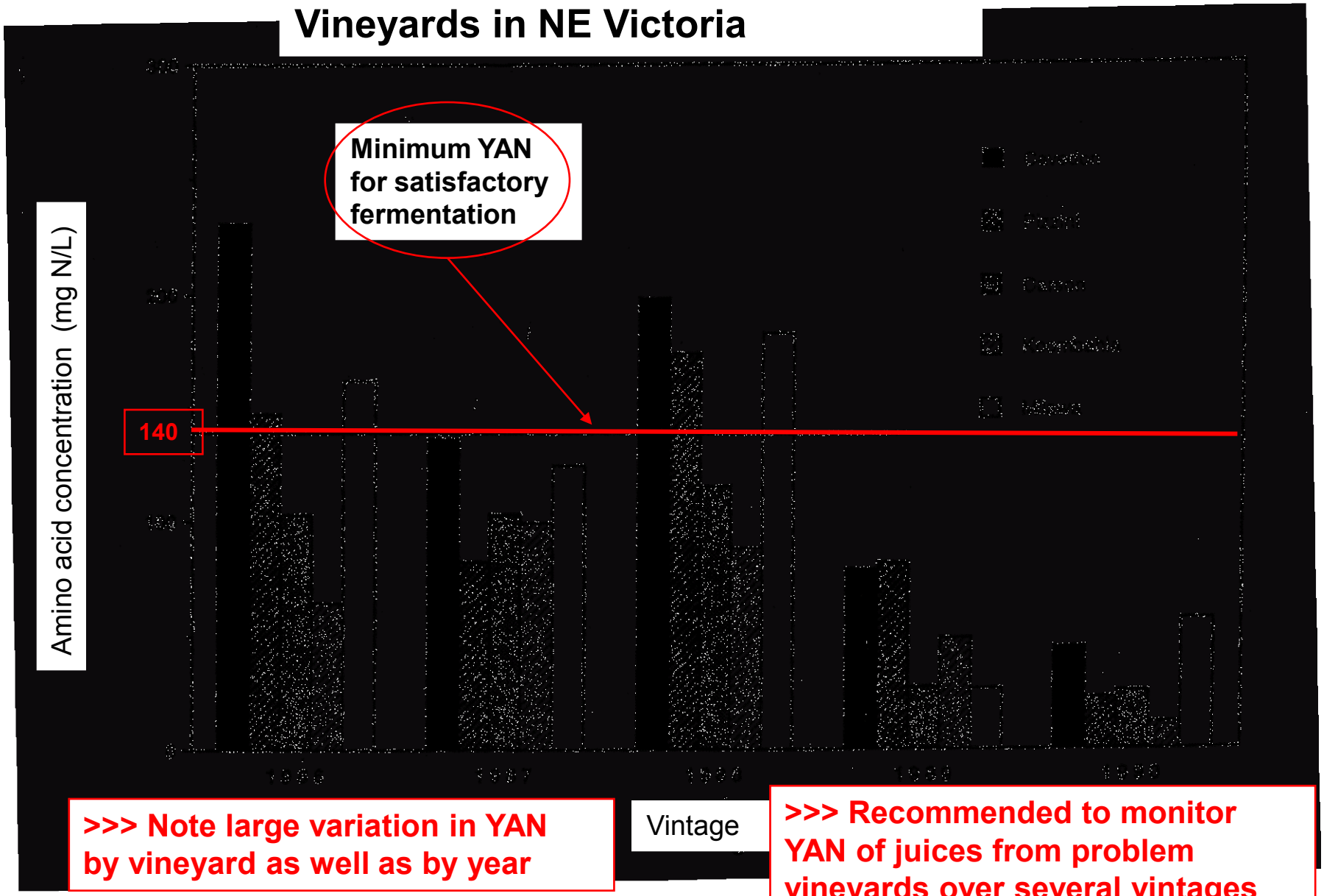
❖ Minerals

- Mineral status of Australian musts/juices poorly known (see Schmidt et al 2010)
- **Phosphate – normally considered adequate; can be added with DAP**
- **Low K^+/Low pH** - stuck ferms with some yeast strains (sparkling/tirage or early harvest must)
- **Magnesium, zinc, manganese, which are enzyme co-factors are thought to be sub-optimal** (these cannot be added under ANZFA Wine Regulations)
- Some proprietary yeast foods provide a limited source of minerals and can be beneficial

❖ Low YAN juices/musts

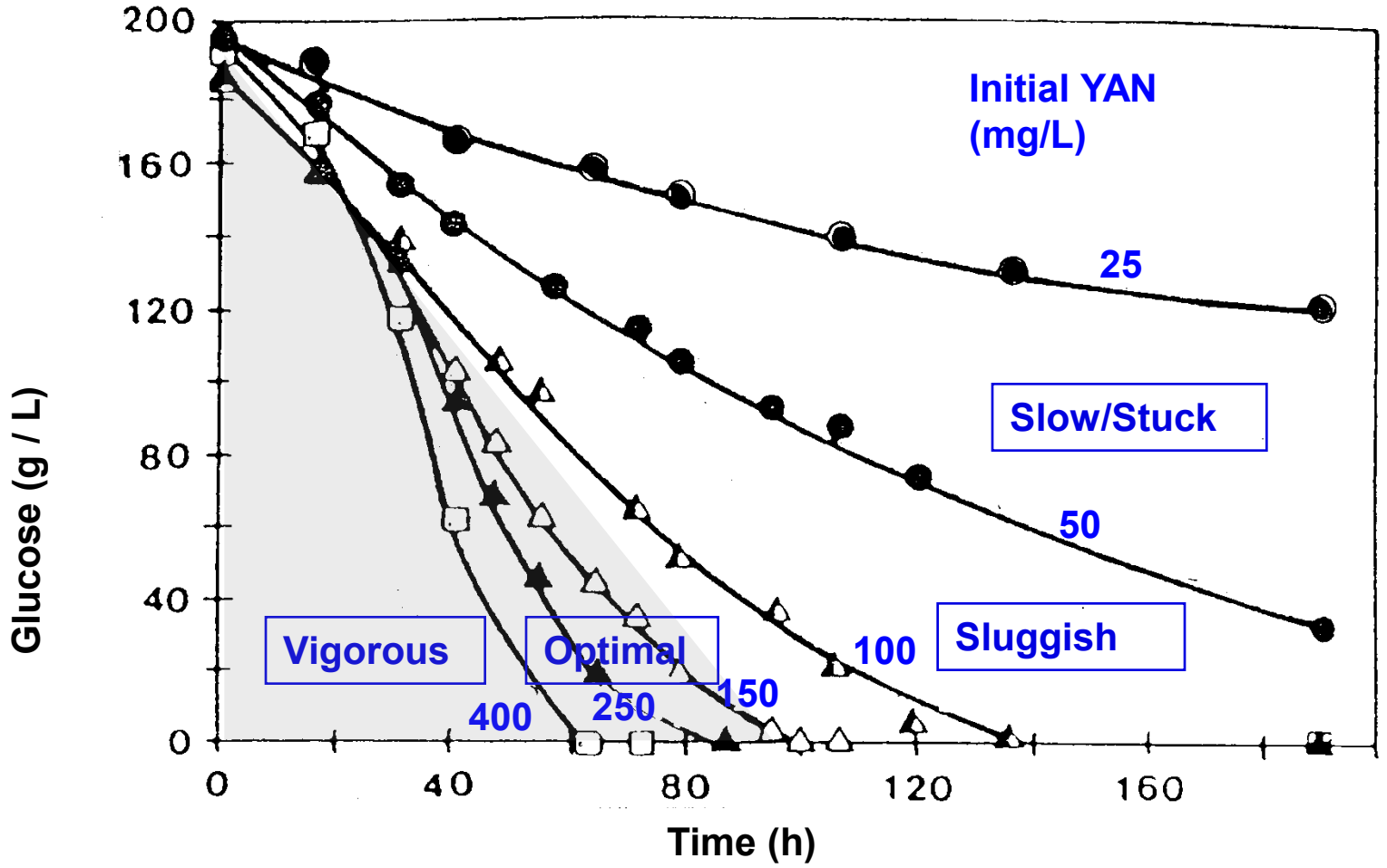
- Low YAN musts can also be suboptimal in other nutrients
- **Useful to add proprietary inactivated yeast nutrients to yeast starter cultures when deficiencies are suspected, especially to difficult to ferment juices/musts**

Vineyard & Year effect on juice YAN



Fermentation response to YAN

Synthetic juice ≡ 'cellar bright' juice
All other nutrients are adequate, representing Nitrogen-limited growth



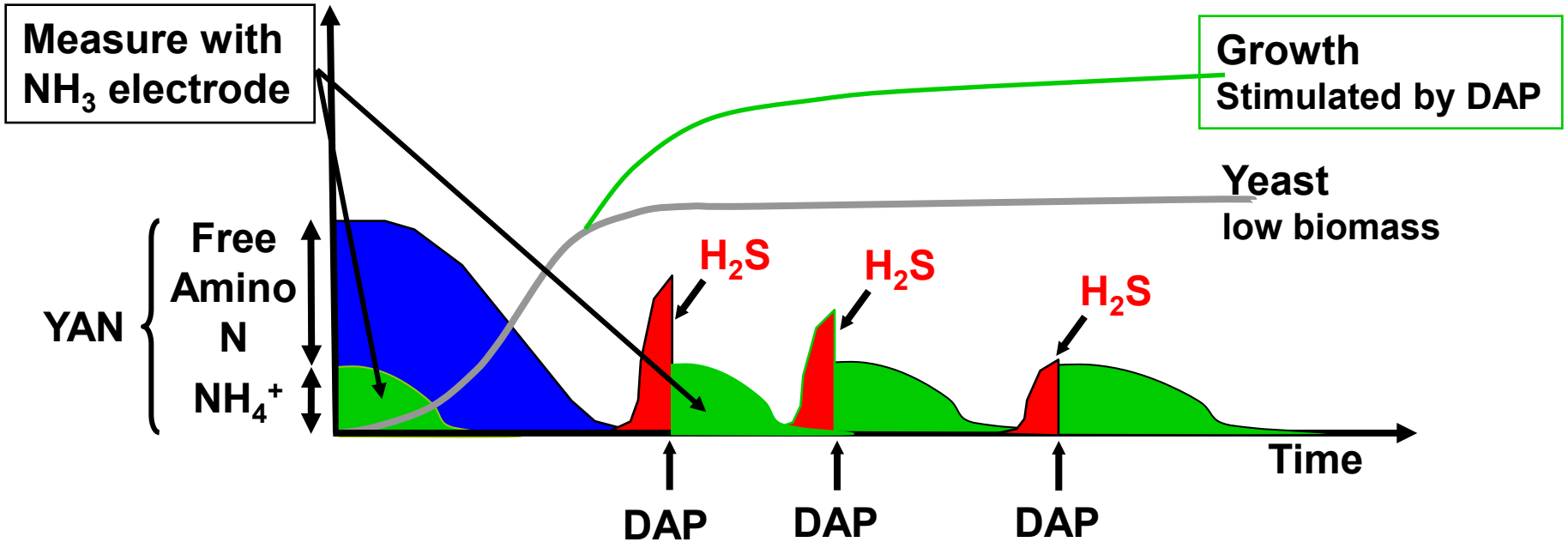
>>> Low YAN - slow/stuck fermentation
Excessive YAN – too vigorous

Sourced from Salmon (1989)
Appl. Envir. Microbiol. 55:953-958

Nitrogen utilisation – Low YAN fermentation
Risk of H_2S as well as slow fermentation

The Australian Wine Research Institute

Low Nitrogen (<200 mg N/L)
Low biomass increases risk of slow/stuck fermentation and H_2S production



- Inverse relationship between Initial YAN and H_2S production
- Initial YAN should exceed 250 mg N/L YAN to prevent H_2S

but H_2S profile depends on yeast strain X juice/must interactn

- Not all Yeast H_2S responds to DAP; could be a vitamin deficiency?

YAN Requirements of Yeast

(depends on yeast, solids content, fermentation conditions & wine style)

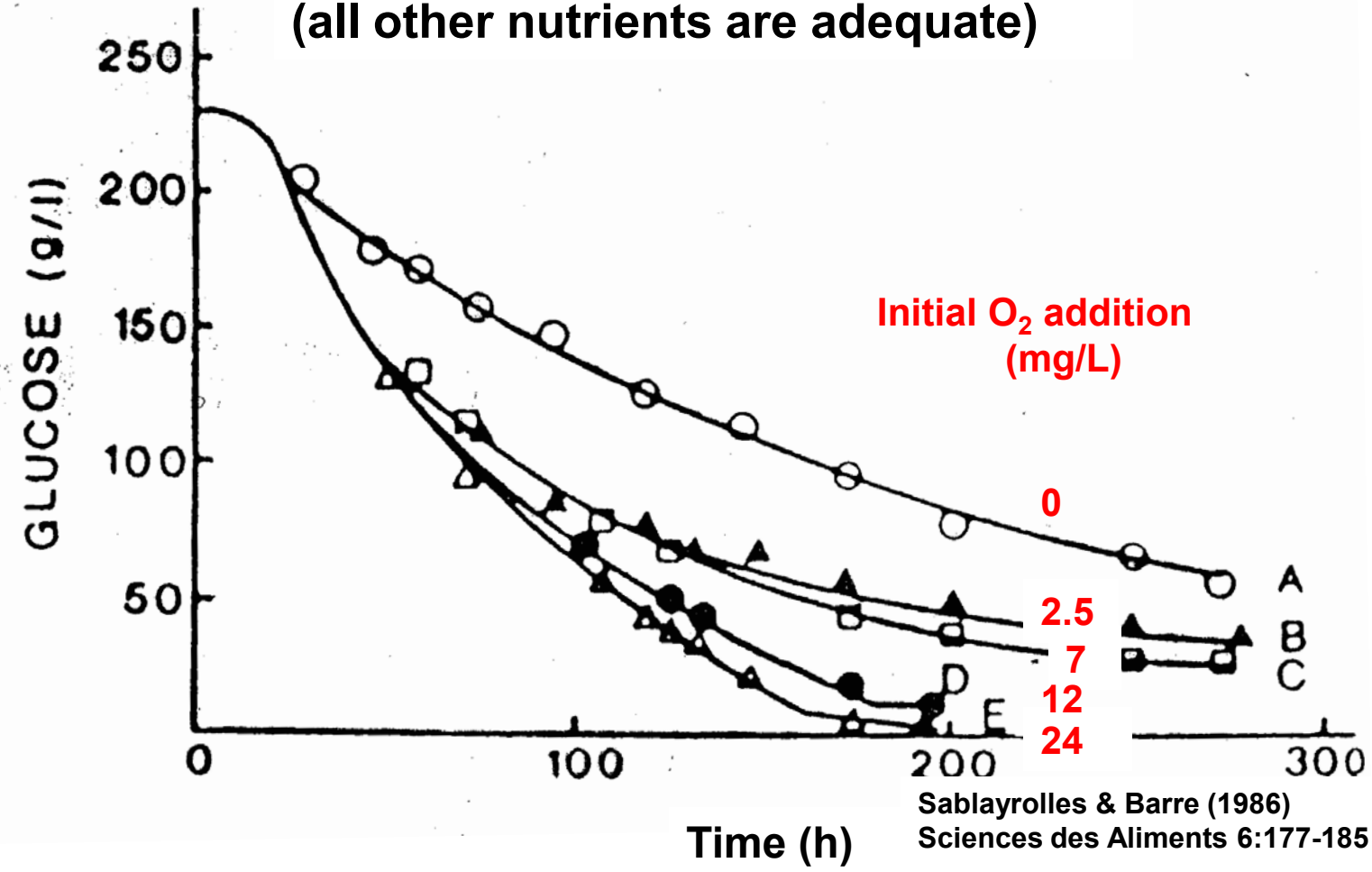
The Australian Wine Research Institute

1. **Maximum N demand:**
   Mean = 400 mg N/L
   Range = 330 – 470 mg N/L
2. **Minimum YAN requirement**
   Whites (clarified) – approx. 150 mg/L
   Reds (high solids) – approx. 100 mg/L
3. **Minimum YAN to prevent H_2S**
   approx. 250 – 350 mg/L (yeast x must dependent)
4. **Optimum flavour formation (YAN & DAP affects ester prod^n)**
   Whites (strong style effects – complex thr' to fruity)
   – Chardonnay – fruity: 250–350 mg/L; <200: complex
   – Sauvignon Blanc – ? mg/L
   – Reds – fruity: 250–350 mg/L ; <200: complex

Fermentation response to O_2

The Australian Wine Research Institute

Synthetic juice ≡ 'cellar bright' juice
(all other nutrients are adequate)



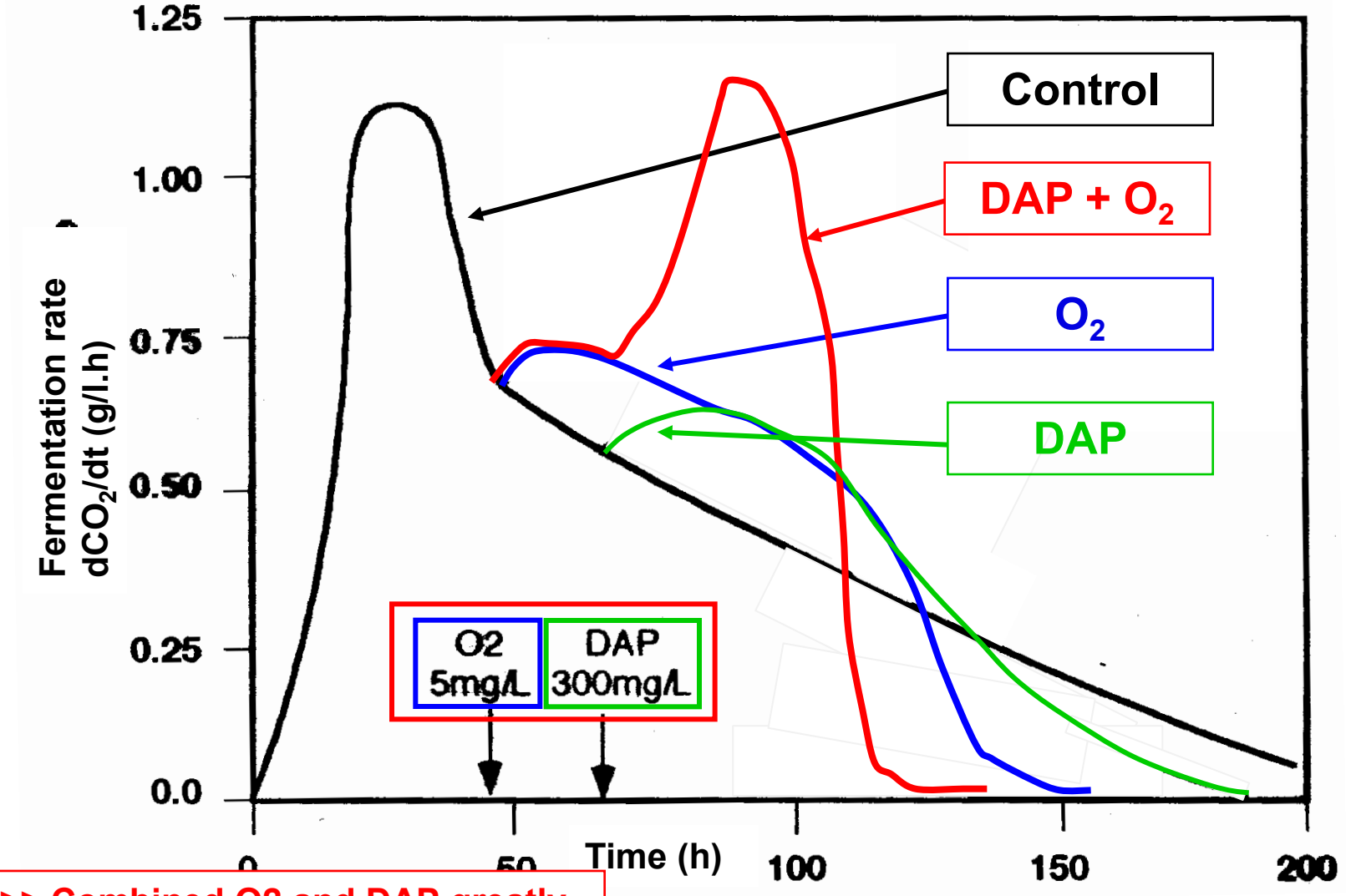
Sablayrolles & Barre (1986)
Sciences des Aliments 6:177-185

>>> Oxygen stimulates fermentation rate and is shown to prevent most suboptimal ferments

Combined effect of DAP + O_2 on fermentation

Nutrient strategy for stimulating fermentation

The Australian Wine Research Institute



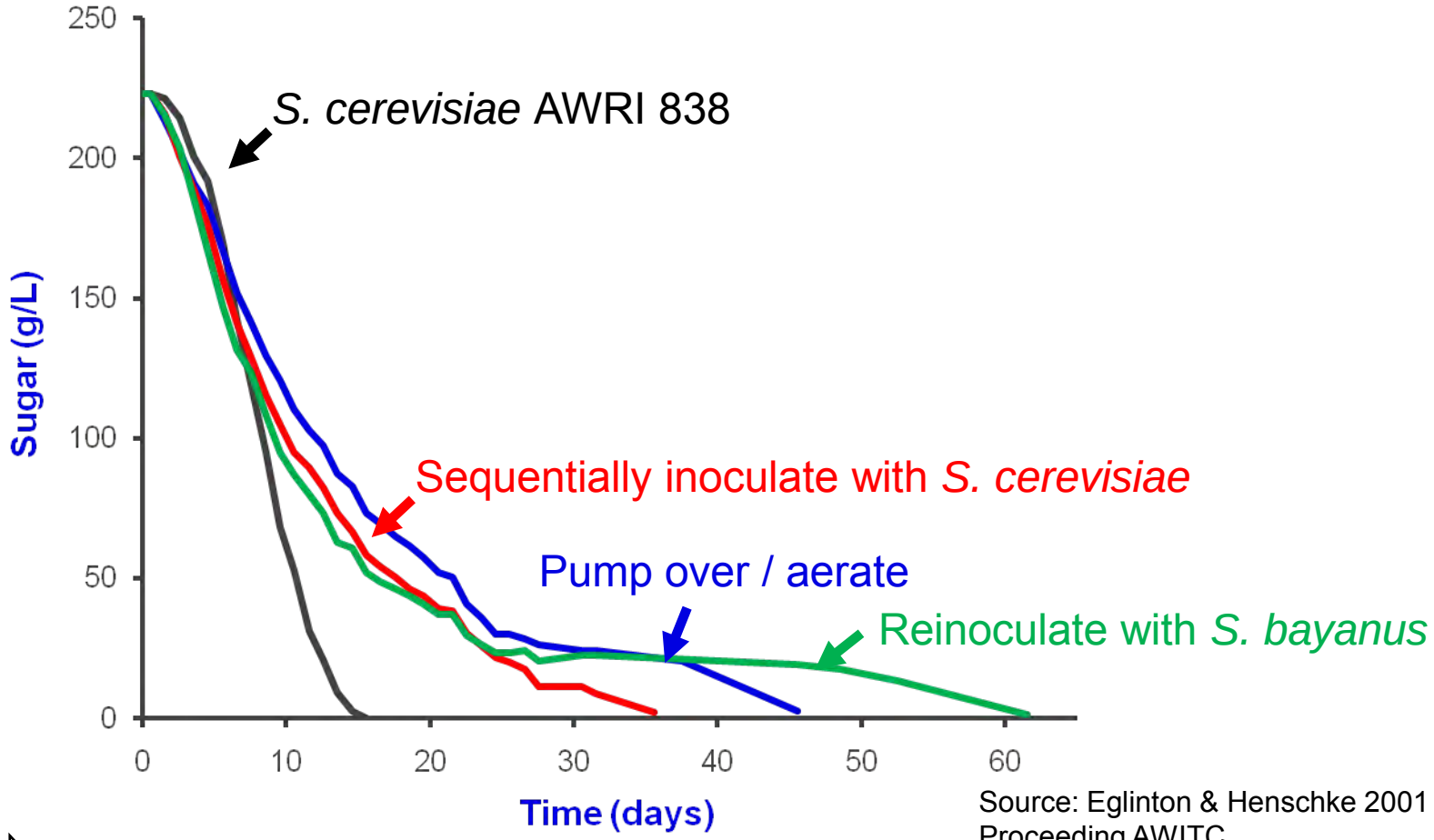
>>> Combined O2 and DAP greatly stimulates fermentation rate

Sablayrolles, Dubois, Manginot & Barre (1986)
J. Ferment. Bioeng. 82:377-381

Practical strategies for ensuring a complete fermentation with low vigour yeasts

eg S. bayanus AWRI 1375

The Australian Wine Research Institute



Source: Eglinton & Henschke 2001 Proceeding AWITC

All treatments tested promoted refermentation and had no signif. sensory affects

N.B. Rescue cultures were prepared by AWRI step-wise acclimatisation procedure

Juice Clarification affects Fermentation Rate and Wine Residual Sugar

The Australian Wine Research Institute

Ferment rate	Wine residual sugar	Clarification treatment (turbidity)
Highest	Lowest	Cold settled
		Bentonite treated and settled
		Enzyme treated and settled
		Centrifugation, 10 min at 1500g
		Coarse filtration
		Centrifugation, 20 min at 10000g
Lowest	Highest	Fine filtration (eg Sietz EK)

High clarity enhances varietal character BUT increases fermentation risk
Therefore, turbidity is adjusted to balance yeast performance and flavour

Inhibitory substances – risk factors

The Australian Wine Research Institute

- **Ethanol – probably largest cause of stuck ferments**
  - inhibition is strain dependent: growth at 8-12%, fermentation at 12-16%
  - **determined by grape maturity at harvest**
- SO_2
  - strain dependent inhibition, typically >10 mg/L free SO_2 at pH 3.5
  - cell death at 45 mg SO_2/L at pH 3.5 (0.8 mg/L mol. SO_2)
- Fatty acids (FAs) (good hygiene / aerate ferments)
  - acetic acid: yeast growth inhibited at >1.5 g/L at 8% EtOH
    fermentation inhibited at 3-4 g/L
  - aliphatics (C6, C8, C10 FAs): ca. >3 mg/L at 10% EtOH
- Toxins (low risk except for lactic acid bacteria infection)
  - yeast toxins most active in low solids (bright) ferments
  - Do not coinoculate non-killer with killer wine yeast
  - **some Lactobacillus toxins can inhibit ferm. (high or low solids) check microscopically for lactic acid bacteria**
- Agrochemical residues (very uncommon)
  - copper oxychloride 10-15 mg/L
- Residues of winery sanitisers (uncommon)
- **Yeast hulls can be used as a broad spectrum detoxification additive**

From: Henschke (1997) ASVO Seminar Procs pp. 30-38,41

Fermentation management – Risk factors

The Australian Wine Research Institute

Temperature stress

Do not commence cooling until 10% sugar fermented
Excessive temperature (32-35 ºC depend on [EtOH]) can inactivate yeast
Over-cooling for particular yeast (non-cryophilic) / may need to use methods to maintain yeast in suspension if T<13-15 ºC
Excess heating or cooling (transition exceeding 5 ºC)
Cooling preferably should be <3 ºC per day to avoid yeast stress during growth

Vigour and sedimentation (flocculation)

Yeast sediments in low vigour ferments (CO_2 bubbles keep yeast in suspension and assists ferment circulation)
Physical stirring can help prevent sedimentation
Avoid flocculating strains in cool, cellar bright, anaerobic, high sugar ferments

Grape solids – avoid over-clarification

Beneficial to wine style but deprives yeast of key nutrients
Lipids increase yeast tolerance to ethanol stress – consider adding cold-settlings to increase turbidity

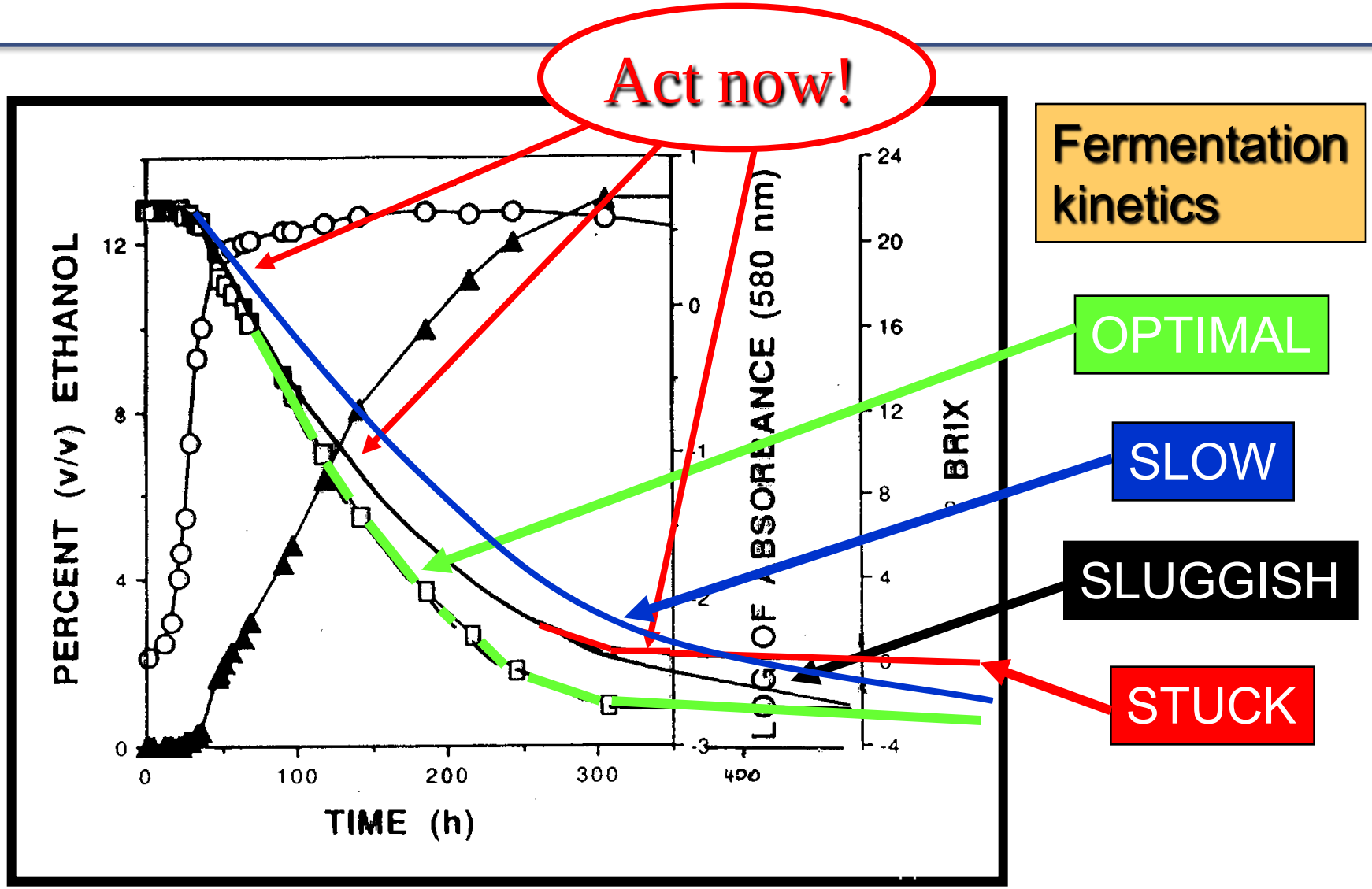
Nutrients

If known or suspected lack of nutrients (especially YAN and O2) recommend aeration (ca. 5 ppm O_2) and adding 300 mg/l DAP at 30-50% fermentation progress; yeast hulls and proprietary ferment nutrients can be beneficial

Henschke (1997) ASVO Seminar pp. 30-38,41

Problem fermentations

The Australian Wine Research Institute



Take corrective action early

Choice of rescue procedure

The Australian Wine Research Institute

If ferment stops with <10 g/L residual sugar and the alcohol content is <12 % v/v:

- **Then recommend** preparing a starter culture in grape juice with a recommended yeast. This procedure is relatively quick and will produce moderate tolerance to alcohol / fresh yeast sediments from active ferments can also prove successful

- **Otherwise** use a rescue culture prepared by stepwise acclimatisation of a recommended rescue yeast. This procedure builds tolerance to the toxic substances present in the problem ferment

AWRI Rescue procedure – key factors

The Australian Wine Research Institute

- Use high yeast rate 500 mg/L (EC1118, PDM, Uvaferm 43 are successful – consult yeast supplier)
- Rehydrate with sterol-rich reactivation nutrient
- Don't let culture run dry – go onto next stage when 50% of sugar has gone (monitor with hydrometry)
- Add DAP/Yeast hulls and aerate once culture is active
- Treatment of stuck wine before adding rescue culture:
  - Measure YAN and add DAP if necessary
  - Adding yeast hulls/ferment nutrients can be beneficial
  - If bacteria present treat stuck wine with SO_2
  - Rack or centrifuge stuck wine (remove dead yeast)
- Add wine to culture, rather than culture to wine
- Avoid temperature shock / Keep yeast in suspension
- Limited aeration beneficial only when yeast are active
- Keep good records

Yeast acclimatisation procedure for restarting difficult and stuck ferments

(See AWRI Website for details)

The Australian Wine Research Institute

Procedure for 1000 L of ferment

Stage	Function		Cumulative volume
1	Preparation of rescue culture		20 L
2	Acclimatisation		
	Step	Proportion of ferment	
	1	50%	40 L
	2	75%	80 L
	3	88%	160 L
	4	94%	320 L
3	Inoculate problem ferment		1020 L

Adapted from Henschke (1997)
ASVO Seminar Procs pp. 30-38,41

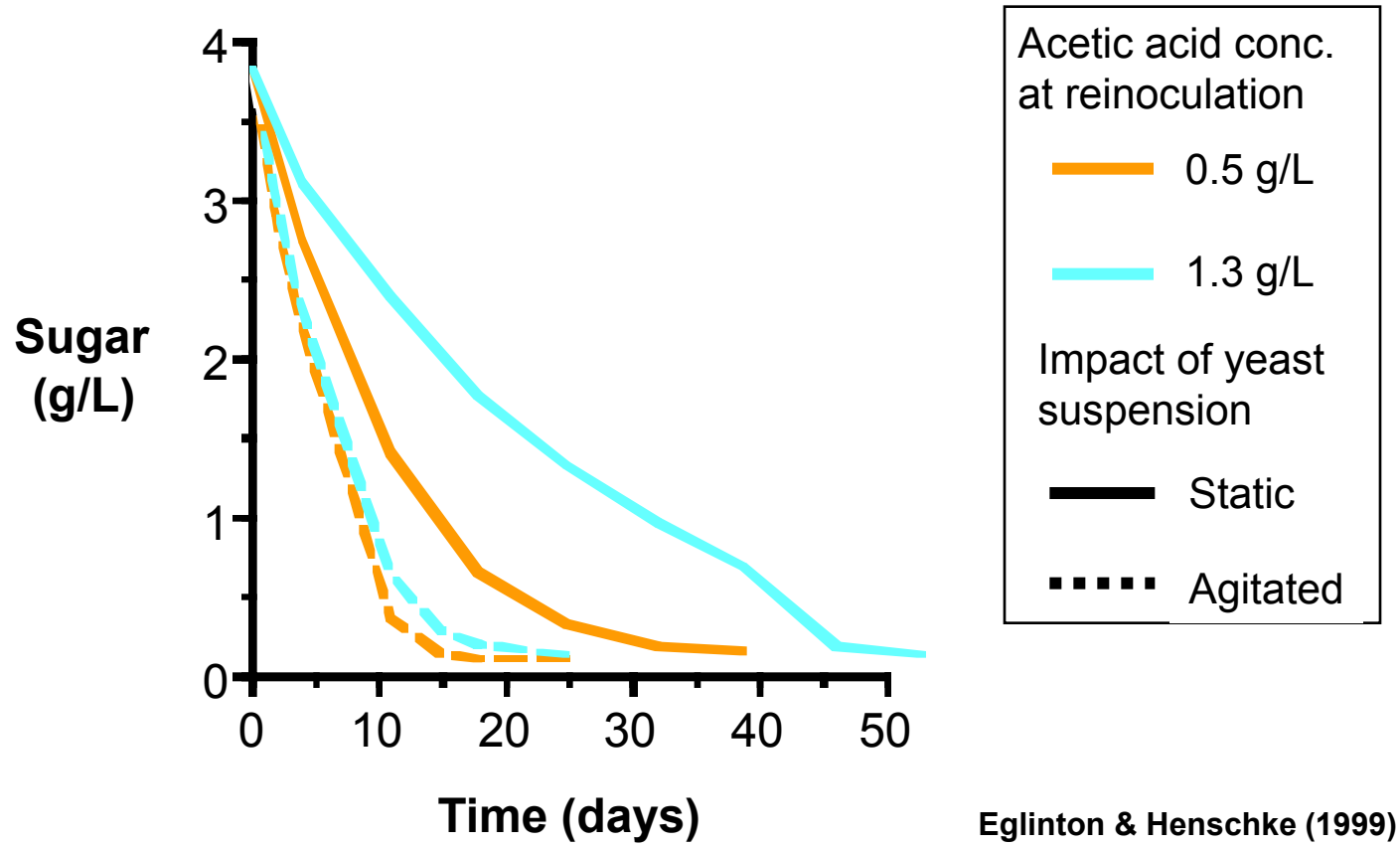
Important principles of rescue procedure

The Australian Wine Research Institute

- Stepwise acclimatisation of yeast to toxic substances of the problem ferment – if possible, incrementally add the ferment to the culture rather than the culture to the ferment
- No sugar depletion stress
- No nitrogen depletion stress
- Aeration yeast during acclimatisation procedure
- Keep yeast in suspension - agitation prevents nutrient starvation stress

Agitation aids refermentation

The Australian Wine Research Institute



Eglinton & Henschke (1999)
***Aust. J. Grape Wine Res.* 5:71-78**

>>> When restarting fermentation, important to keep yeast in suspension by physical means until CO_2 production commences, which then maintains yeast in suspension

For more information

The Australian Wine Research Institute

- **AWRI website – wealth of practical information**
- **ASVO seminar proceeding (1997) papers by: Henschke, Monk & Four industry practitioners**
- **Industry Services Group ; AWRI Technical Note 05 (updated 2013)**
- **Contact AWRI Industry Development & Support team: Con Simos, Adrian Coulter, Geoff Cowey, Matthew Holdstock for technical advice**

Acknowledgments

Peter Leske (former AWRI team leader)/Peter Godden (IA Team)

Wine Microbiology team:

Simon Schmidt, Radka Kalouchova, Paul Chambers , Paul Henschke

(former members: Jeff Eglinton, Holger Gockowiak, Nancy Davis and Lisa Buckingham)

Research at The AWRI is supported by Australia's grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

GWRDC GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

A W R I

The Australian Wine Research Institute

Using timing of MLF inoculation to optimise your winemaking

Will I get a quicker MLF?

How can I use MLF on sensory attributes?

Peter Costello

Research Scientist

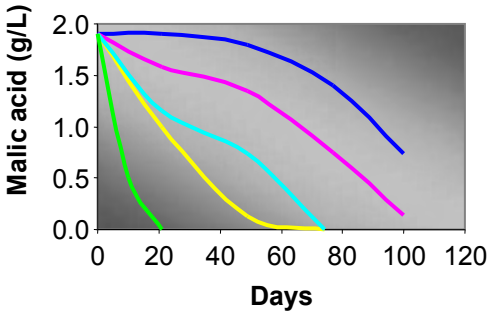
Eveline Bartowsky

Senior Research Microbiologist

What is a successful MLF?

The Australian Wine Research Institute

- MLF ...
  - Reduce wine acidity
  - Microbial stability
  - Sensory changes
- When can it occur?
  - Spontaneous
  - Inoculated



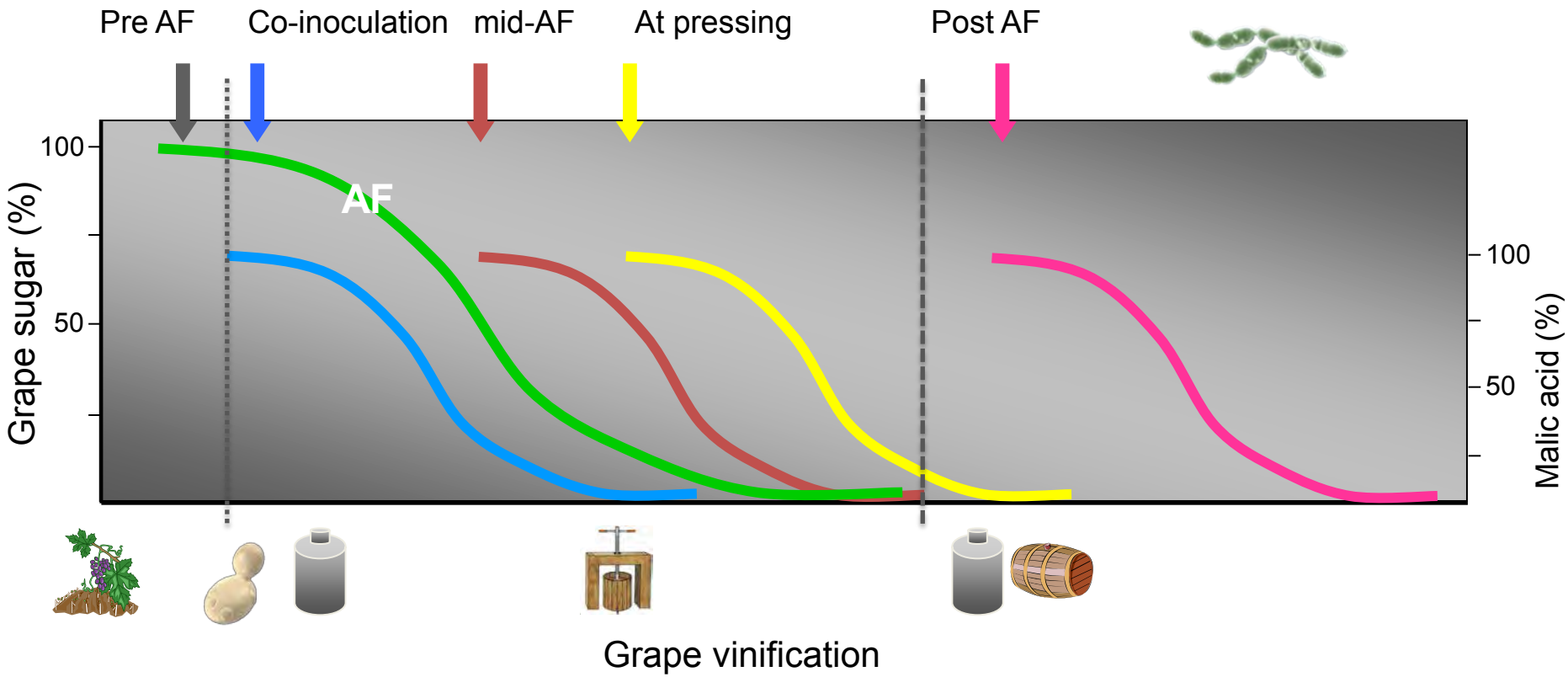
- Sensory impact
  - Buttery character
  - ↑ fruity & ↓ vegetative characters
  - Improved mouthfeel

- Delayed/failed MLF
  - Can increase the risk of wine spoilage, especially Brett & biogenic amines

MLF is generally more difficult to manage that AF

What are my options for MLF inoculⁿ ?

The Australian Wine Research Institute



What are my options? *Considerations*

The Australian Wine Research Institute

With AF (Co-inoculation/simultaneous)	Concerns
More nutrients (juice-derived) available	Acetic acid production
EtOH at lower concentration; consider SO_2	Antagonistic problems with yeast & bacteria
Could be more rapid	May lead to yeast arrest
Inoc. at pressing	
EtOH still lower concentration	
Ferment is still warm	
After AF (sequential inoculation)	
Yeast lees interactions	Antagonistic problems with yeast & bacteria
Less risk of VA	Nutrients depleted
Less risk of sugar metabolism by bacteria	
Sensory modifications	
Better temperature control	

It all comes down to …

- What do you want from MLF
- Wine Style

Co-inoculation

The Australian Wine Research Institute

- Concerns
  - VA production during AF by the bacteria
  - The yeast will stop fermenting
  - Wine colour affected
- What are some sensory consequences
- *Examples examining these questions*
  - Cabernet Sauvignon, Shiraz, and Chardonnay

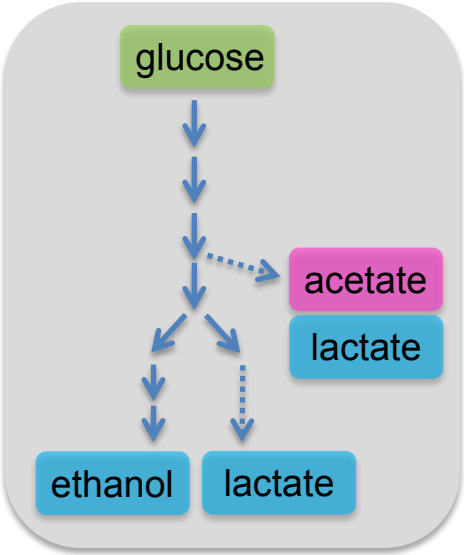
Co-inoculation concerns

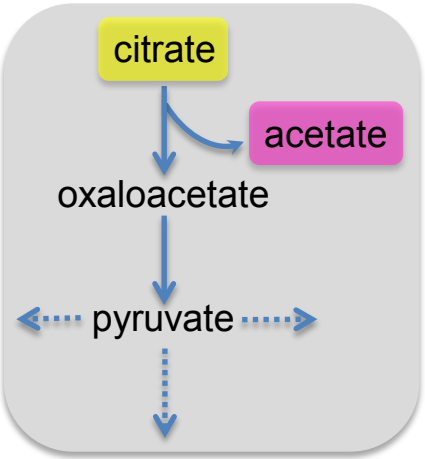
- VA production by the bacteria during AF
  - Very much linked to metabolism and grape must pH

O. oeni metabolism & pH

The Australian Wine Research Institute

- ***O. oeni***
  - Heterolactic fermentation = lactate + CO_2, acetate & ethanol
- **Acetate formation from glucose metabolism**
  - Reductive conditions
    - Produce EtOH in preference to acetate (NAD^+ balance)
  - Oxidative conditions
    - Acetate produced (↑ ATP)
- **Glucose & fructose metabolism in *O. oeni;* pH-dependent**
  - Higher pH
    - Utilise sugars after organic acids
  - Lower pH
    - Preferentially use organic acids (ATP gain)
- **Citric acid metabolism**
  - Always gives rise to acetic acid (VA)

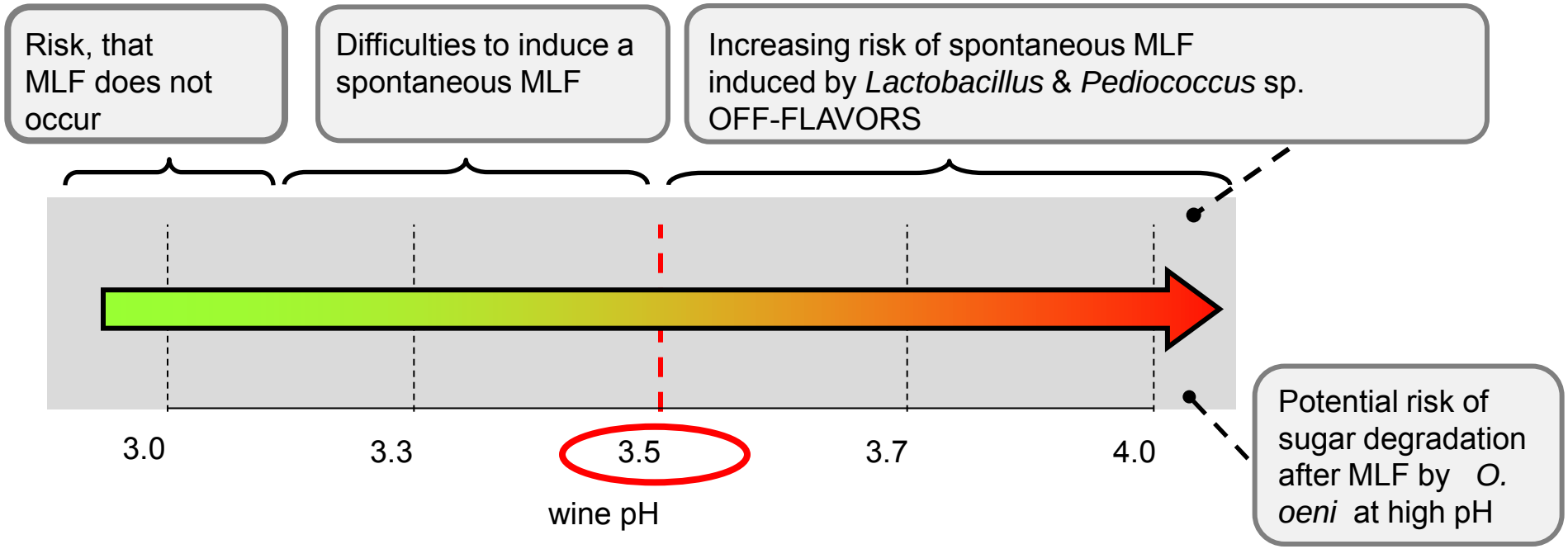




Co-inoculation concerns

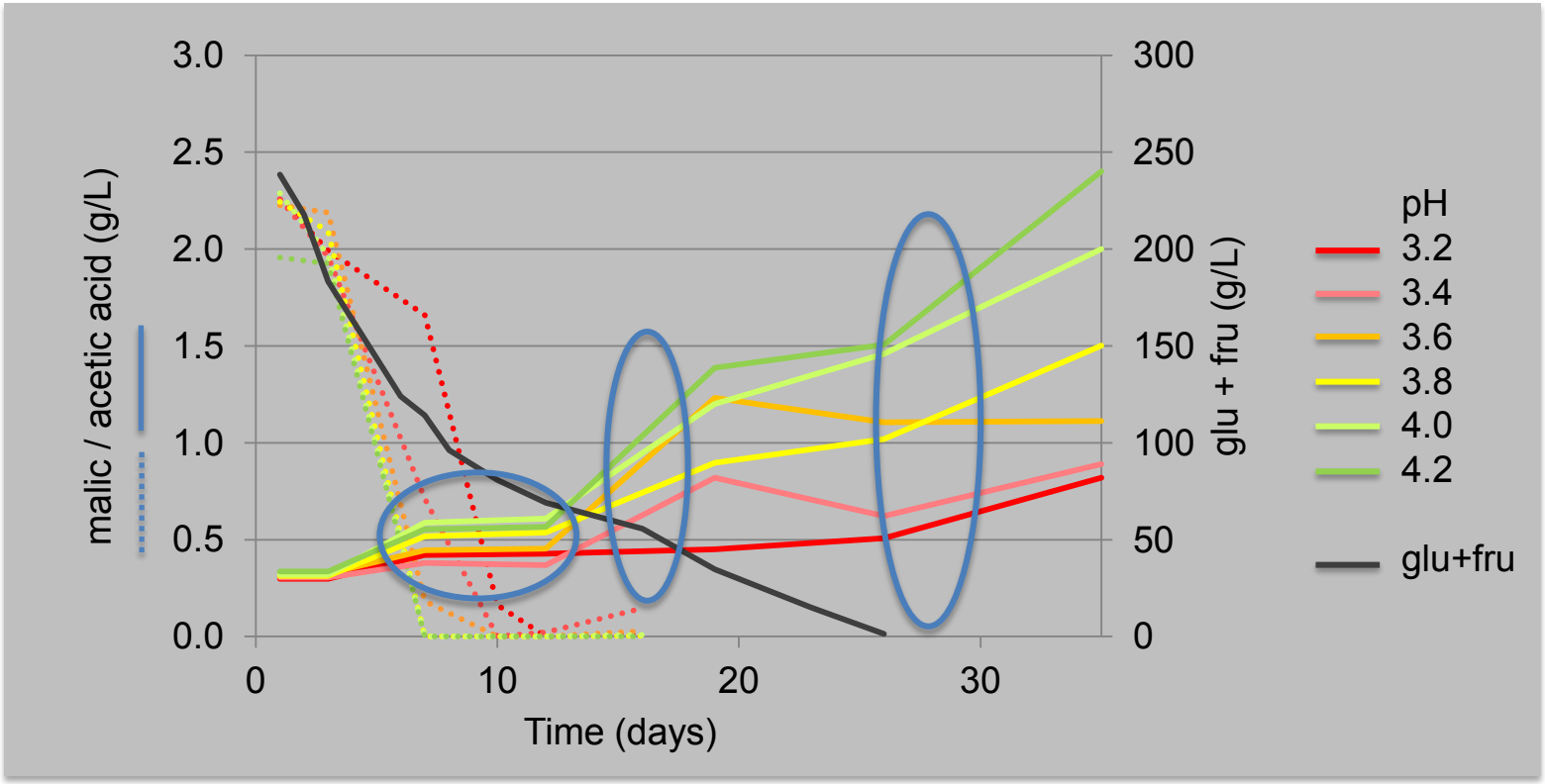
The Australian Wine Research Institute

- VA production by the bacteria during AF
  - Very much linked to metabolism and grape must pH



Co-inoculation & Acetic acid - effects of pH

The Australian Wine Research Institute

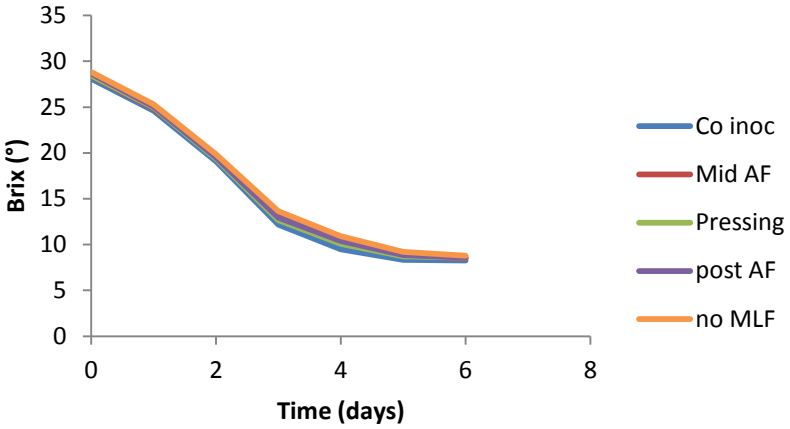


Chardonnay, 2008
Eden Valley
230 g/L glu+fru

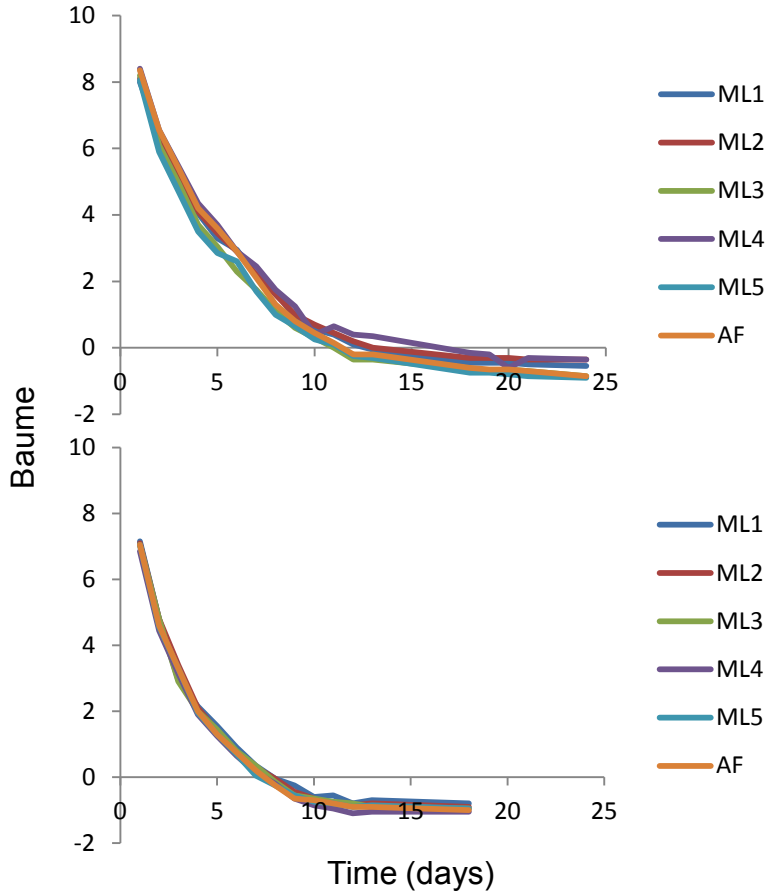
Co-inoculation

The Australian Wine Research Institute

- Will the yeast will stop fermenting ?



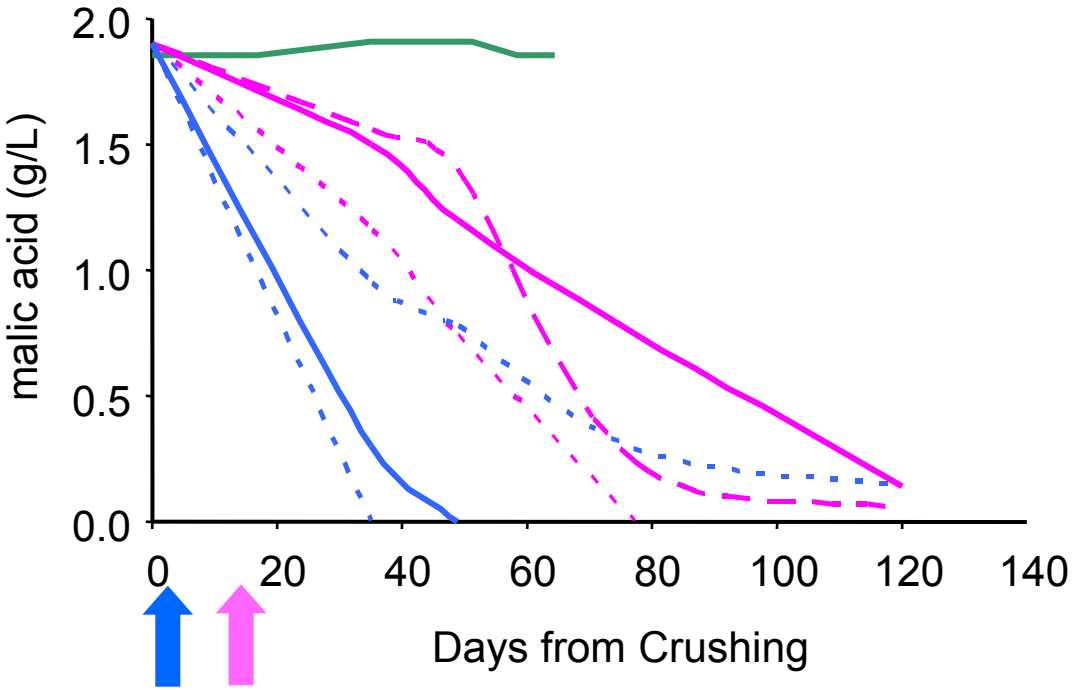
Shiraz (2008)
Clare Valley



Chardonnay (2011)
Barossa Valley

Example: Cabernet Sauvignon

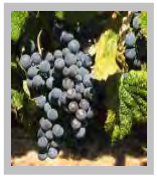
The Australian Wine Research Institute



Co-inoc

Sequential

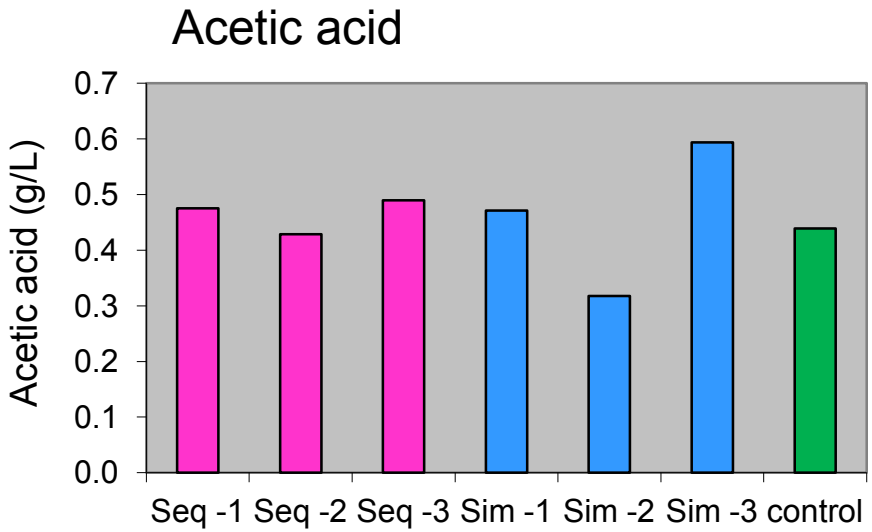
AF

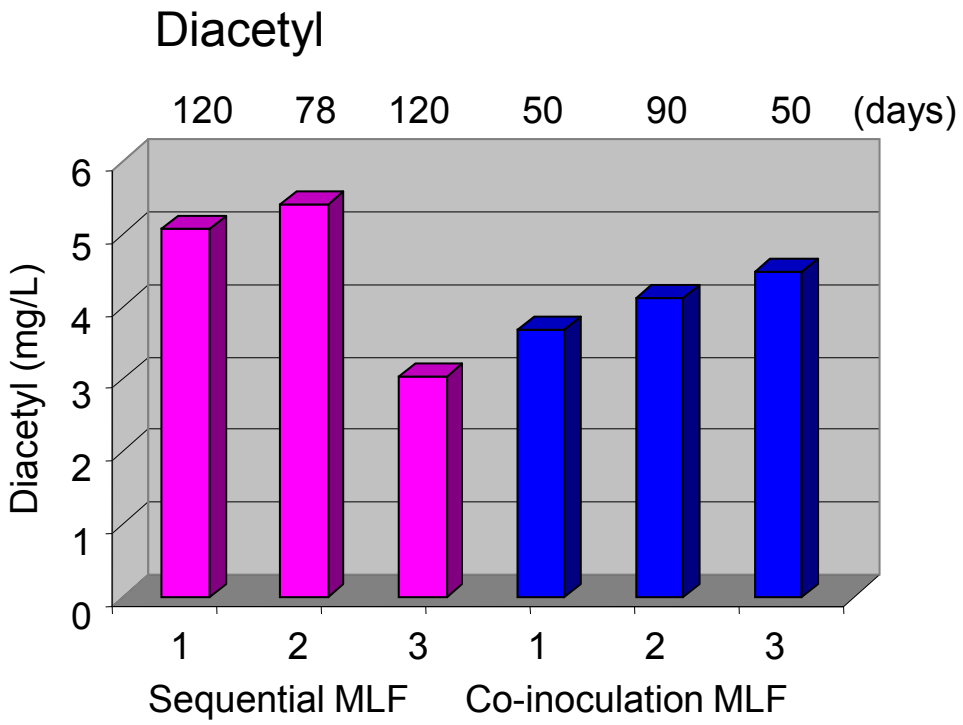


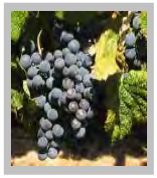
Cabernet Sauvignon
2006
Bordertown

Cab Sauv: Acetic acid & diacetyl

The Australian Wine Research Institute





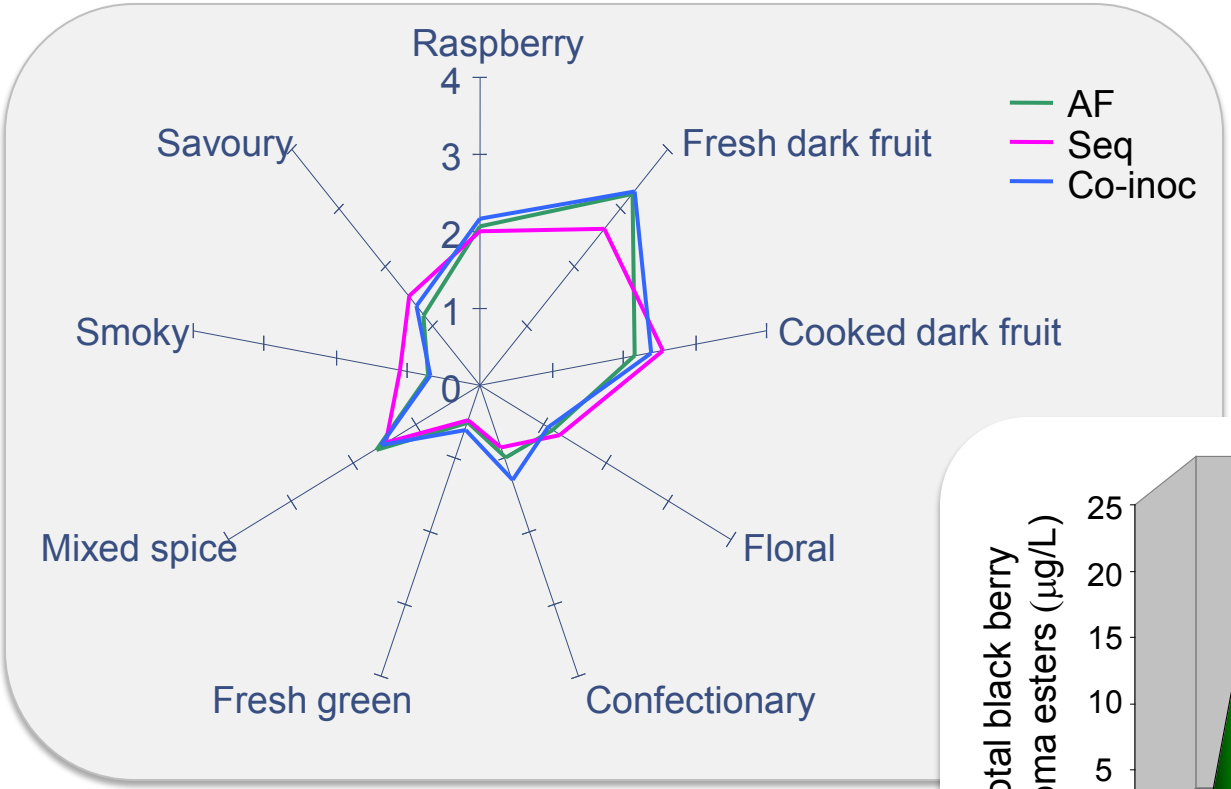


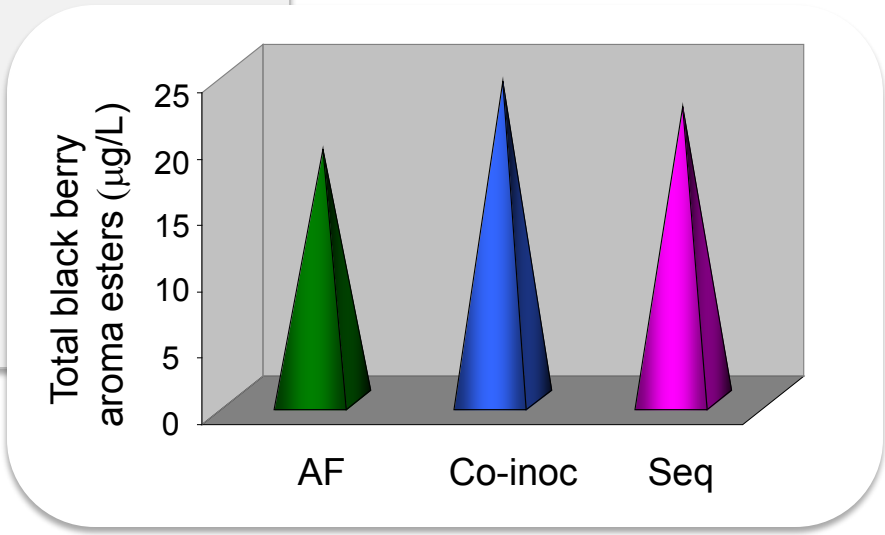
Cabernet Sauvignon
2006
Bordertown

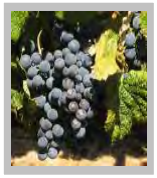
Tend to have higher diacetyl concentrations with a slower MLF

Cab Sauv: Aroma profile

The Australian Wine Research Institute





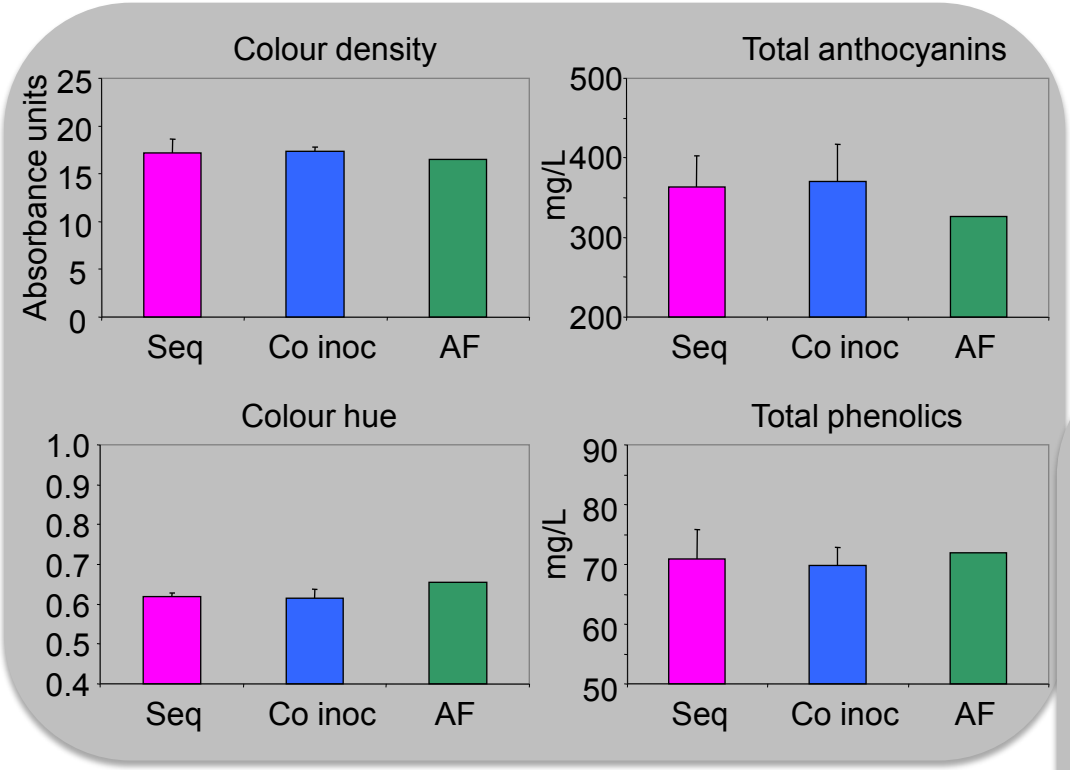


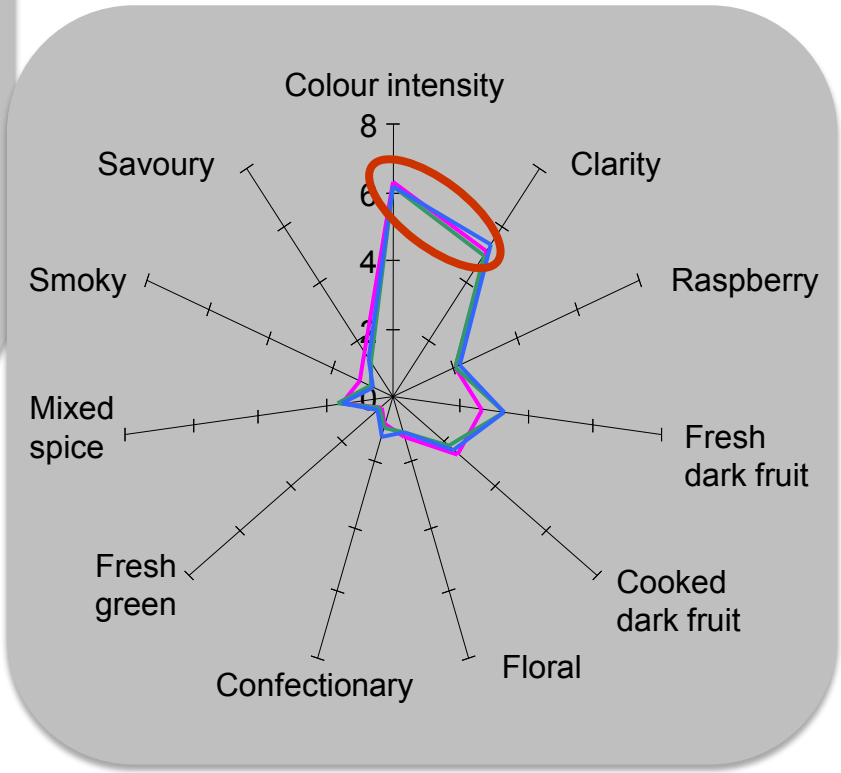
Cabernet Sauvignon
2006
Bordertown

Co-inoculation increased fruity characters

Cab Sauv: Wine colour

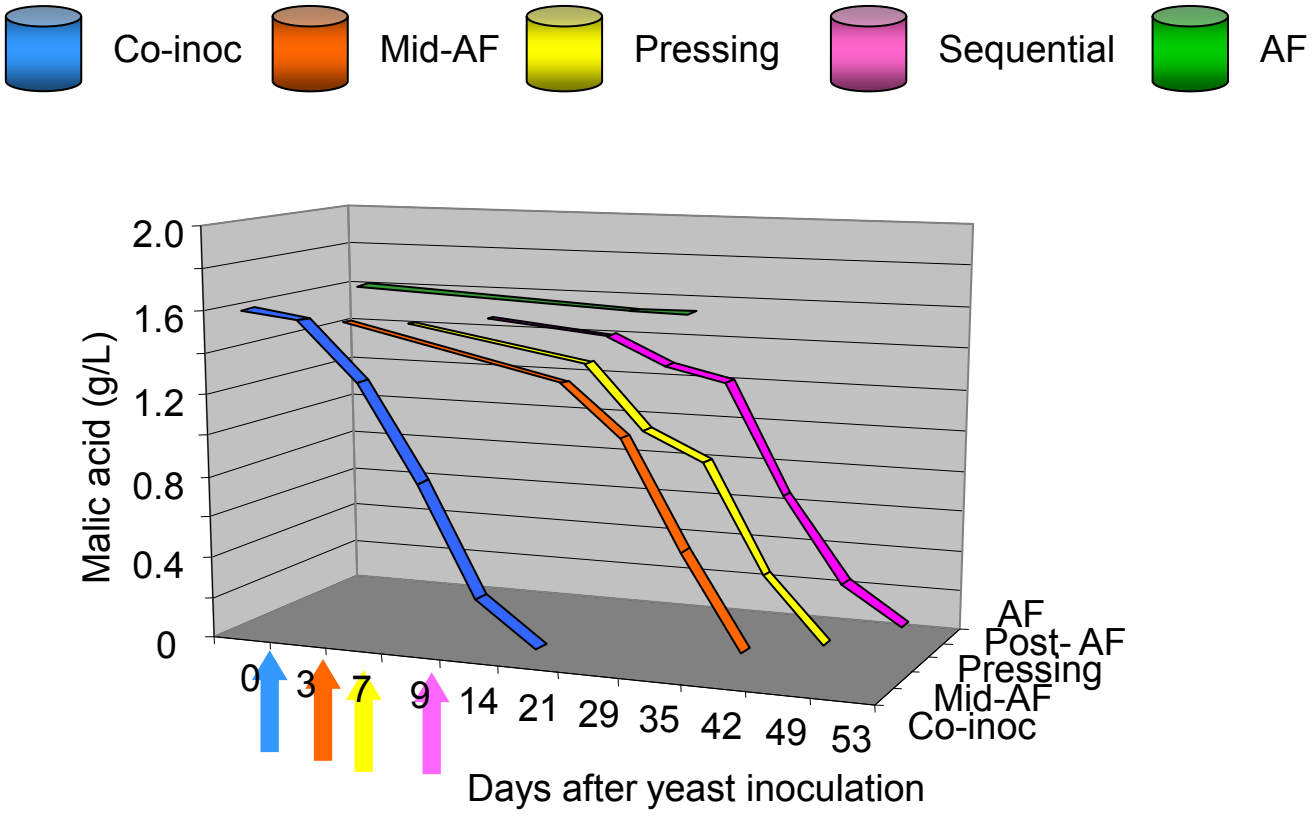
The Australian Wine Research Institute





Example: Shiraz

The Australian Wine Research Institute



Shiraz
2008
Clare Valley

Reduced fermentation time with co-inoculation

Shiraz: Wine composition

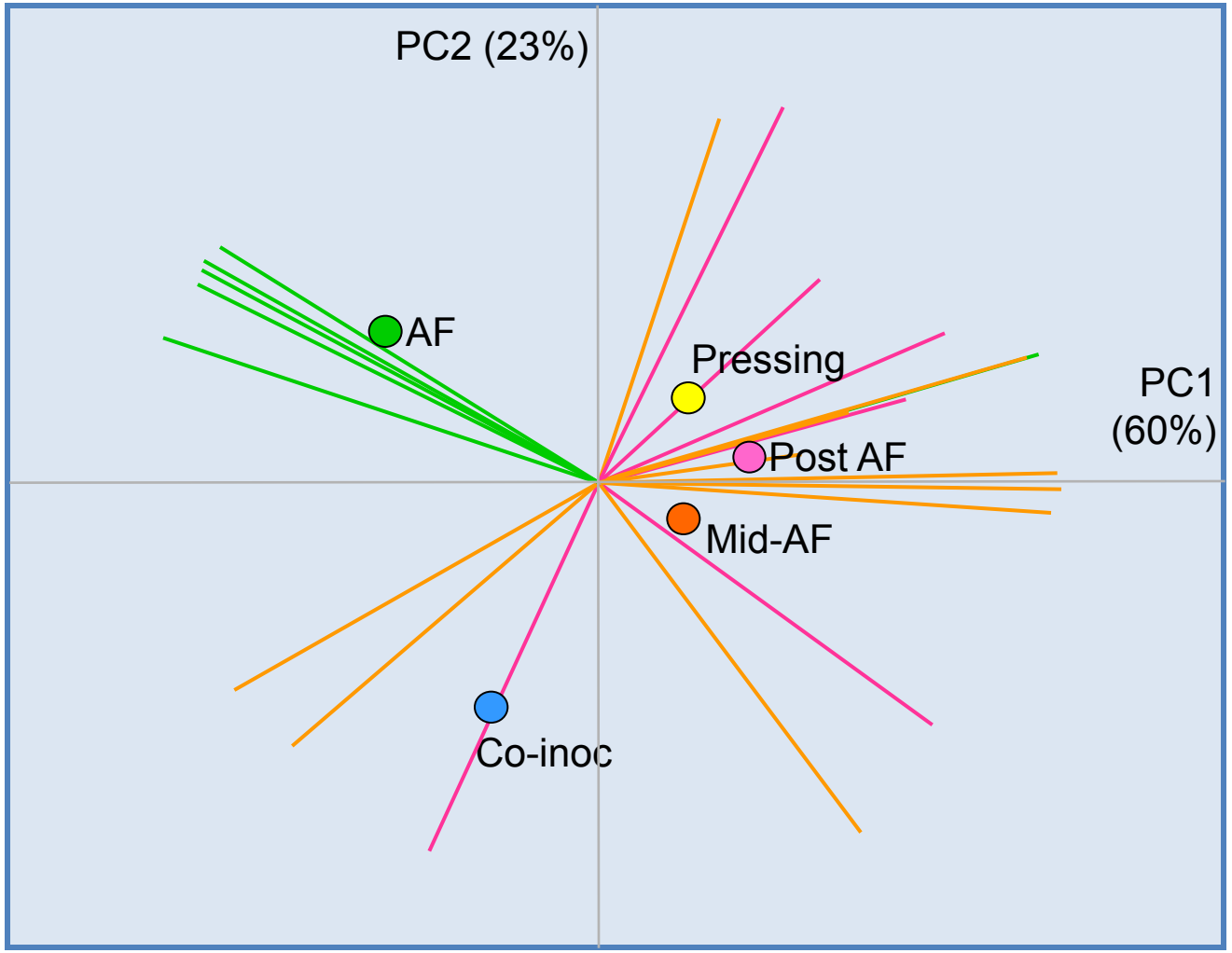
The Australian Wine Research Institute

	RS (g/L)	EtOH (%)	Malic (g/L)	Lactic (g/L)	Citric (g/L)	Acetic (g/L)	pH	TA (g/L)
Juice	189.6	0.0	1.8	0.0	0.1	0.1	3.5	6.45
AF	0.0	14.8	1.8	0.3	0.1	0.5	3.62	6.45
Co-inoc	0.7	14.0	0.2	1.3	0.0	1.0	3.8	6.0
Mid AF	0.7	14.3	0.3	1.3	0.0	0.9	3.8	6.0
At Pressing	0.7	14.1	0.3	1.3	0.0	0.9	3.8	6.0
Post AF	0.7	14.4	0.3	1.3	0.0	0.9	3.82	6.0

Shiraz
2008
Clare Valley

Shiraz: Volatile fermentaⁿ metabolites

The Australian Wine Research Institute

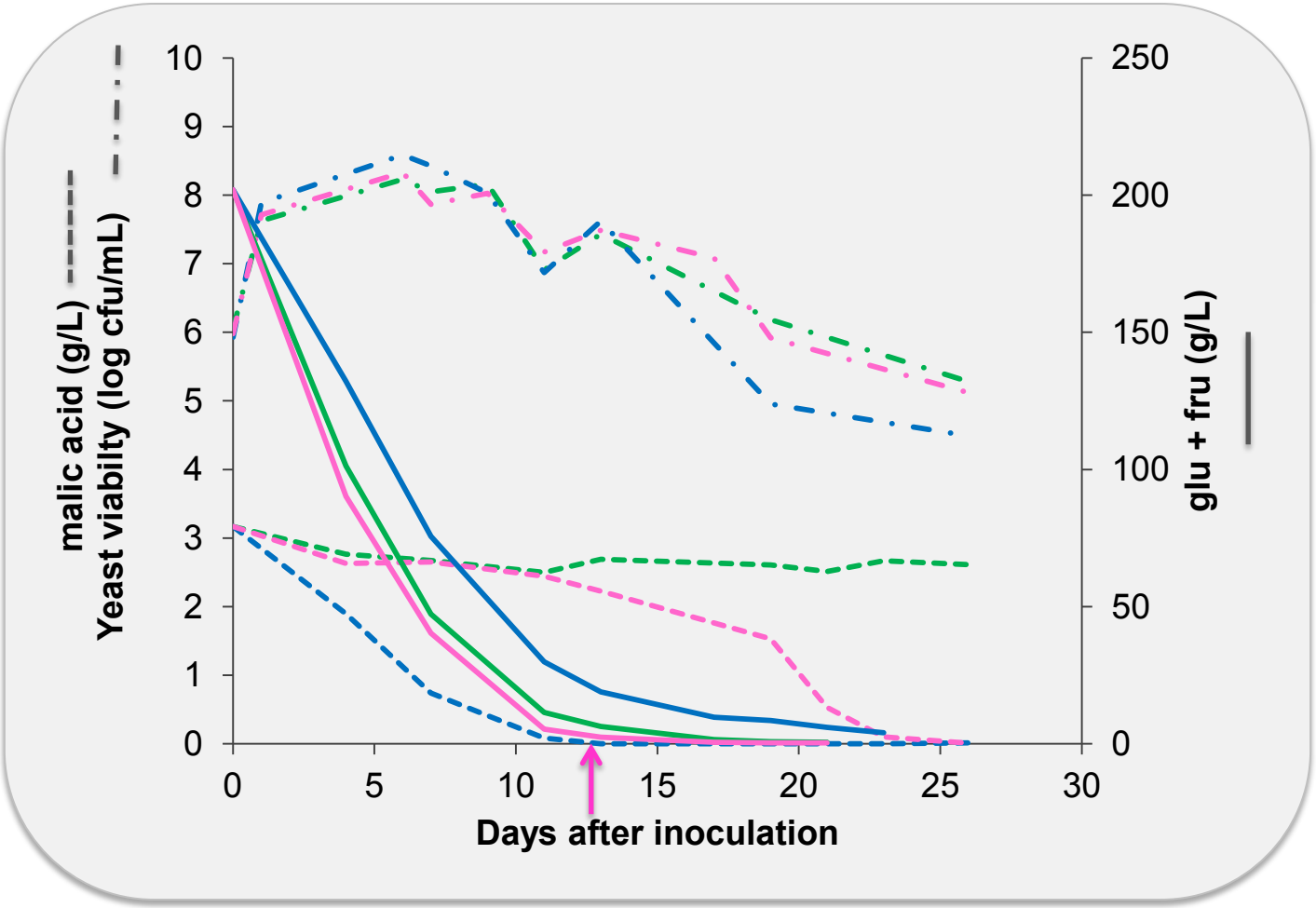


Ethyl fatty esters
Higher alcohols
Acetate esters

Shiraz
2008
Clare Valley

Example: Chardonnay

The Australian Wine Research Institute



Co-inoc
Seq
AF

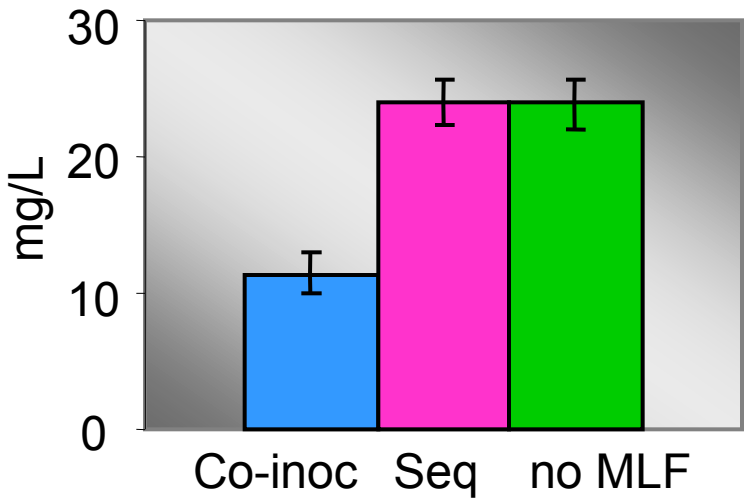
Chardonnay
2001
Langhorne Creek

Co-inoculation – Reduced time for MLF completion

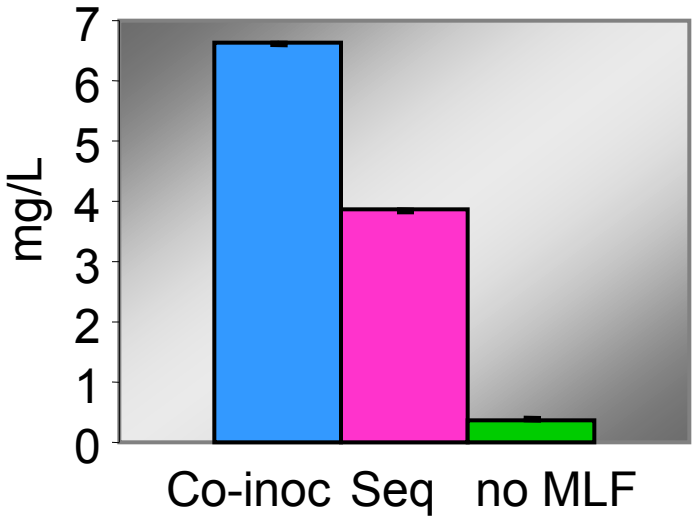
Chard: Volatile fermentaⁿ metabolites

The Australian Wine Research Institute

Total higher alcohols



Total ethyl fatty esters



Chardonnay
2001
Langhorne Creek

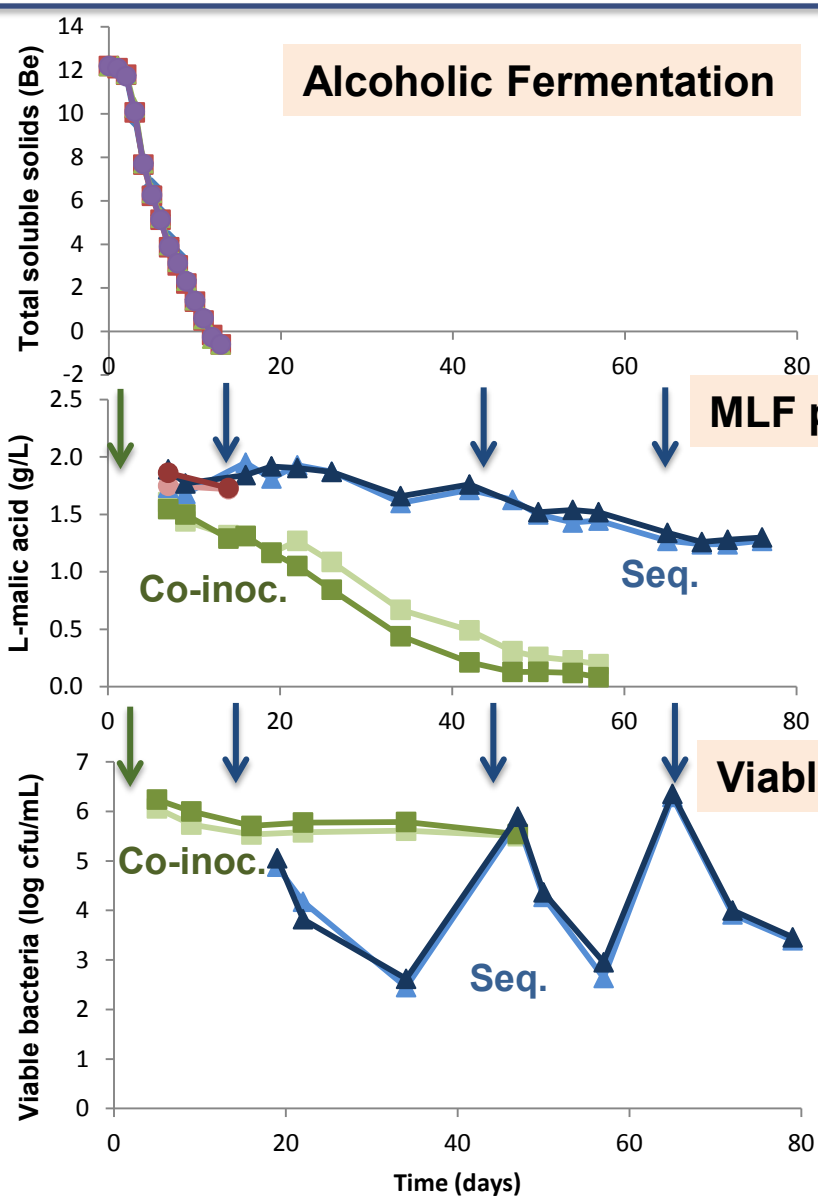
Co-inoculation increased fruity characters

Co-inoculation vs. Sequential MLF - in difficult juice / wine conditions

The Australian Wine Research Institute

2012 Chardonnay, Eden Valley

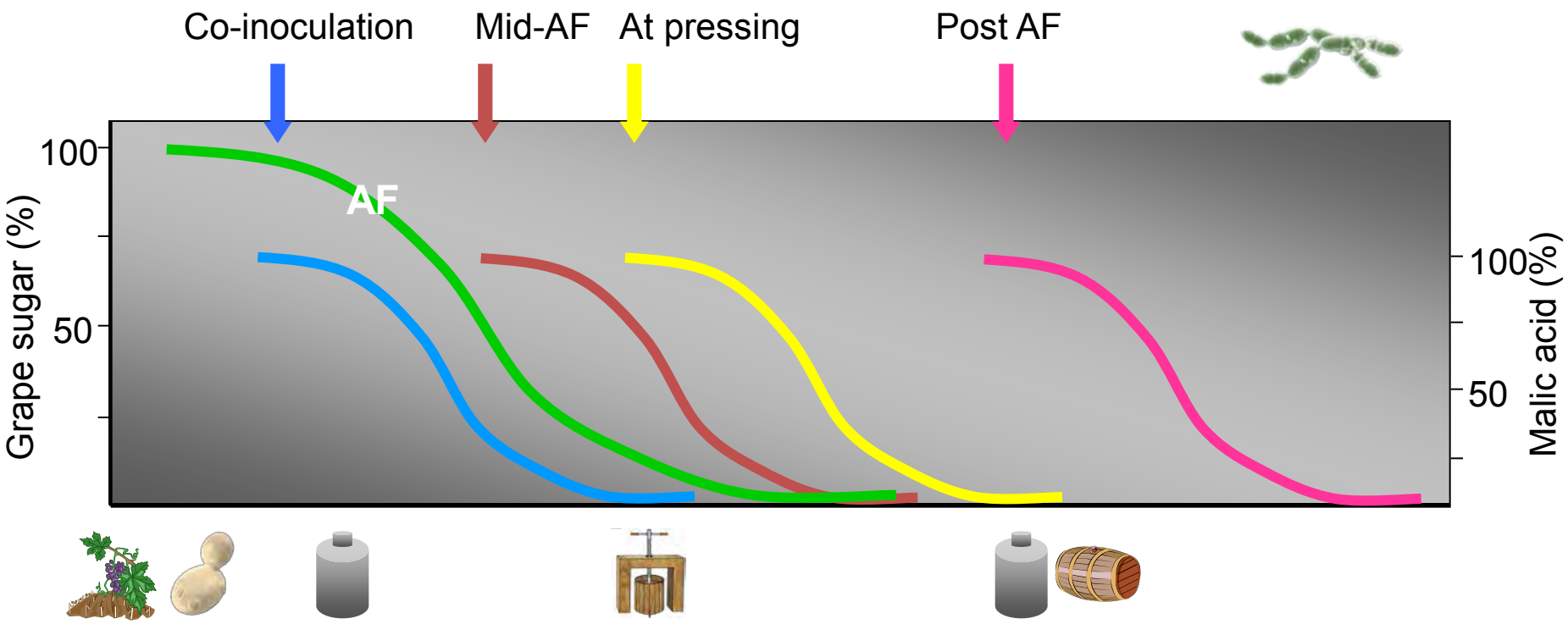
Baume	12.2 °Be
pH	3.25
TA	5.4 g/L
YAN	177 mg/L
malic acid	2.1 g/L
FSO_2	13 mg/L
TSO_2	57 mg/L



LALLEMAND

Options for MLF inoculation

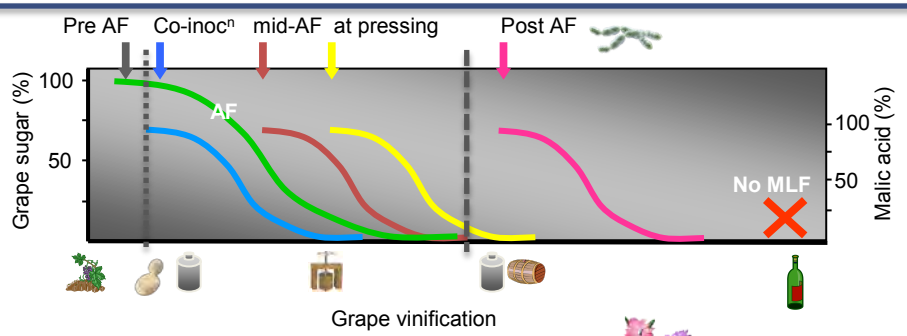
The Australian Wine Research Institute



Choice of inoculation point affects the relative difficulty of MLF induction and competition by indigenous strains, which are often better adapted to the wine

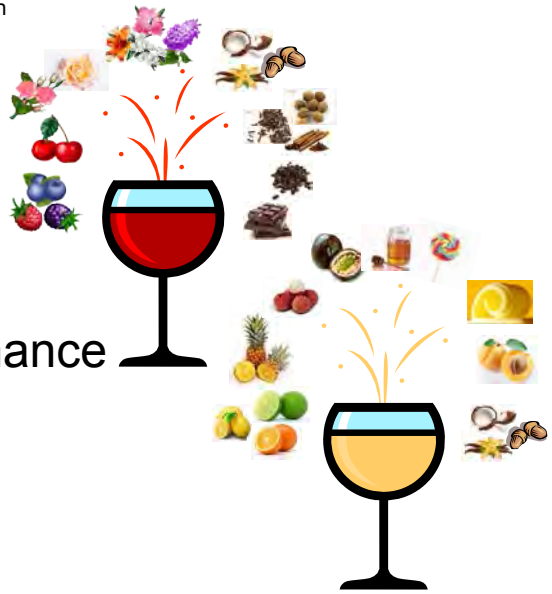
Using timing of inoculation to optimise MLF

The Australian Wine Research Institute



- What are my options?
  - Co-inoculation
  - Sequential inoculation

- Co-inoculation:
  - Can be used in red & white wine
  - Can reduce overall fermentation time
  - No affect on wine colour
  - Generally no / little affect on AF or yeast performance
  - Sometimes slightly higher acetic acid/VA



- Sensory
  - Fruity compounds tend to be higher with co-inoculation and correlate with wine sensory characters

➢ ***MLF inoculation regime can be used to influence wine style***

Acknowledgments

The Australian Wine Research Institute

- AWRI Wine Biosciences

  MLF Team
  - Caroline Abrahamse
  - Jane McCarthy

- Wineries: kind donation of grapes & wine for research

- This project is supported by Australia's Grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government

gwrdc GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

AWRI

The Australian Wine Research Institute

Health, nutrition and other warning labelling for alcoholic beverages

Creina Stockley

Health and Regulatory Information Manager


BOY.. I'M GLAD WE KNOW WHAT WE'RE EATING -. WHAT'S FOR TEA?
THE USUAL... PRESERVATIVES, COLOURING, ADDITIVES..
GENETICALLY MODIFIED FOOD LABELLING

Contents

The Australian Wine Research Institute

1. Current labelling in Australia

Allergens

Nutritional and health

2. Proposed labelling in Australia

Health warnings

Other

3. International labelling

Health warnings

Current labelling in Australia

The Australian Wine Research Institute

Allergen labelling

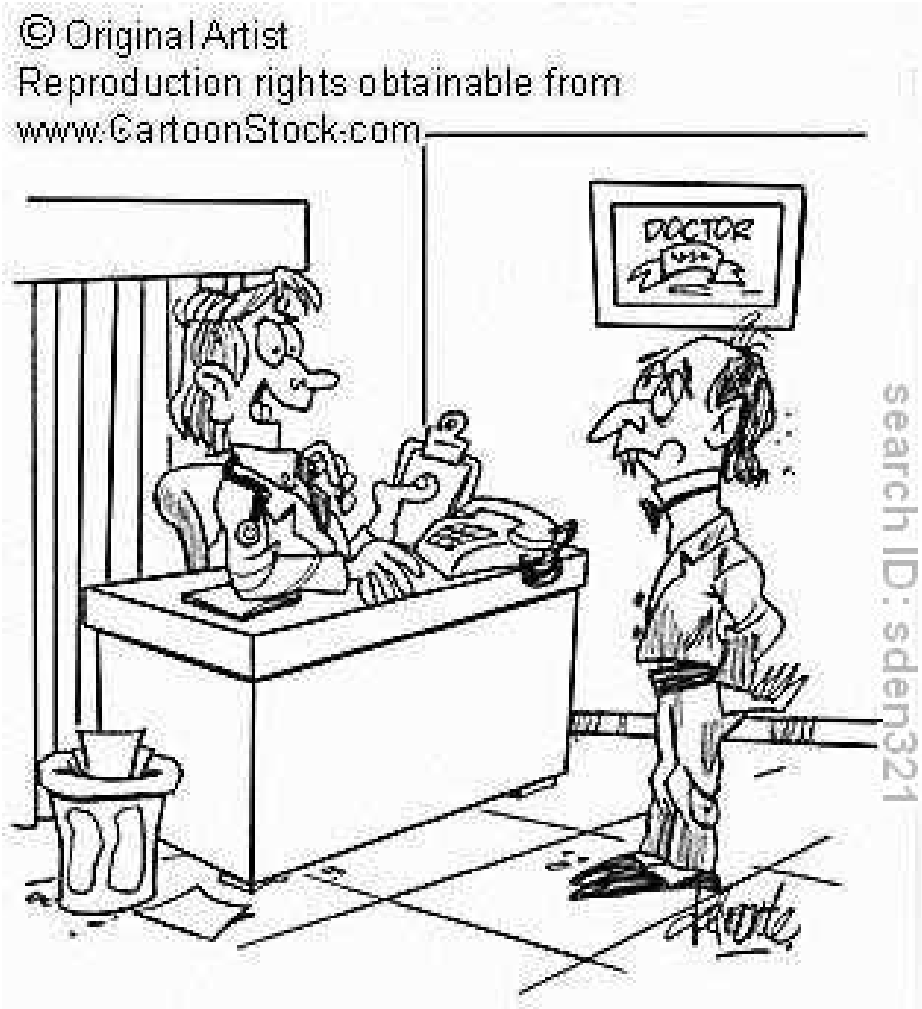
was introduced December 2002

for egg, fish and milk and their products

but

in May 2009

was repealed for fish and fish products



“You have a food allergy.
Even worse - its to wine!”

Standard 1.2.3
Mandatory warning labels and advisory statements and declaration

The Australian Wine Research Institute

Clause 4. Mandatory declaration of certain substances in food

(1) The presence in a food of any of the substances listed in the Table to this clause, must be declared in accordance with subclause (2), when present as

(a) an ingredient; or

(b) an ingredient of a compound ingredient; or

(c) a food additive or component of a food additive; or

(d) a processing aid or component of a processing aid.

(2) Any substance required to be declared by subclause (1) must be —

(a) declared on the label on a package of the food;…

Table to Clause 4

The Australian Wine Research Institute

Cereals containing gluten and their products, namely, wheat, barley, rye, oats and spelt and their hybridized strains other than where these substances are present in beer and spirits standardized in Standards 2.7.2 and 2.7.5, respectively.

Crustacea and their products

Egg and egg products

Fish and fish products

Milk and milk products

Nuts and sesame seeds and their products

Peanuts and soybeans and their products

Added sulphites in concentration of 10 mg/kg or more

Tree nuts and sesame seeds and their products

The Australian wine industry must label for:

The Australian Wine Research Institute

casein

potassium caseinate

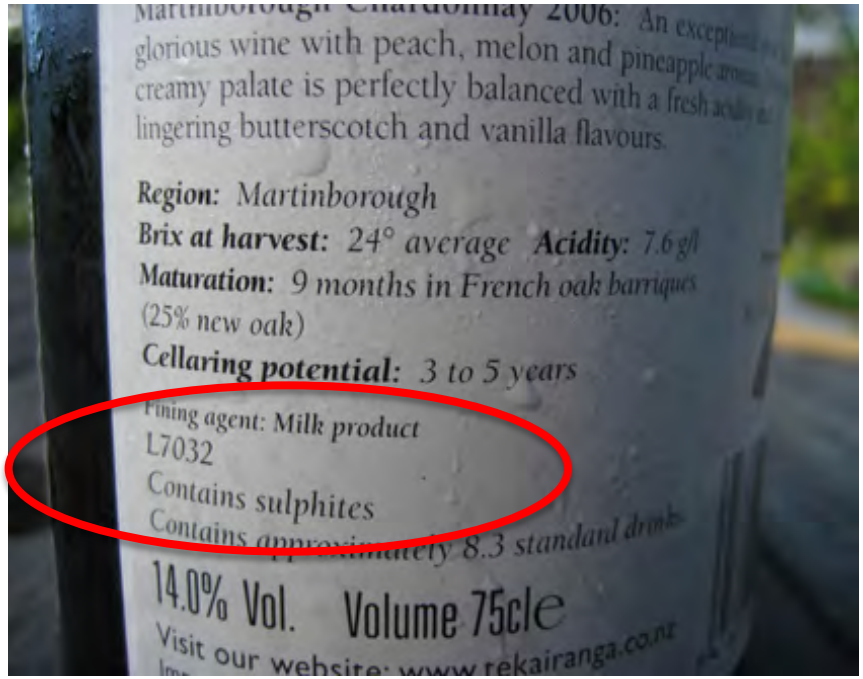
egg white

lysozyme

isinglass

milk and evaporated milk

and sulfites



Appropriate wording:

The Australian Wine Research Institute

Produced with milk.

Contains/produced with milk product.

Produced with milk. Traces may remain.

Produced with milk products. Traces may remain.

Example:

The Australian Wine Research Institute

HARDYS

BRUT RESERVE

Established in 1853, Hardys is one of Australia's most respected and highly awarded winemakers. Hardys Brut Reserve is a stylish Australian sparkling wine ideal for any occasion. Carefully blended and matured to produce a wine with rich fruit, soft full flavours and complex, yeasty characters. Serve chilled.

00168

BOTTLED BY THOMAS HARDY & SONS

REYNELL RD, REYNELLA STH AUST 5161

CONTAINS SULPHITES AND MILK PRODUCTS

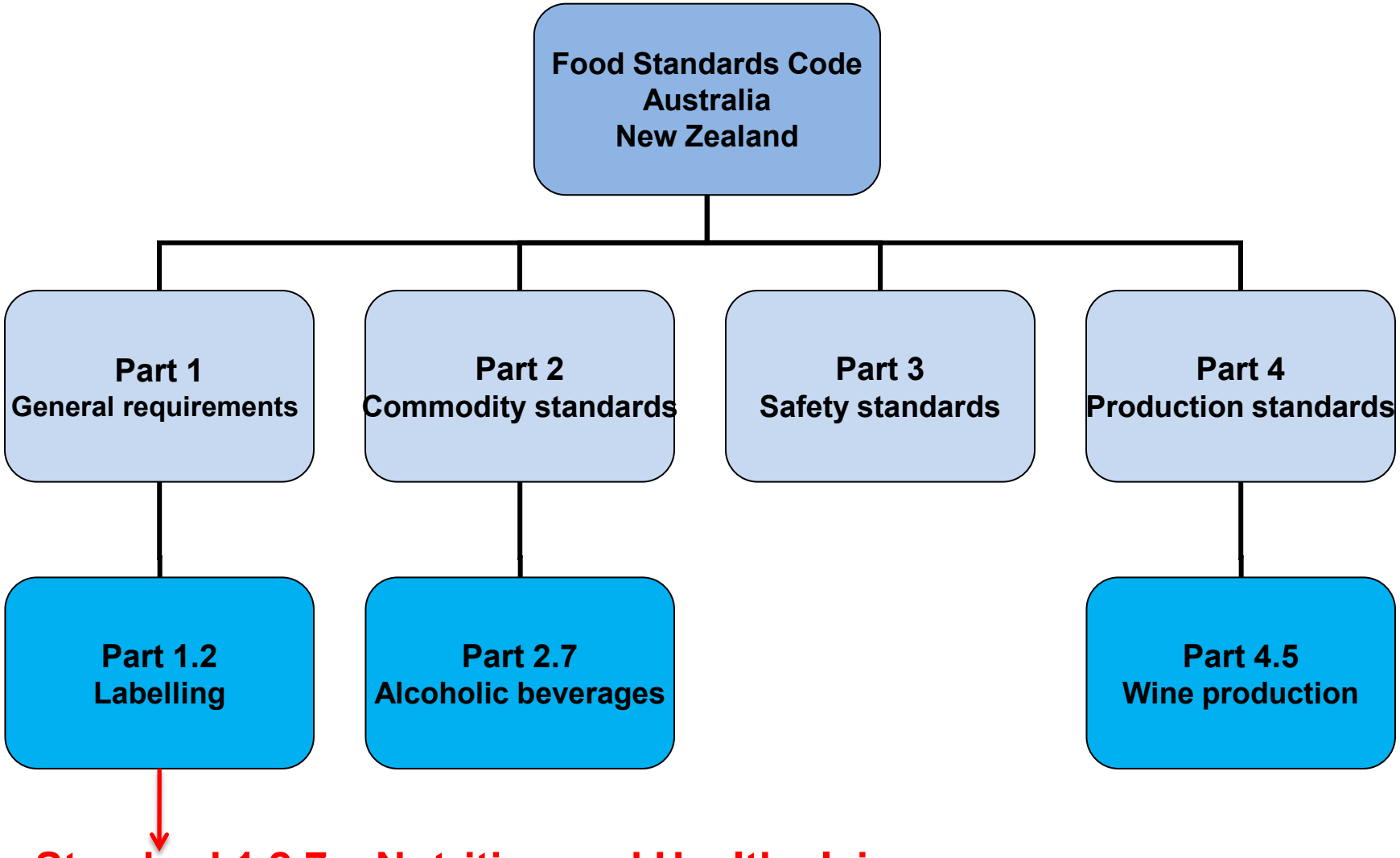
PRODUCT OF AUSTRALIA 12.0% ALC/VOL

APPROX 7.1 STANDARD DRINKS

WARNING: THIS WINE IS STORED UNDER PRESSURE. TAKE CARE NOT TO SCRATCH OR DAMAGE THIS BOTTLE AS IT MAY CAUSE IT TO EXPLODE. TO OPEN, POINT BOTTLE AWAY FROM SELF & OTHERS. DO NOT USE A CORKSCREW TO REMOVE THE CORK.

New nutrition and health labelling in Australia

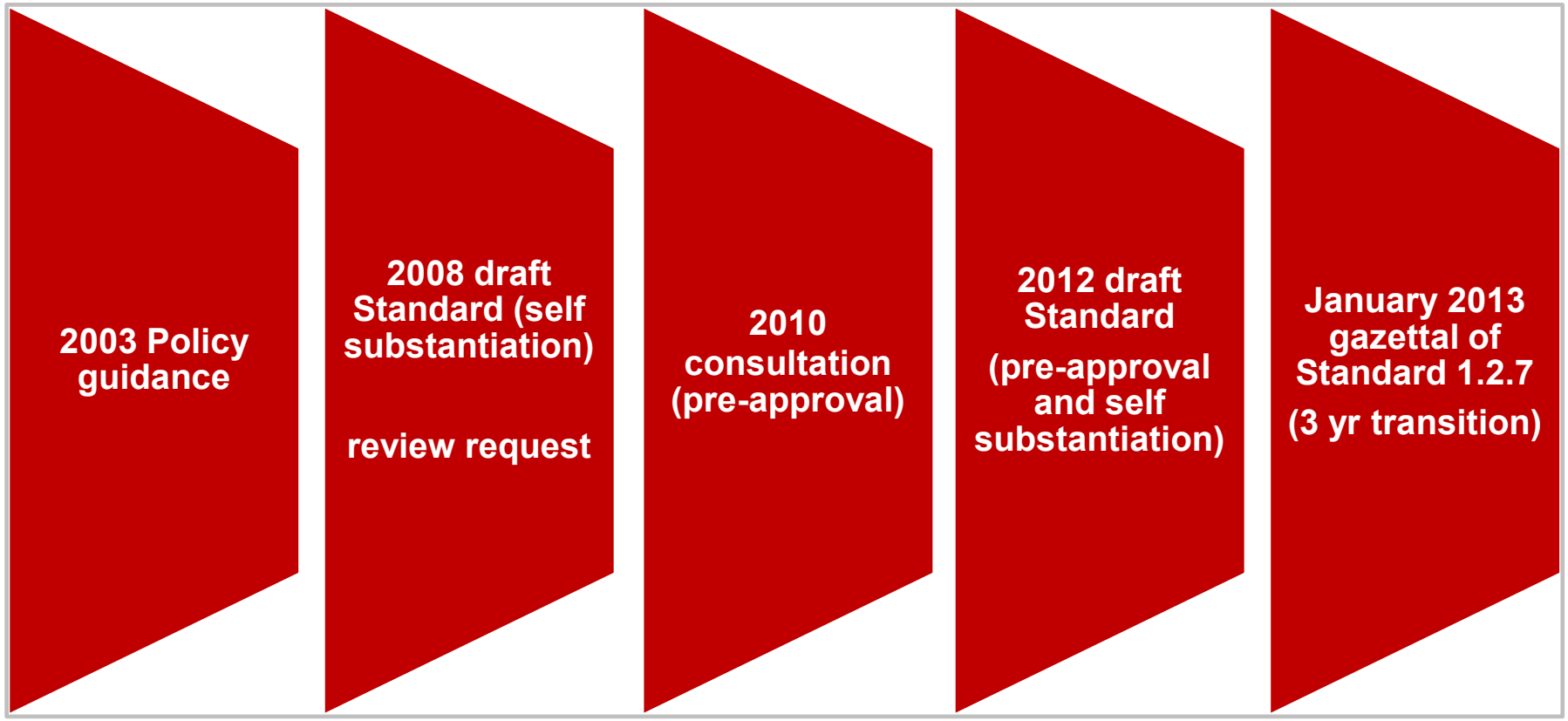
The Australian Wine Research Institute



Standard 1.2.7 – Nutrition and Health claims

FSANZ journey: January 2003→2013

The Australian Wine Research Institute



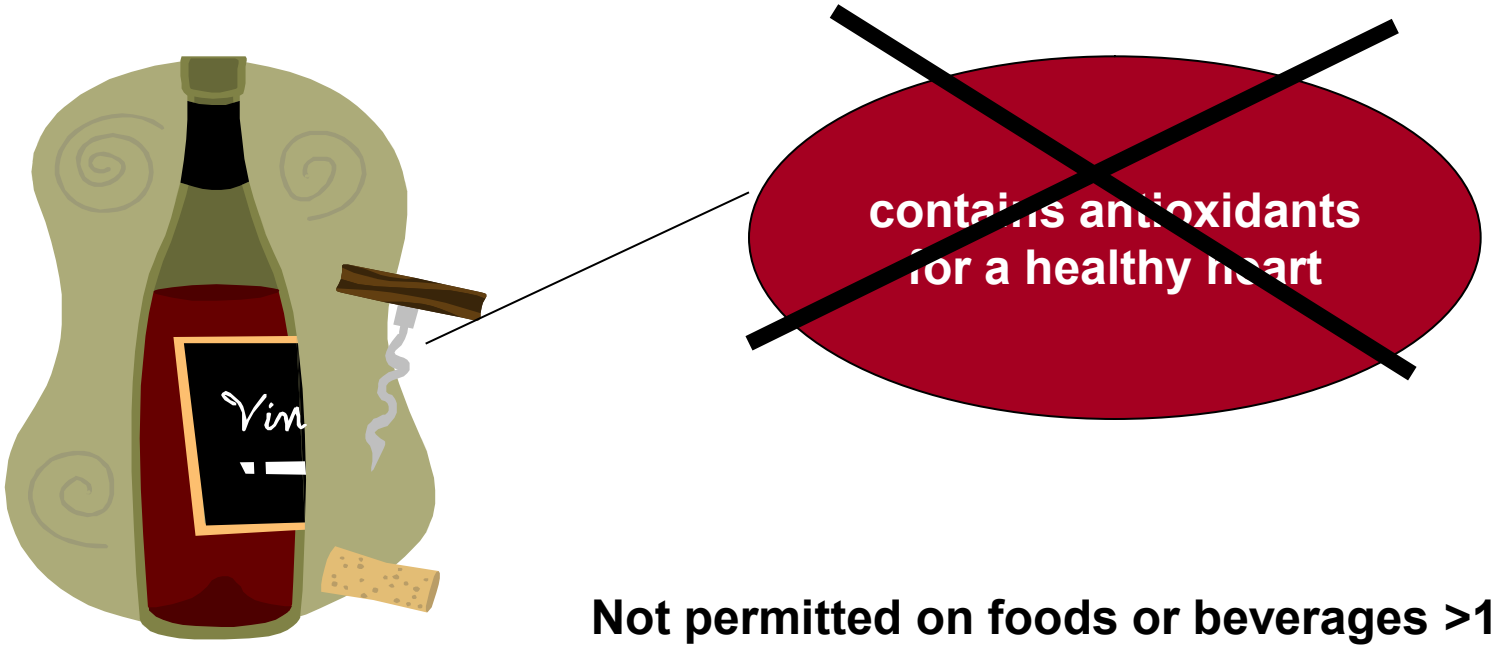
- Regulatory measure for voluntary use of nutrition and health claims
- Requirements for health and nutrition claims in a single standard
- Permit health claims where they support healthy food choices
- Permit certain disease risk reduction claims
- Not mislead consumers
- Support industry innovation

Application to alcoholic beverages

The Australian Wine Research Institute

	Standard 1.2.7 – application to alcoholic beverages
Health Claims	**Prohibited on alcoholic beverages > 1.15% abv**
Nutrition Content Claims	**Claims about energy and carbohydrate only [food profiling (NPSC) does not apply]**
	Claims that refer to the presence or absence of alcohol are not considered to be a nutrition content claim or a health claim

Health claim - links to health effects such as cancer or heart disease



Not permitted on foods or beverages >1.15%abv

The Australian Wine Research Institute

Nutrition content claim – about nutrient content

Low energy
Low or reduced carbohydrate
ONLY

Criteria may apply:

- energy < 80 kJ/100 mL
- carbohydrate – no criteria set

Standard 1.2.7 – Schedule 1

The Australian Wine Research Institute

Nutrient	Schedule 1 - criteria
Carbohydrate	Reduced / Light – 25% less than reference food Low – no criteria set (note misleading applies)
Energy	Reduced / Light – 25% less than reference food Low - <80 kj/ 100 mL

Energy

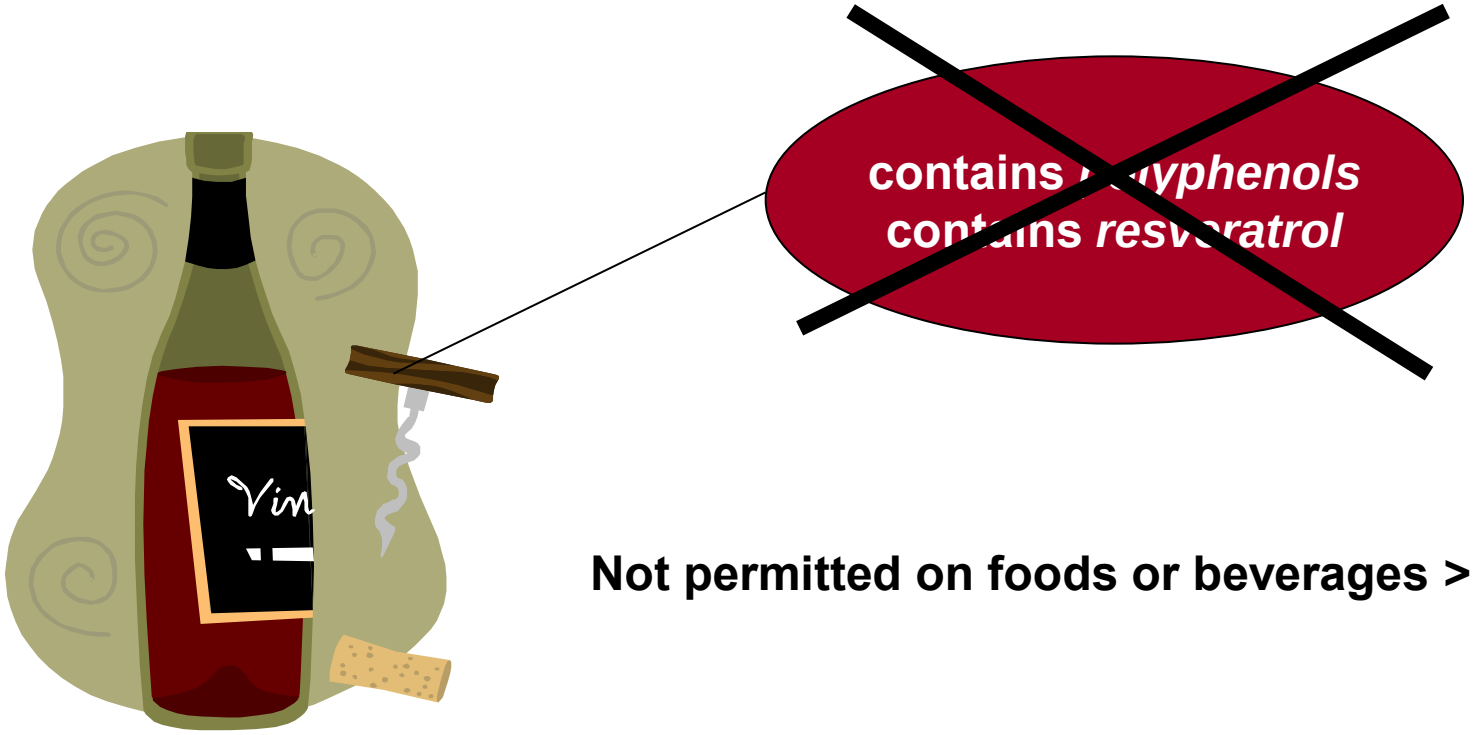
McWilliams “Balance” Wine endorsed by Weight Watchers

3rd party endorsement and participation in a proprietary commercial weight loss scheme with period of exclusivity

McWilliams “Balance” has just 8.5% alcohol, being 1/3 lower in alcohol and 1/3 lower in kilojoules. Not only does one glass of McWilliams “Balance “wine have a Weight Watchers POINTS value of one but it also equals exactly one standard drink.*

The Australian Wine Research Institute

Biologically active substances – 'non traditional nutrients'

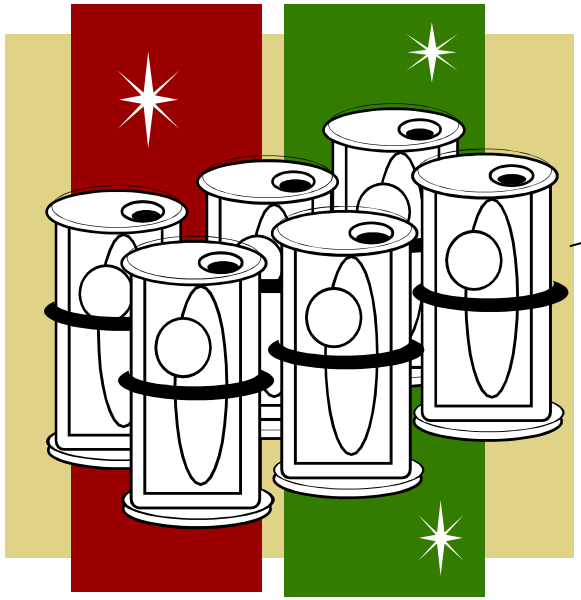


Not permitted on foods or beverages >1.15%abv

The Australian Wine Research Institute

Biologically active substances – **e.g., bioactive grape extracts such as resveratrol**

ONLY to be allowed on alcoholic beverages 1.15% abv or less



contains *'wunderstuff'*

- **must state amount of BAS in NIP**
- **cannot use descriptors e.g. 'high' / 'rich in'**

Biologically active substances

REW WINE DOCTOR WINES

100 mg/L added grape-derived resveratrol

WHITE

R.E.W 2006 Chardonnay

This Chardonnay is vibrant green with gold hues. The bouquet shows ripe, tropical fruit and peach, typical of very ripe Chardonnay. The palate has fresh, tropical fruit flavors with a tingling acid finish.

RED

R.E.W 2005 Shiraz

Australia has adopted Shiraz to be its classic red wine variety. It has aromas of spiciness, pepper, mulberries and raspberries. The palate is generous and plumy with soft oak tannins and a long acid finish typical of this variety.

REW = resveratrol enhanced wine

Nutrition information (REW wine)

The Australian Wine Research Institute

Servings per package: 6
Serving size: 125 mL

Ave Quantity	per serving	per 100 mL
Energy	856.3 kJ	685 kJ
Protein	0.5 g	0.4 g
Fat, total	<0.1 g	<0.1 g
- Saturated	<0.1 g	<0.1 g
Carbohydrate	1.63 g	1.3 g
-Sugars	0.25 g	<0.2 g
Dietary fibre, total	<0.75 g	<0.6 g
Sodium	6.1 mg	4.9 mg
Resveratrol	13.8 mg	11.0 mg

Information for educational purposes

The Australian Wine Research Institute

Drink in moderation

Standard 1.2.7 Clause 5(b)

This standard does not apply to…a claim about the risk or dangers of alcohol consumption or about moderating alcohol intake

Requirement for Nutrition Information Panel (NIP)
0.5% or more abv

The Australian Wine Research Institute

Claim about…	NIP required?
alcohol	No
energy carbohydrate	Yes
moderation or health advisory	No

May be provided voluntarily - Standard 1.2.8 Clause 19(4)

Transition – Standard 1.2.7

The Australian Wine Research Institute

- ***Three-year transition period (18 January 2016)*** **to enable industry to adjust products and claims**
- **For existing claims in the market industry can make an application to FSANZ for new permissions or self-substantiate general level health claims**
- **Monitoring of claims internationally is being initiated**
- **Guidance for self-substantiation is being developed**
- **Expert committee for reviewing health claims is being established**

2. Proposed labelling in Australia

Health warnings
Other

Labelling Logic
Review of Food Labelling Law and Policy (2011)

The Australian Wine Research Institute

REC 24
REC 25
REC 26
REC 27
REC 21
REC 50

Council of Australian Governments (COAG)

The Australian Wine Research Institute

61 recommendations

21 directed to FSANZ

Advice to government 2012-15

Australia & New Zealand

FSANZ labelling review work plan 2013/14 includes:

The Australian Wine Research Institute

- nutrient declarations
  - trans fatty acids, dietary fibre
  - energy on alcoholic beverages
  - per serve column
- ingredient labelling – ‘added fats’, ‘added sugars’
- allergens
- date marking
- use & storage instructions
- warning statements on alcoholic beverages
- format and presentation

Recommendation 25
Alcohol pregnancy warning labels

The Australian Wine Research Institute

Warning message about the risks of consuming alcohol while pregnant on containers of alcoholic beverages and at the point of sale for unpackaged alcoholic beverages

Ministers allowing two years for alcohol industry to adopt voluntary labelling before mandatory labelling regulated

Independent evaluation to be undertaken to analyse voluntary labelling implementation by the Dept Health and Ageing due March 2014

FSANZ asked to provide advice on steps required if were to regulate

Proposed health warning labelling
Application A576

The Australian Wine Research Institute

Advisory statement for pregnant women under consideration by FSANZ

Application from Alcohol Advisory Council of NZ (ALAC) received in February 2006, initiated 2007, on hold 2010

Request for mandatory statement relating to the risk of drinking alcohol when planning to become pregnant and during pregnancy on alcoholic beverage containers

Endorsed in Recommendation 25 of the *Ministerial Review of Food Labelling Law and Policy*

Submitter views

The Australian Wine Research Institute

Support

- Evidence of harm from alcohol consumption
- Provision of information – consumers right to know
- Culture of heavy drinking
- Governments duty of care
- Easy to implement and inexpensive
- Label can inform & reinforce health promotion
- Alcohol consumption increasing

Don't support

- Uncertainty around amount that causes harm
- Labelling is ineffective
- May not be most cost effective approach
- Many drinks served in bars, clubs are unlabelled
- Costs
- Labelling may be alarmist
- Incidence of FASD in Australia unknown

"It is safest not to drink while pregnant"

On hold pending outcomes of voluntary labelling initiatives and work on Recommendation 25

Recommendation 26
Energy on alcoholic beverages

The Australian Wine Research Institute

Declaration of energy content (KJ) on alcoholic beverages, consistent with other food products

- **Contributes to energy intake → contributes to overweight/obesity?**
- **FSANZ asked to do cost-benefit analysis to assess full impact**
  - **Industry views?**
  - **Implementation costs?**
  - **Benefits gained?**
- **Ministers to consider advice before decision made on further action**

Recommendation 24
Generic alcohol warning message

The Australian Wine Research Institute

Generic alcohol warning messages on alcohol labels but only as element of comprehensive multifaceted national campaign targeting public health problems of alcohol in society.

- **Ministers noted broader health policy implications and sought advice from the Standing Council on Health**

- **Advice from the Australian Health Ministers' Advisory Council sought on the efficacy of generic alcohol warnings re a comprehensive national campaign on the public health problems of alcohol consumption**

The Australian Wine Research Institute

Two types of warnings were identified:

1. generic warning messages

which warn about the general implications of excessive alcohol intake

"Drinking to excess is a danger to yourself and those around you"

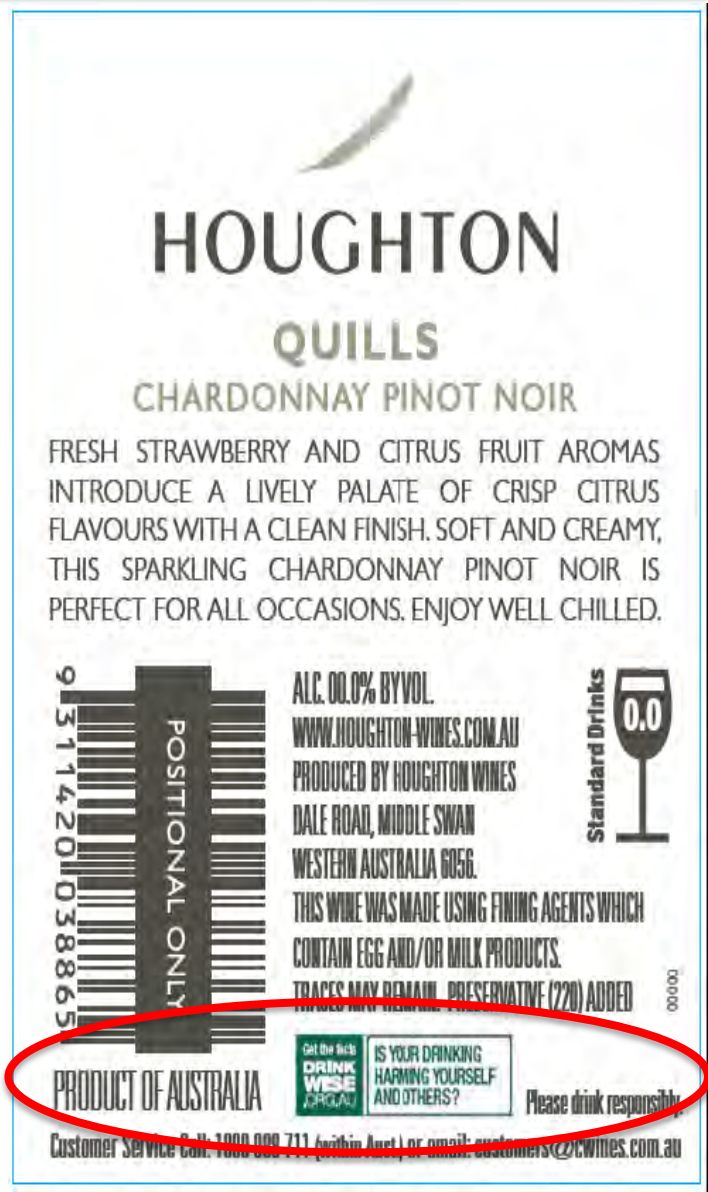
"Alcohol can damage your health"

2. specific warning messages

which link alcohol consumption to a specific outcome

"Do not drink and drive"

"Drinking alcohol harms your liver"



Recommendation 27
Nutrition labelling on mixed alcoholic beverages

The Australian Wine Research Institute

Drinks that are mixtures of alcohol and other beverages comply with all general nutrition labelling requirements, including a nutrition information panel (NIP)

- **Ministers agreed not to pursue due to potential unintended health consequences, international trade implications and costs to the alcohol industry**

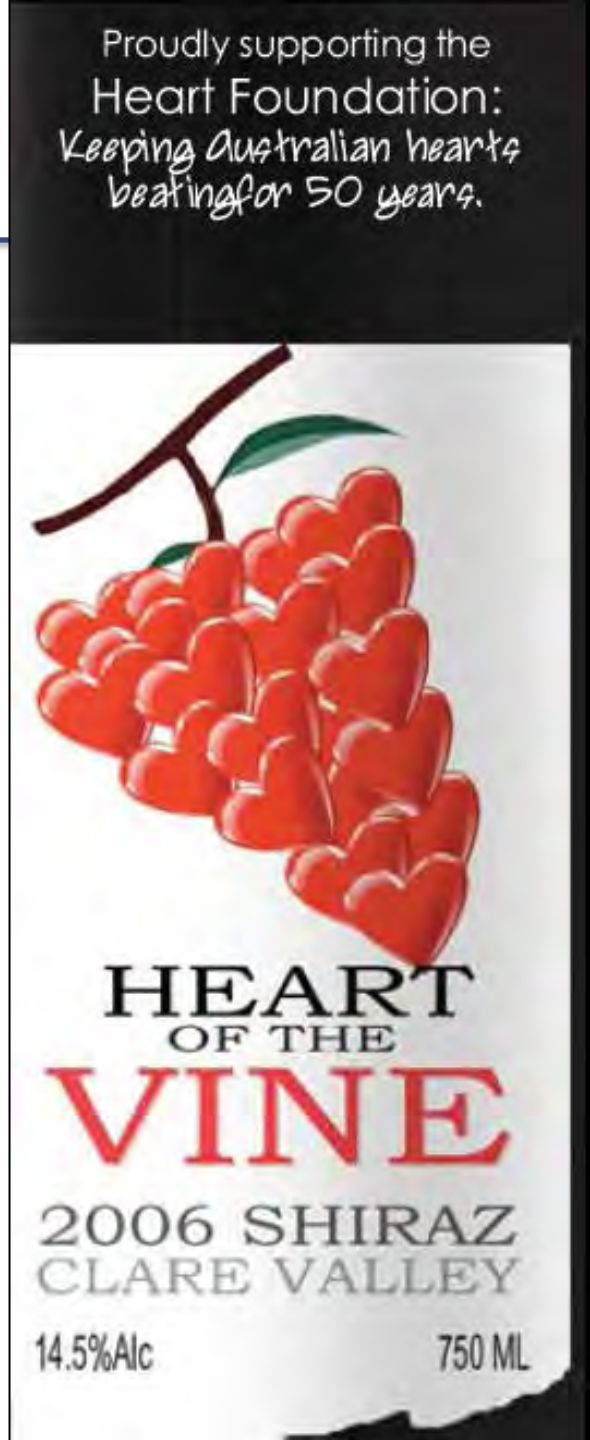
- **Noted that requiring an NIP on mixed alcoholic beverages but not all packaged alcoholic beverages would create labelling inconsistency**

Recommendation 21
Trademarks and trade names

Applications for trade names and trademarks be scrutinised by the relevant agencies to identify and reject words and devices that have the effect of inferring health implications that are otherwise prohibited under the Food Standards Code.

- **Potentially prohibit a range of names and trademarks used by that could arguably imply health benefits**

- **Questions endorsement and cause-related marketing partnerships where the recipients of financial support include health related causes or organisations, eg Victorian Cancer Council**



Recommendation 50
Front of pack nutrition labelling

The Australian Wine Research Institute

- **Voluntary system developed by Australian government (not FSANZ) in collaboration with industry, public health and consumer groups**
- **Underpinned by a nutrient profiling model, adapted from the health claims *nutrient profiling scoring criterion (NPSC)***
- **Star rating = ½ to 5 stars; more stars = better**
- **Alcoholic beverages are excluded from using FoPL**

- **For further information, see:**
  http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-front-of-pack-labelling-1

3. International labelling

Health warnings

At least 25 countries have mandated warning labels

The Australian Wine Research Institute

Argentina	All alcoholic beverages must have a label which states: (1) Drink with moderation; and (2) Prohibited for people under 18 years old
Armenia	Not available
Benin	Not available
Brazil	For alcohol beverages < 13% alcohol: Avoid the excessive consumption of alcohol
Cape Verde	Not available
Colombia	Alcohol >2.5%: Not recommended for pregnant women Alcohol <2.5%: This product is harmful to the health of children and pregnant women

Costa Rica	One of the following statements must be placed on bottles: (1) Drinking liquor is harmful to health; or (2) The abuse of liquor is harmful to health.
Ecuador	Warning: the excessive consumption of alcohol restricts your capacity to drive and operate machinery, may cause damage to your health and adversely affects your family.
Finland	Rescinded legislation in 2008 prior to implementation. Finnish parliament conceded that warning labels were unlikely to change behaviour.
France	
Guatemala	All containers, packaging and labelling for alcoholic beverages must include: 1) The excessive consumption of this product is harmful to the health of the consumer; or 2) The consumption of this product causes serious harm to your health
Honduras	Preventative legends must be displayed on all alcoholic beverage packaging.

Iceland	**Not available**
India	**Consumption of liquor is injurious to health** **Alcohol is injurious to your health**
Indonesia	**Not available**
Mexico	**Excessive consumption of this product is hazardous to health** **Abusing consumption of this product is harmful to health**
Mongolia	**Not available**
Republic of Korea	**One of the following three statements must be placed on alcohol beverage containers:** **(1) Warning: Excessive consumption of alcohol may cause liver cirrhosis or liver cancer and is especially detrimental to the mental and physical health of minors;** **(2) Warning: Excessive consumption of alcohol may cause liver cirrhosis or liver cancer, and especially women who drink while they are pregnant increase the risk of congenital abnormalities; or** **(3) Excessive consumption of alcohol may cause liver cirrhosis or liver cancer, and consumption of alcoholic beverages impairs your ability to drive a car or operate machinery and may increase the likelihood of car accidents or accidents during work.**

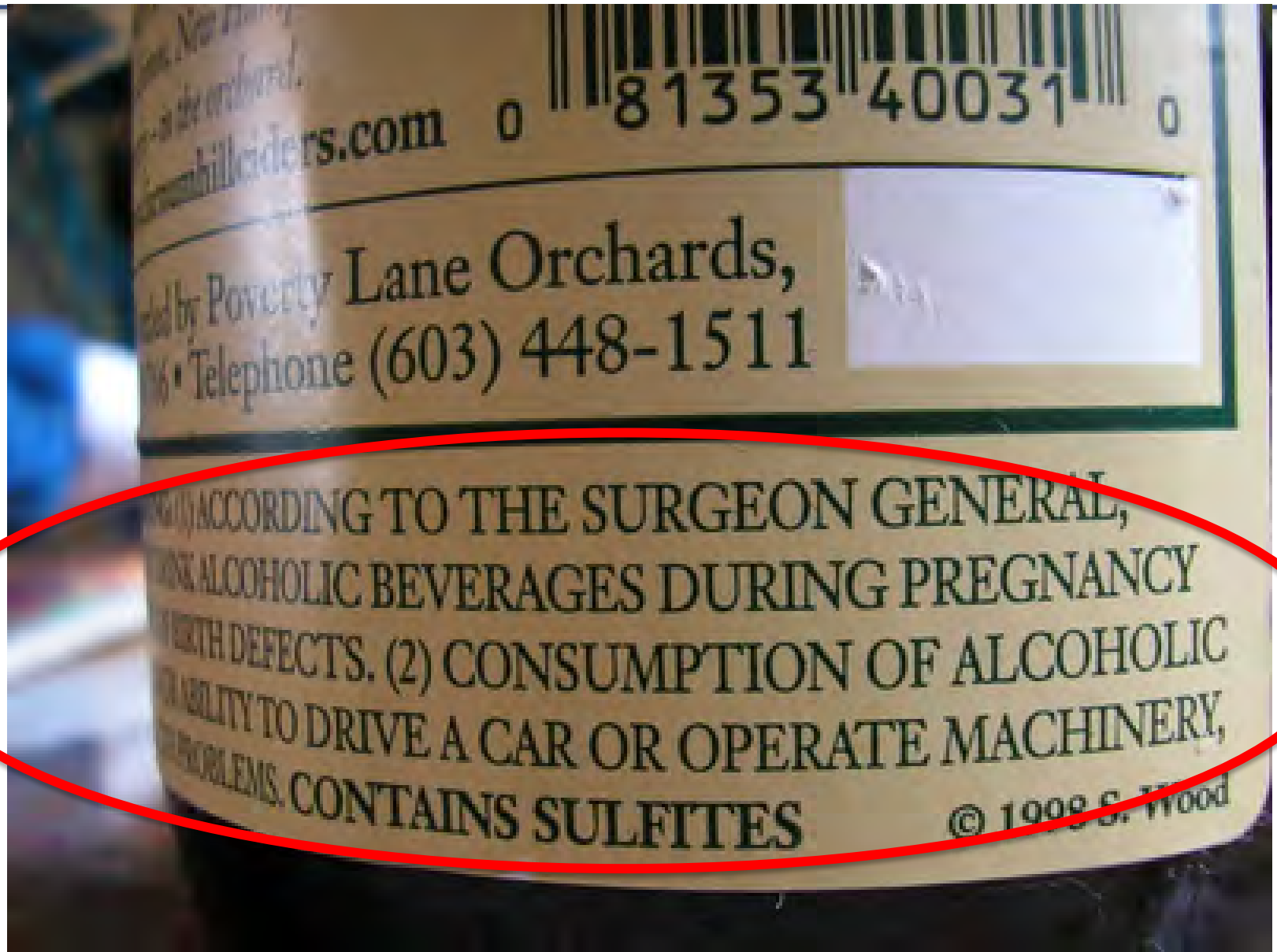
Spain	**Not available**
Taiwan	**<7% alcohol: Excessive drinking endangers health** **>7% alcohol, one of the following warnings:** **(1) Excessive consumption of alcohol is harmful to health;** **(2) To be safe, don't drink and drive;** **(3) Excessive drinking is harmful to you and other; or** **(4) Please do not drink if you are a minor.**
Thailand	**Warning: Drinking liquor reduces driving ability**
USA	**Government warning:** **(1) According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects; and** **(2) Consumption of alcohol impairs your ability to drive a car or operate machinery, and may cause health problems.**
Uruguay	**Alcoholic beverage containers should have a label advising on the risks of the excessive consumption of alcohol**
Venezuela	**One for the following statements or similar is required:** **(1) The abuse of alcoholic beverages can damage the health; or** **(2) Excessive consumption can be harmful to health.**
Zimbabwe	**(1) Alcohol may be hazardous to health if consumed to excess; or** **(2) Operation of machinery or driving after the consumption of alcohol is not advisable.**

South African health warning label

The Australian Wine Research Institute

US health warning label

The Australian Wine Research Institute



Thailand's proposed warning labels

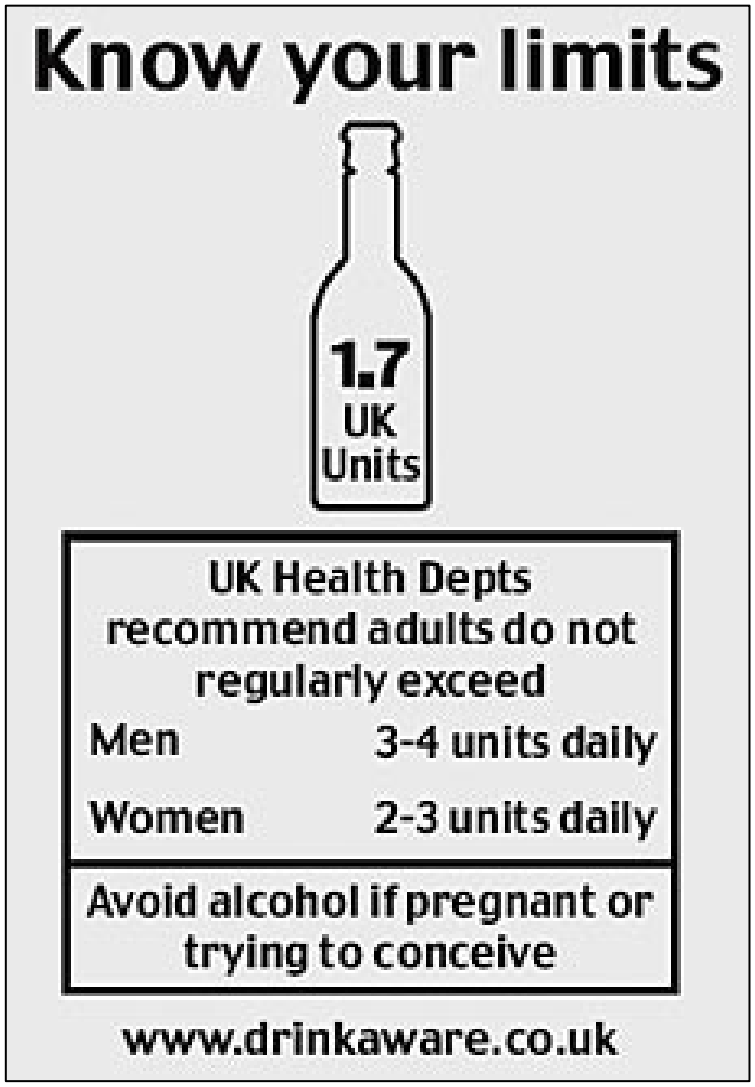
The Australian Wine Research Institute

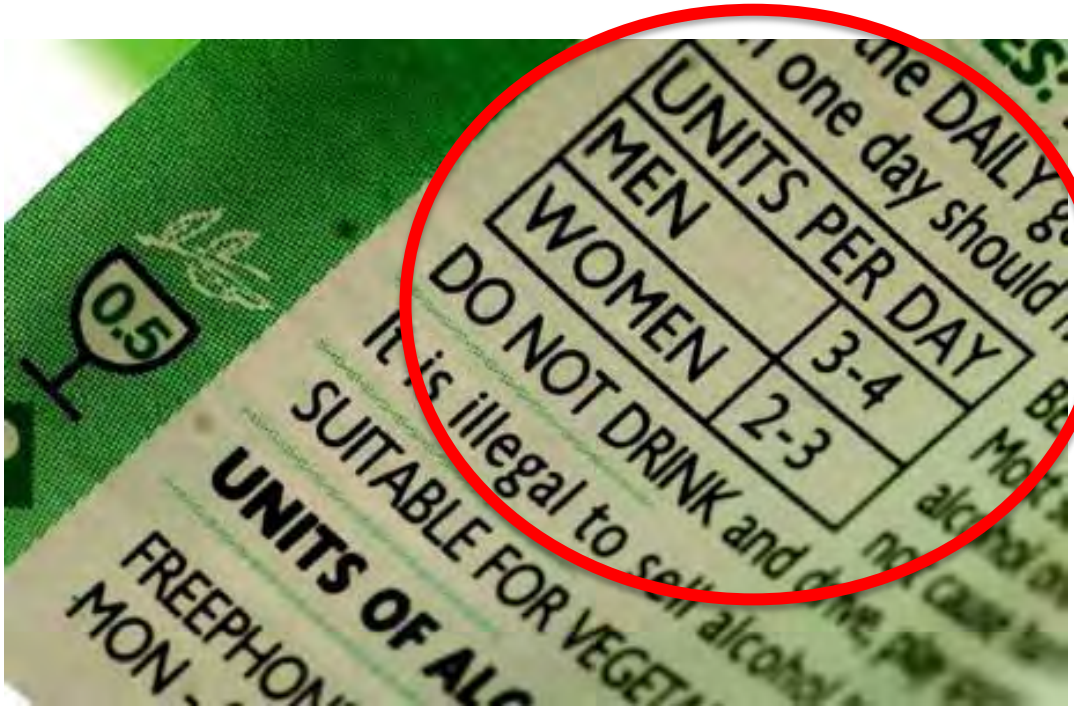
"Liquor drinking may cause cirrhosis and sexual impotency"

"Drunk driving may cause disability or death"
"Liquor drinking may cause less consciousness and death"
"Liquor drinking is dangerous to health and causes less consciousness"
"Liquor drinking is harmful to you and destroys your family"

UK health warning label

The Australian Wine Research Institute





A W R I

The Australian Wine Research Institute

The origin of eucalyptol (1,8-cineole) ‘minty’ flavour in wine

Dr Dimitra L. Capone

1,8 – Cineole (eucalyptol)

The Australian Wine Research Institute

The characteristic aroma is ‘eucalyptus’, ‘fresh’, ‘cool’, ‘minty’, ‘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 Australian Wine Research Institute

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 α-terpineol and limonene are possible precursors of 1,8-cineole

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

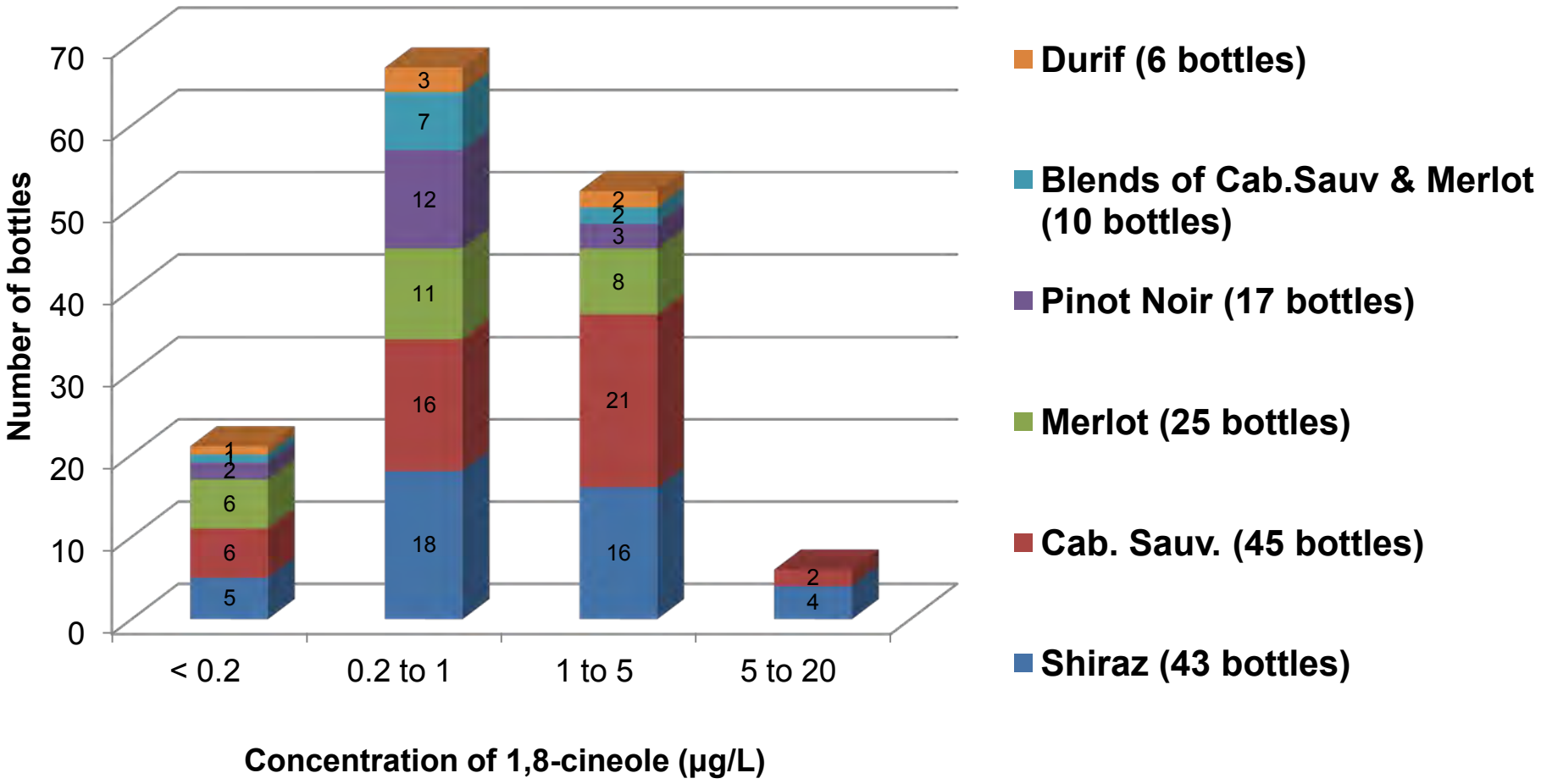
The Australian Wine Research Institute

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?

The Australian Wine Research Institute

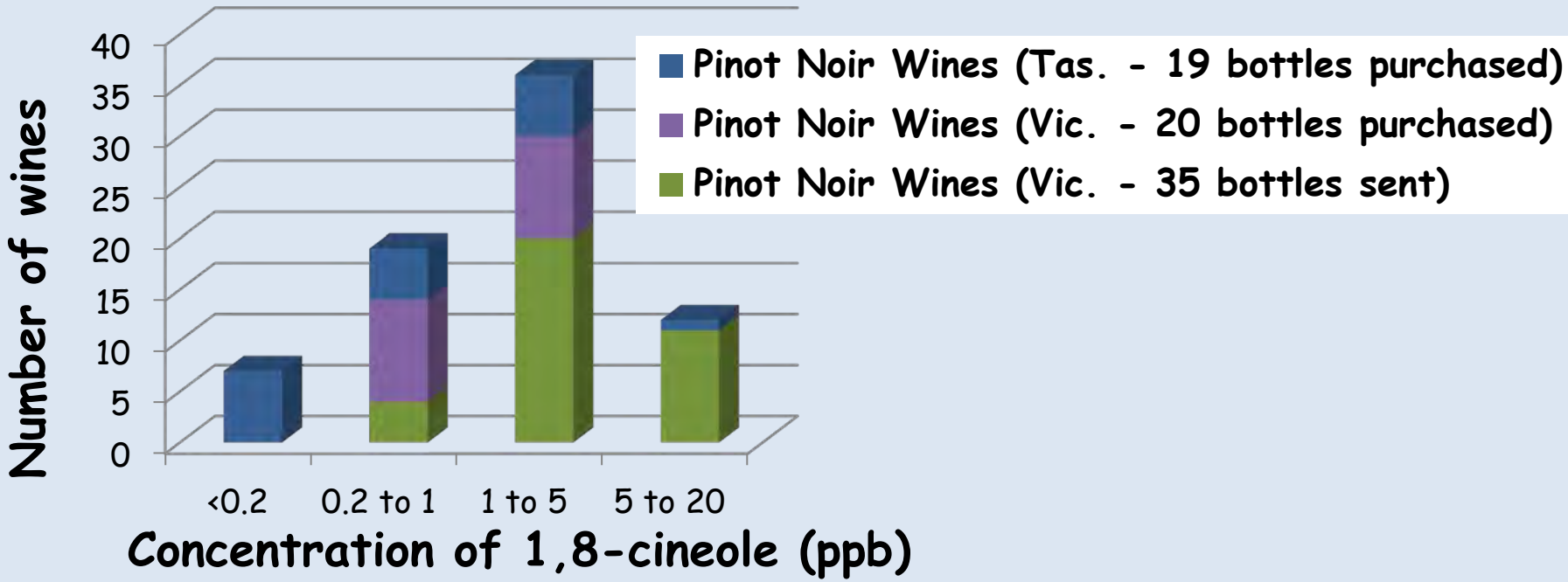


40% contained 1,8-cineole above reported detection threshold.

The highest level of 1,8-cineole found was 19.6 µg/L

1,8-cineole concentration in a New Pinot Noir Wine survey

The Australian Wine Research Institute

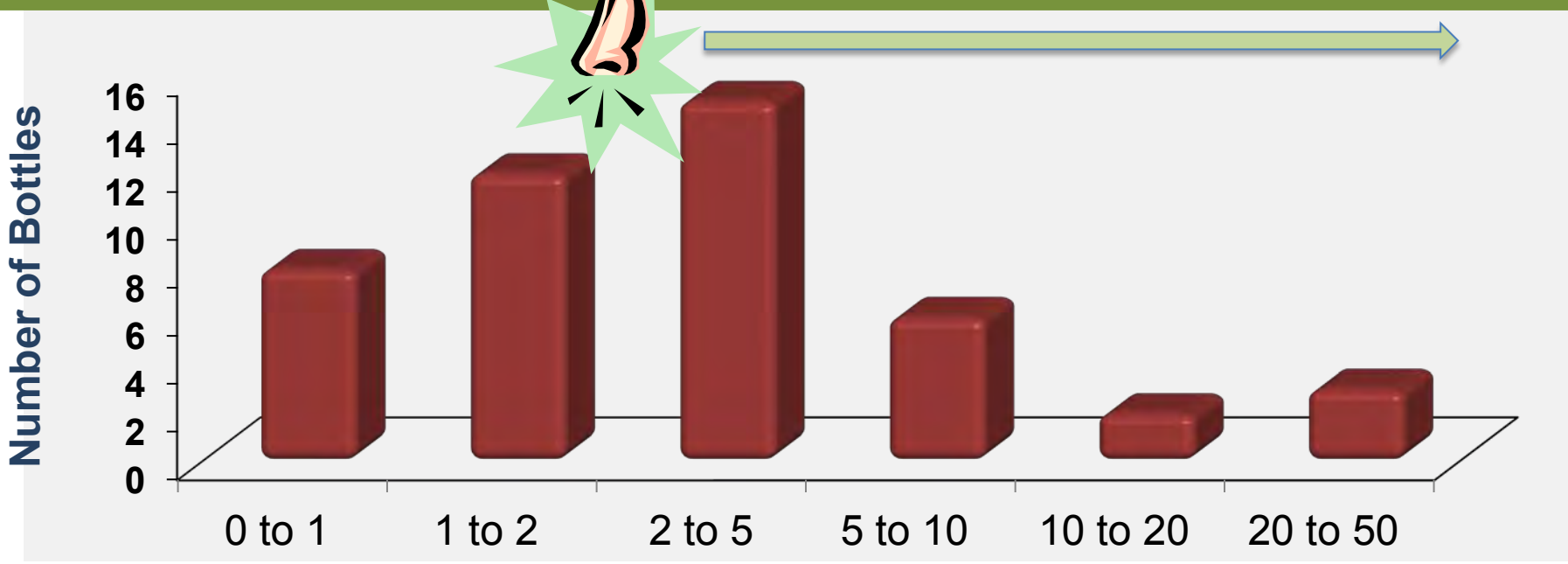


65% of the current Pinot Noir wines analysed contained 1,8-Cineole at or above its aroma detection threshold

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

The Australian Wine Research Institute

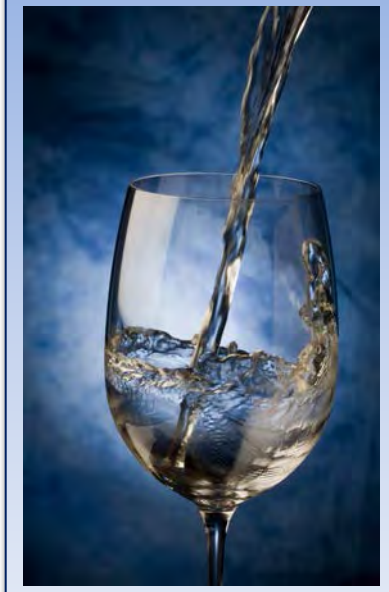


Is 1,8-cineole found in significant concentrations in Australian white wine?

The Australian Wine Research Institute

NO!

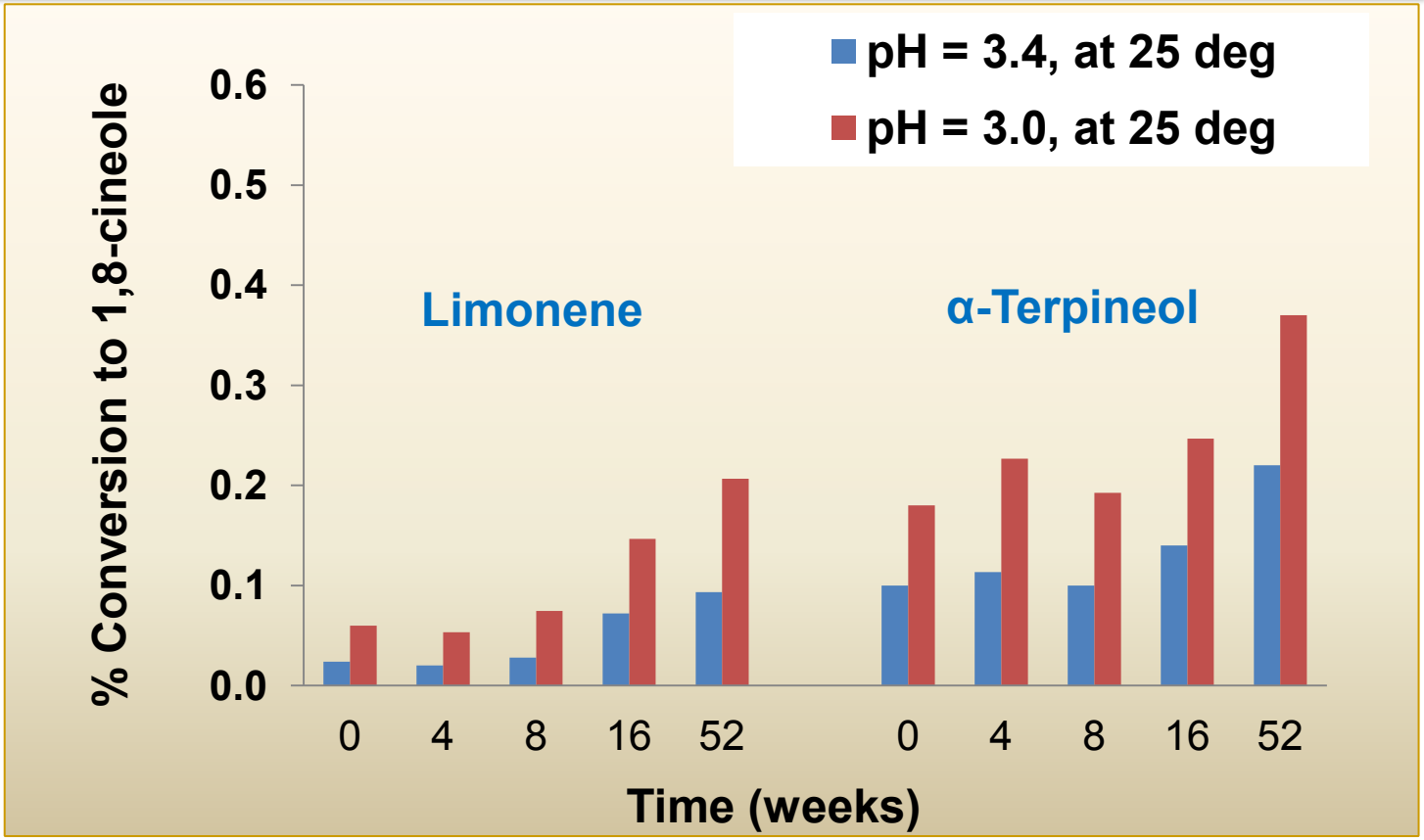
Out of 44 white wines
(12 Rieslings, 10 Sauvignon Blancs, 10 Semillons and 12 Chardonnays)
1,8-cineole was not detected above 0.8 µg/L in any wine



Formation of 1,8-cineole from precursors?

The Australian Wine Research Institute

% Conversion to 1,8-Cineole from terpenoid precursors

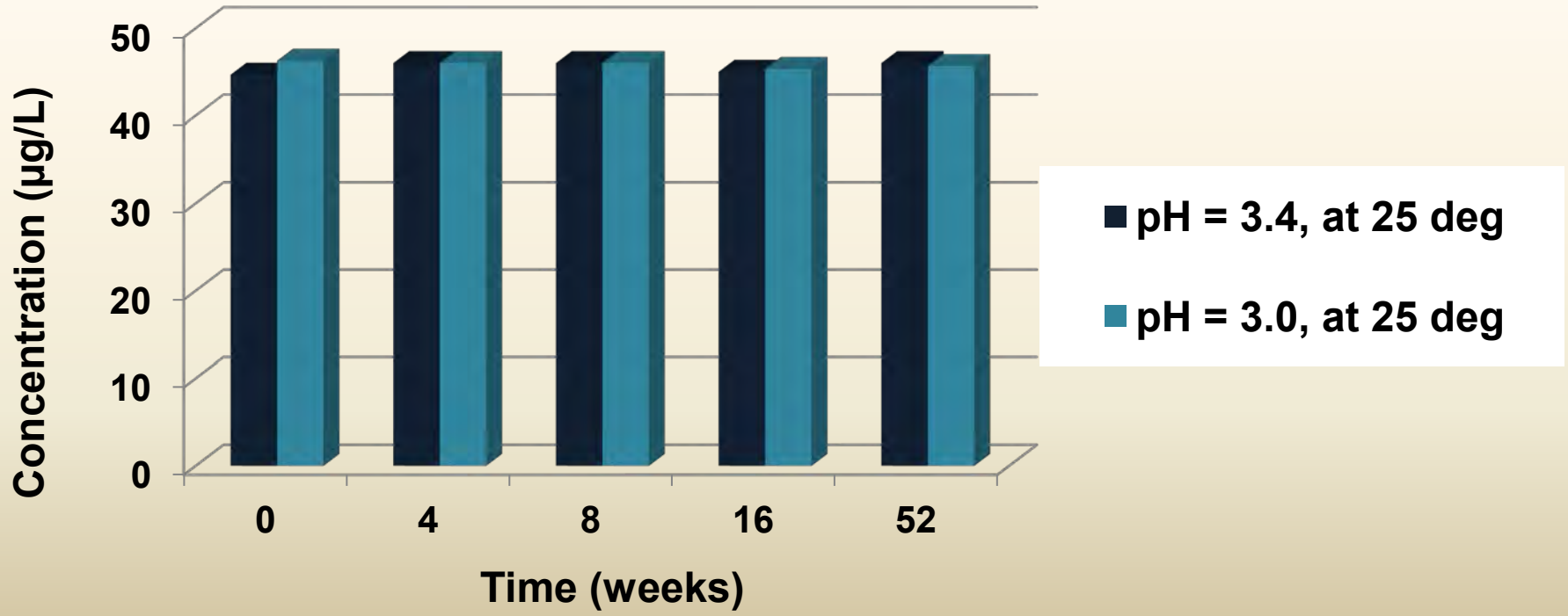


limonene and α-terpineol not significant precursors

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

Stability of 1,8-cineole over 12 months in 10% model wine

The Australian Wine Research Institute



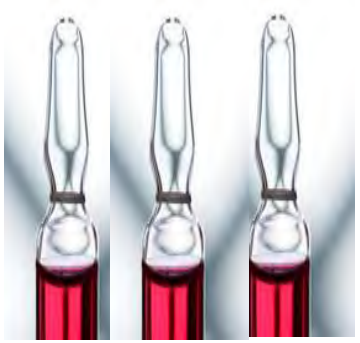
- 1,8-Cineole was stable after 12 months of storage at both model wine pH values
- 1,8-cineole was also stable when samples were heated to 45 ^{o}C for 4 months

Scalping of 1,8-cineole

The Australian Wine Research Institute

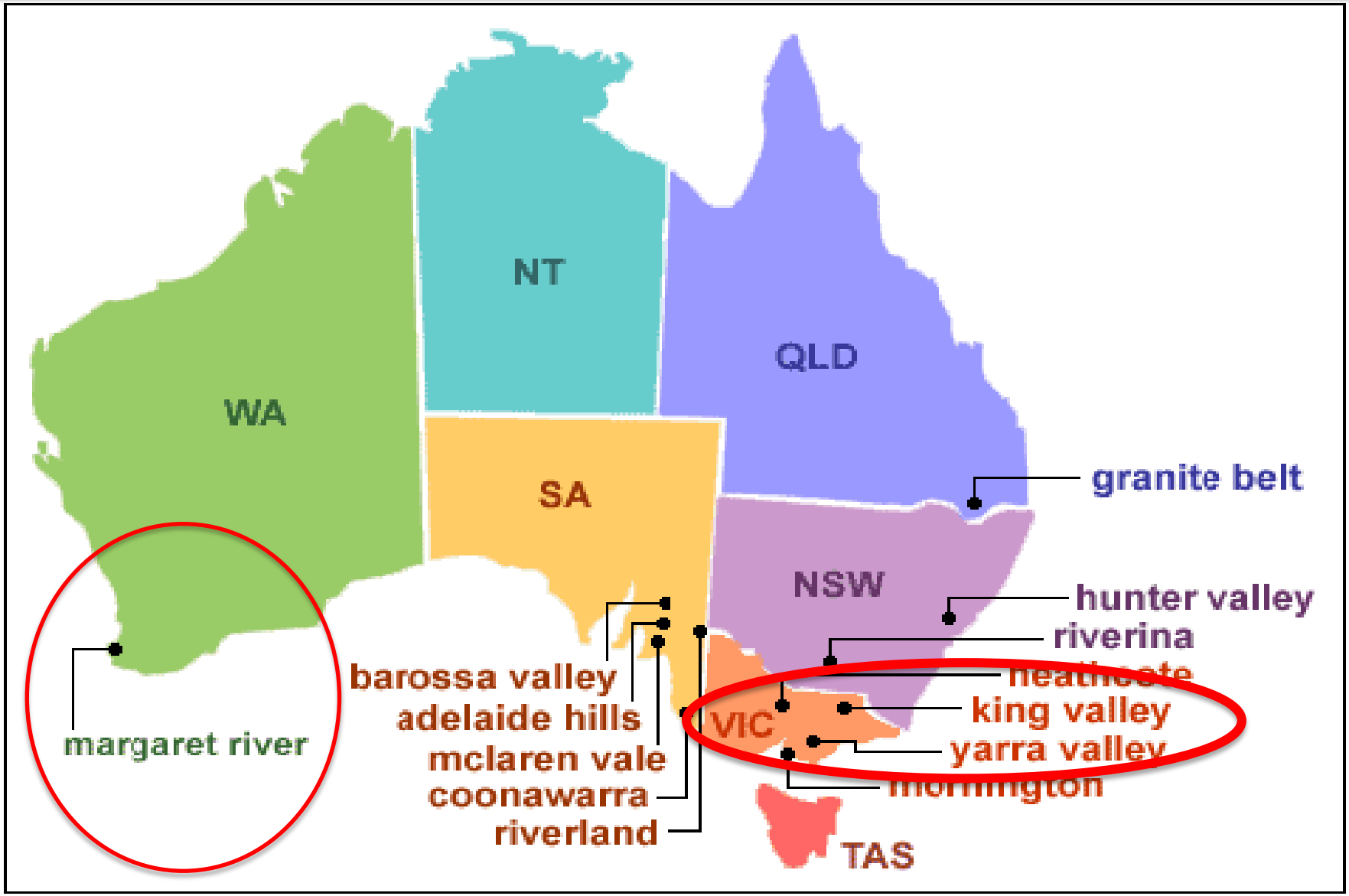
- We investigated whether 1,8-cineole could be scalped by natural cork, synthetic or screw cap closures from a Shiraz wine (& glass ampoules as controls)
- Over a 12 month period there was minimal scalping for natural cork or screw cap closures
- Only 14% reduction of 1,8-cineole under synthetic closure was observed



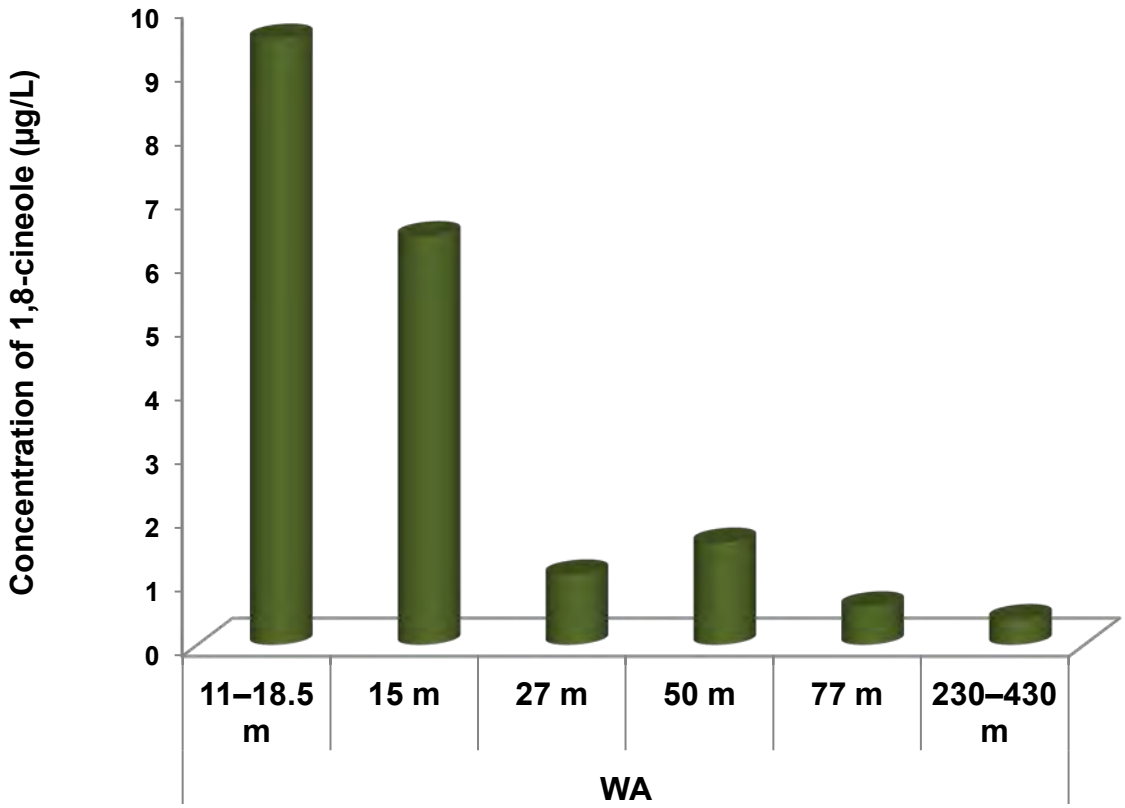
Wines obtained from a single vineyard in Western Australia & the Yarra Valley

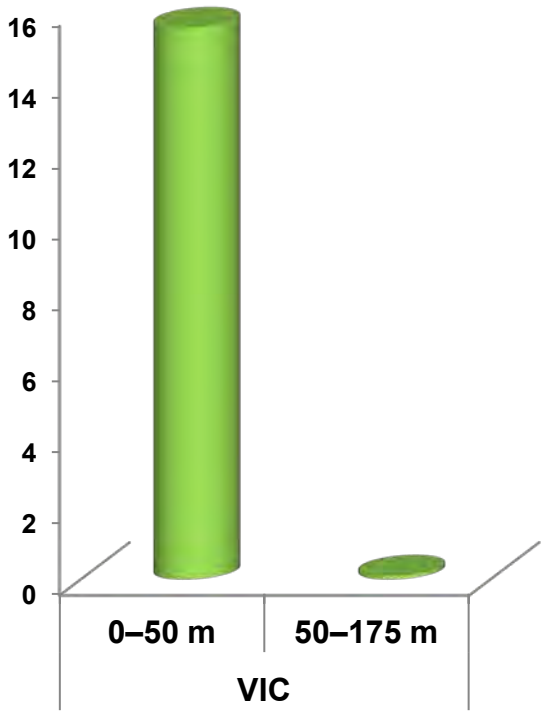
The Australian Wine Research Institute



1,8-Cineole concentration decreases

further away from Eucalyptus trees





Commercial ferments

The Australian Wine Research Institute

- 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

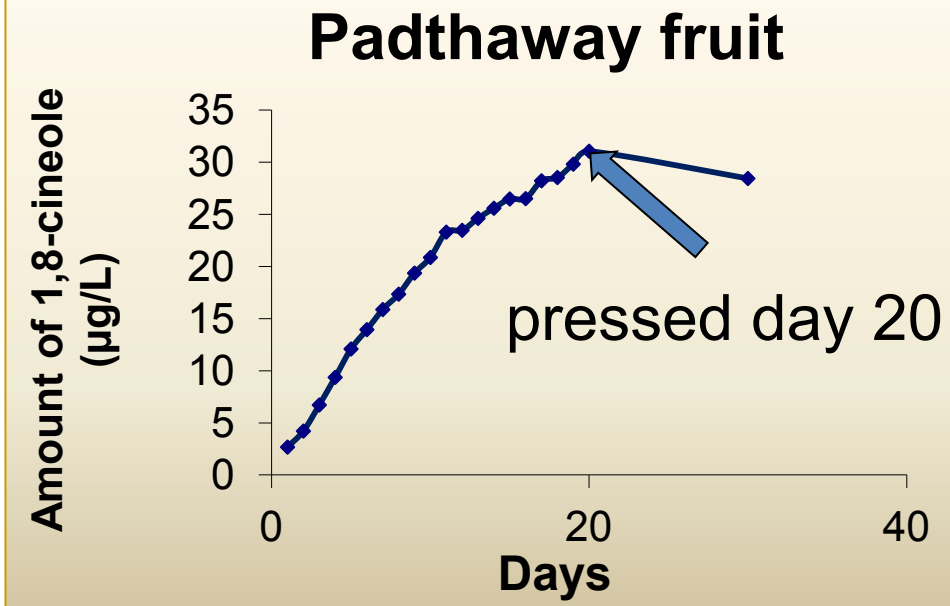
The Australian Wine Research Institute

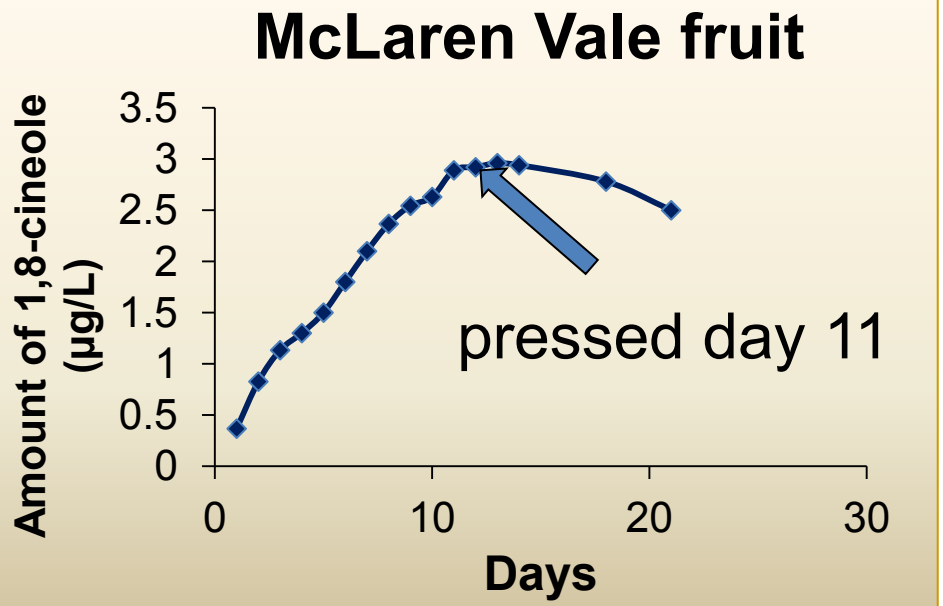
Changes of 1,8-cineole during fermentation

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

The Australian Wine Research Institute

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

Eucalyptus trees

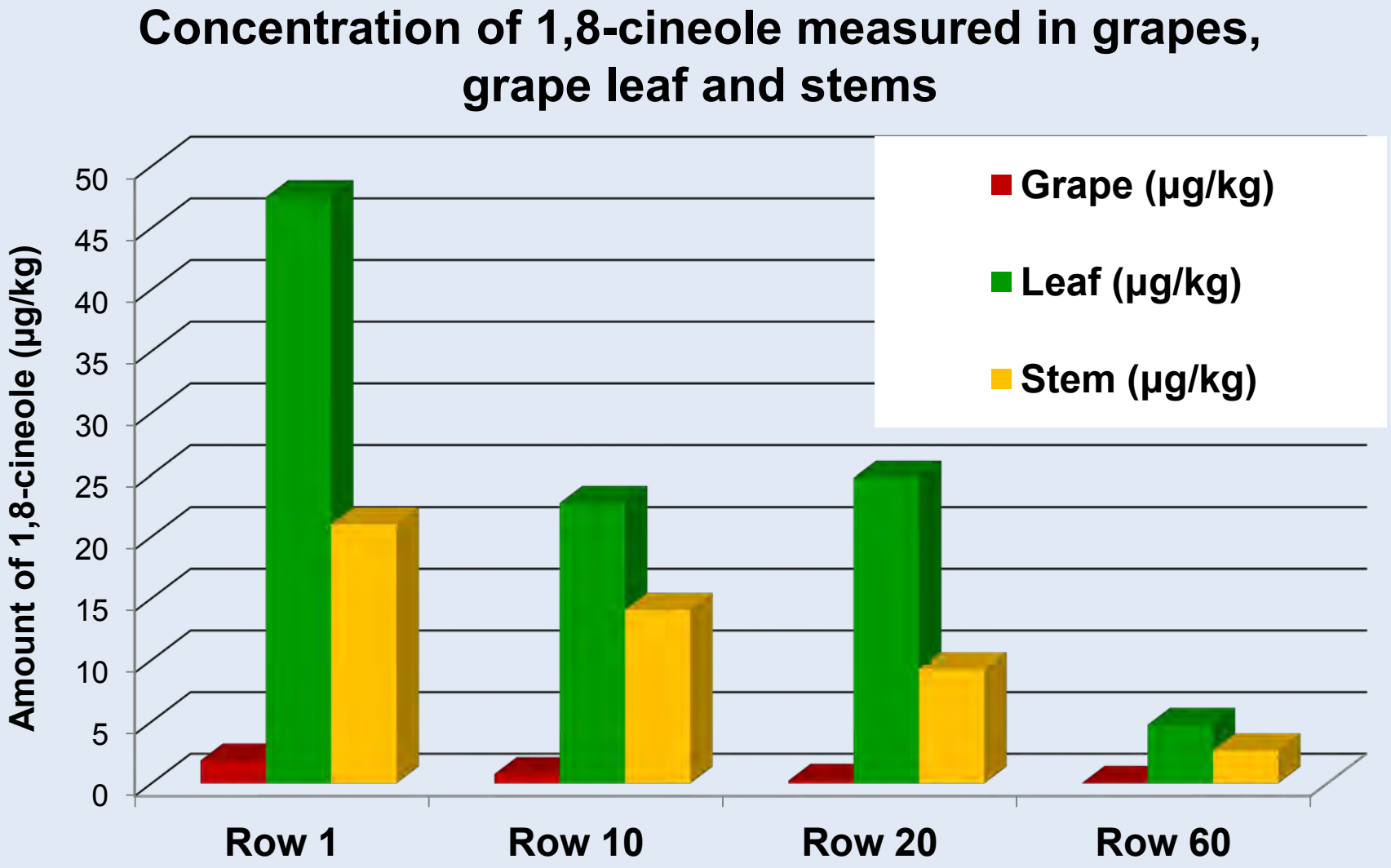
The Australian Wine Research Institute

Effect of distance to *Eucalyptus* trees

The Australian Wine Research Institute

Vineyard Study

The Australian Wine Research Institute



Concentration of 1,8-cineole in grape skins & grape pulp

The Australian Wine Research Institute

0.36 ng/berry in the grape pulp

1.31 ng/berry in the grape skins

Airborne transmission

The Australian Wine Research Institute

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

Traps installed in both vertical and horizontal configurations

The Australian Wine Research Institute

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

The Australian Wine Research Institute

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

Only the first 3 Rows picked

Rows 1 to 3

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

Fermentation design

The Australian Wine Research Institute

Treatment 1

Rosé
Pressed
Immediately

Treatment 3

Grape Leaves & Stem

Treatment 2

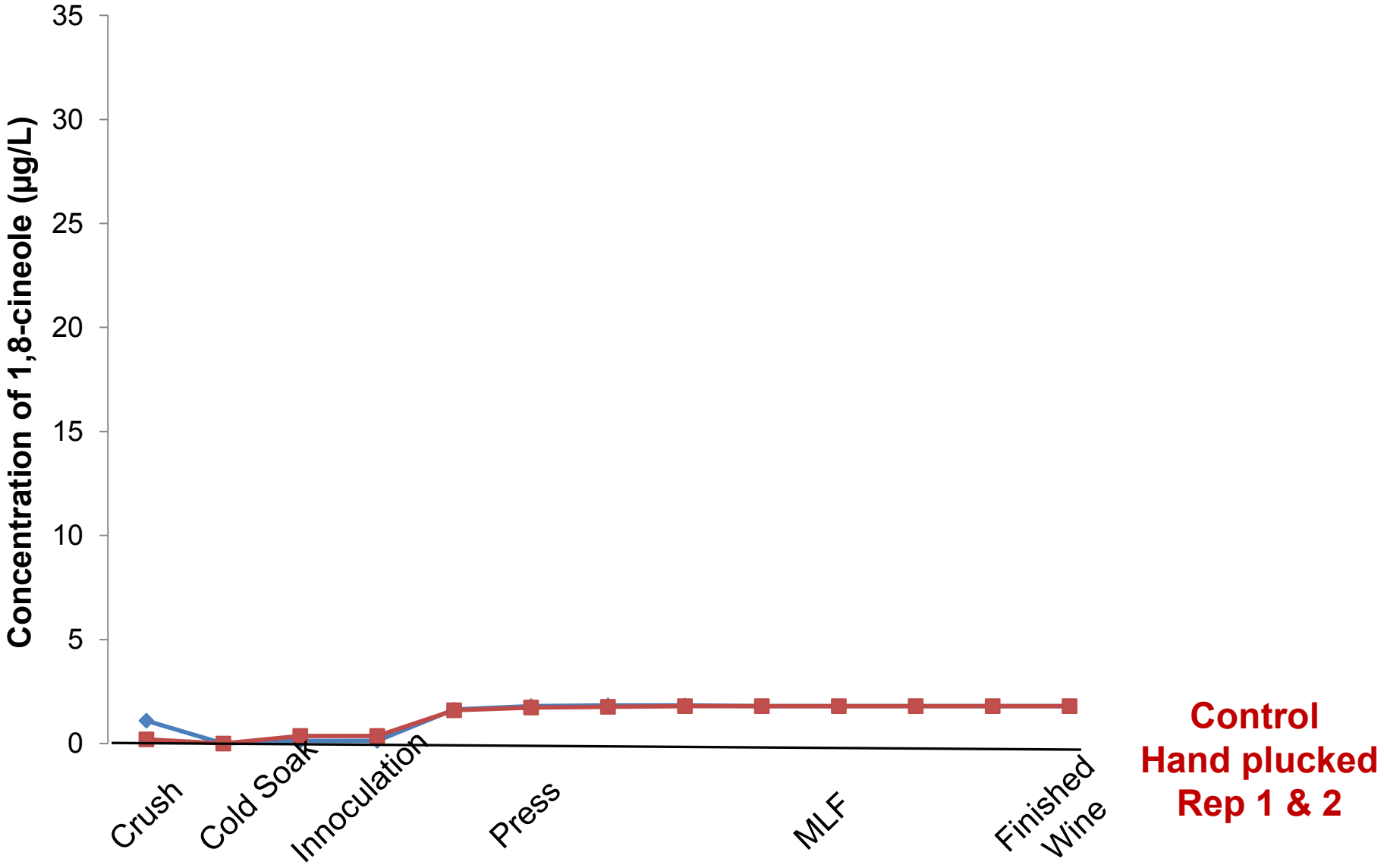
Control
Hand
Plucked

Treatment 4

Eucalyptus
Mix

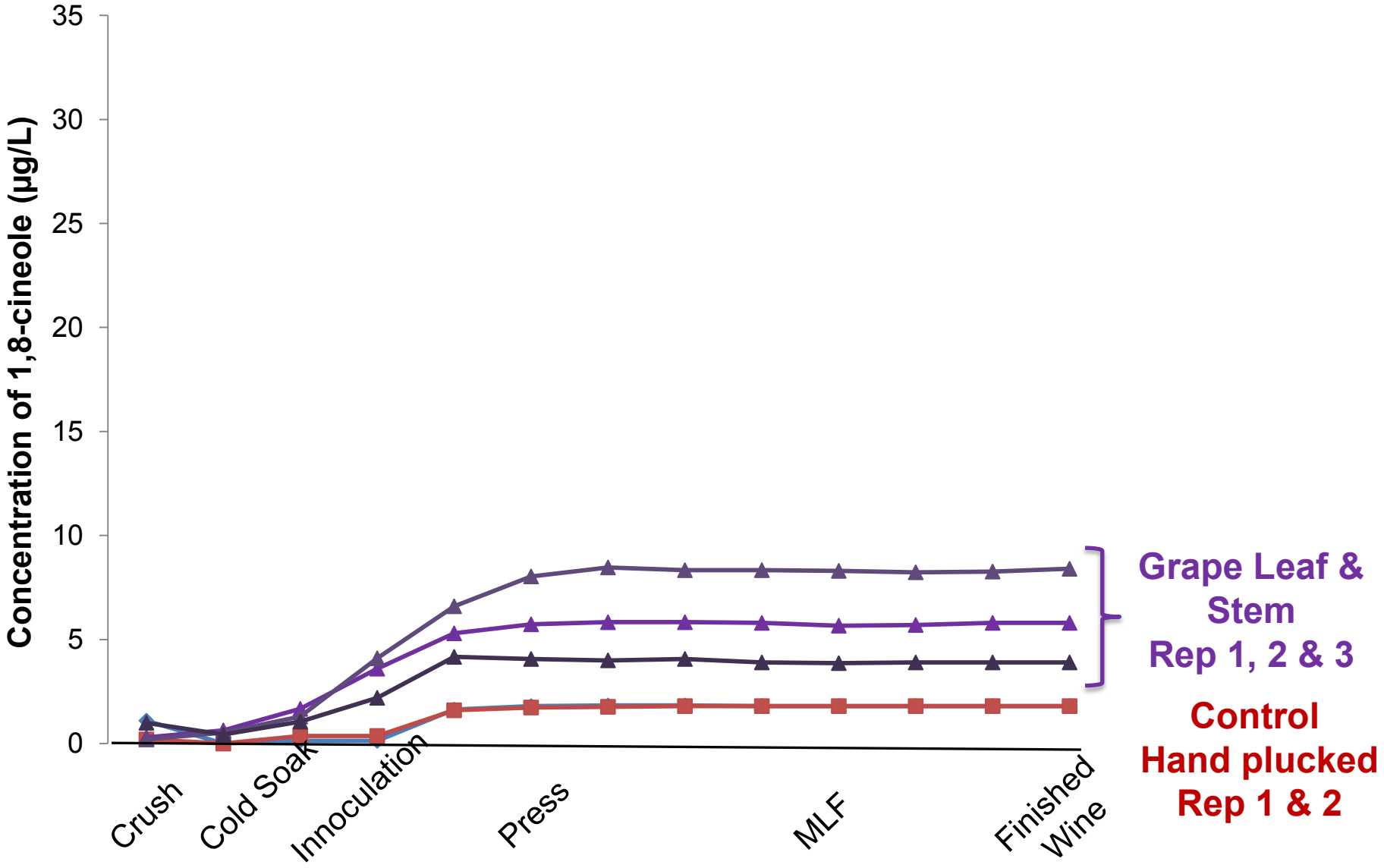
Fermentation curves: Influence of MOG

The Australian Wine Research Institute



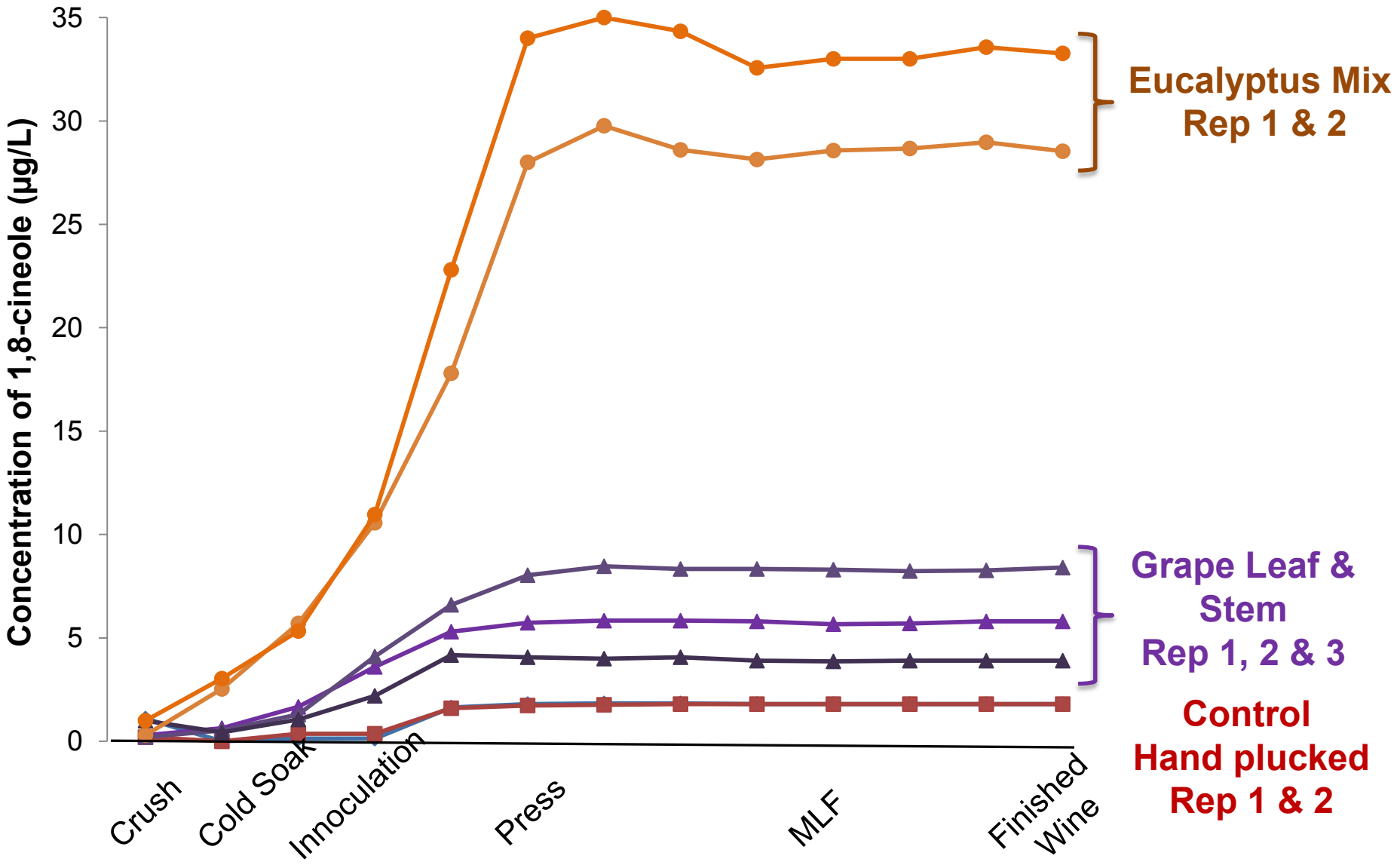
Fermentation curves: Influence of MOG

The Australian Wine Research Institute



Fermentation curves: Influence of MOG

The Australian Wine Research Institute



The Australian Wine Research Institute

33 *Eucalyptus* leaves found –

In 550 kg of hand picked fruit

Yet fruit is often harvested mechanically

Possibility of Translocation ?

The Australian Wine Research Institute

Experiment 1

d_6-1,8-cineole was added into the soil of the potted vines

Experiment 2

d_6-1,8-cineole was painted onto the grape leaves from the potted vines

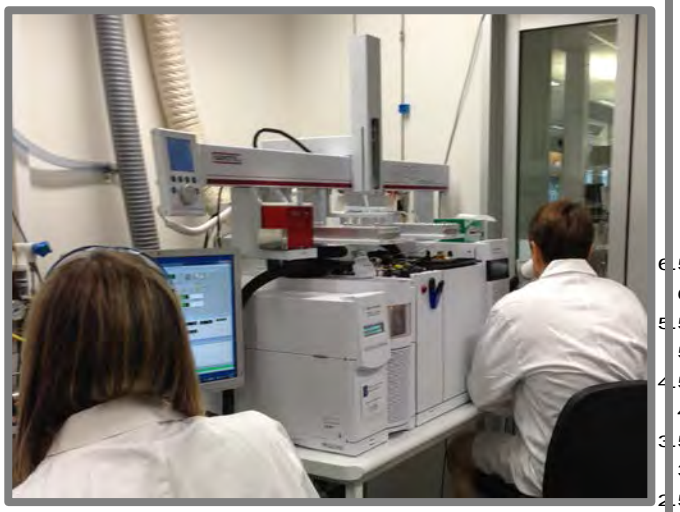
Results

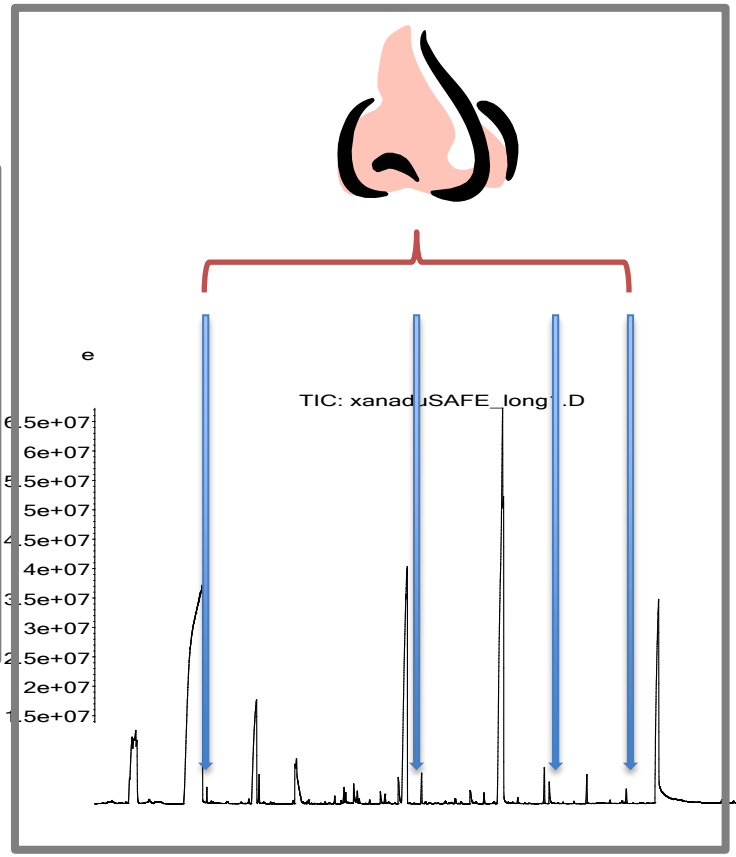
Results have shown that in both of these experiments no d_6-1,8-cineole was found in any detectable levels – indicating no translocation is occurring.

Additional Experiments

The Australian Wine Research Institute

Investigated whether other compound(s) contribute to ‘minty’ aroma in red wine or is it purely an effect of 1,8-cineole concentration ?





Conclusions

The Australian Wine Research Institute

- 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 wine

Tips to modulate 1,8-cineole in wine

The Australian Wine Research Institute

- 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

Acknowledgements

Dr Mark Sefton, Dr David Jeffery & Dr Leigh Francis

Industry partners – vineyard/ferment samples

Samantha Anderson, Katryna van Leeuwen & Natoiya Lloyd

Kevin Pardon & Dr Gordon Elsey

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australia's grapegrowers and winemakers through their investment body, the Grape and Wine Research Development Corporation, with matching funds from the Australian Government.

Thank you

Wine Innovation Cluster, Urrbrae SA

A W R I

The Australian Wine Research Institute

Information and online tools available on the AWRI website

www.awri.com.au

The Australian Wine Research Institute

Supporting Australian grape and wine producers

Home | Con

About Us | Research & Development | Industry Support and Education | Commercial Services | Information Services | Our People & Employm

m.au

New resources navigation

The Australian Wine Research Institute

Resources for vineyards

Information on agrochemicals and related analytical services, advice and support, fact sheets and more.

Resources for wineries

Includes permitted additives, winemaking calculators, laboratory setup and method, Frequently Asked Questions, and products and suppliers.

Resources for wine exporters

Information for exporters such as factsheets and publications, analytical services and more.

Resources for consumers

Factsheets and publications, library resources, links to other websites, research projects and wine and health

Sign up for new website account

The Australian Wine Research Institute

Resources for vineyards

Information on agrochemicals and related analytical services, advice and support, fact sheets and more.

Member Login

User Name

forgotten your password sign up

Subscribe to eNews

and eBulletins

Search The AWRI Website

Search keywords

Username

E-mail

First Name

Last Name

Company Name

Category

-- choose a category --

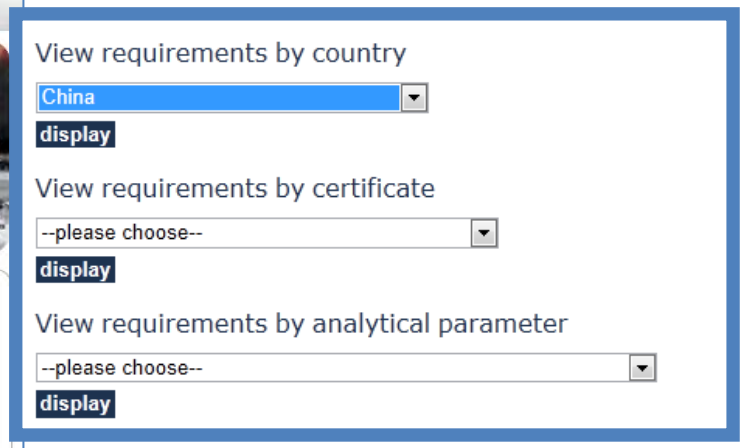
-- choose a category --
Levy payer (Australian winery or grapegrower)
Industry body (GWRDC, AWBC, WFA, State/Regional industry body, etc.)
Australian research organisation or university
Student (Australian resident)
Student (overseas)
Journalist
Consultant (winemaking, Australian resident)
Consultant (viticulture, Australian resident)

Enter account details

- AWRI will verify account requests.
- All approved requests will be activated.
- A confirmation email including password will be sent to the requester.
- Some sections can only be accessed via username / password.

Regulatory Assistance

The Australian Wine Research Institute

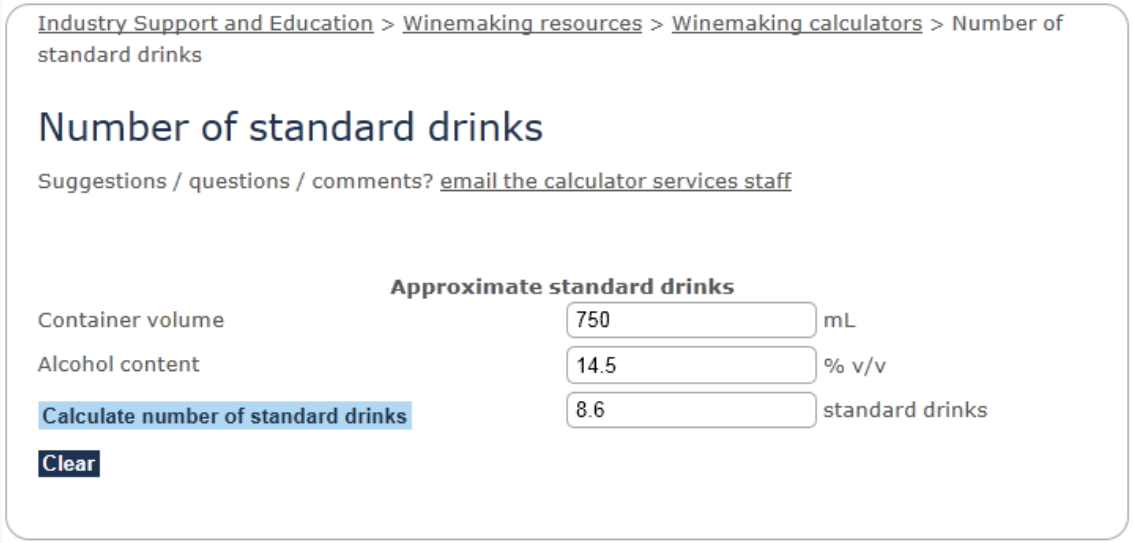


Searchable databases on permitted additives and processing aids, and export analytical requirements

Winemaking calculators

The Australian Wine Research Institute

- Acid addition
- Ascorbic acid addition
- Bentonite addition
- Carbon addition
- Copper sulfate addition
- Crème of Tartar addition
- Deacidification
- Diammonium phosphate additions
- Ferro Cyanide trial
- Fining trial
- Fortification
- Gelatine addition
- General conversion calculators
- Grape juice concentrate (GJC) addition using Pearson Square
- Hydrogen peroxide addition
- Interconversion of acidity units
  - Acetic acid
  - Citric acid
  - Lactic acid
  - Malic acid
  - Sulfuric acid
  - Tartaric acid
  - Tartaric acid (meq/L)
- Isinglass addition
- Laboratory stock solution
- Methanol expressed as proportion of ethanol calculator
- Micro-ox addition
- Molecular sulfur dioxide addition
- Number of standard drinks
- Paired preference
- PMS addition
- PVPP addition
- Same/Different
- Sensory difference test
  - Duo-trio
  - Paired comparison
  - Triangle
- Sorbic acid addition
- Sulfur dioxide addition
- Tannin addition
- Winery stock solution



Industry Support and Education > Winemaking resources > Winemaking calculators > Number of standard drinks

Number of standard drinks

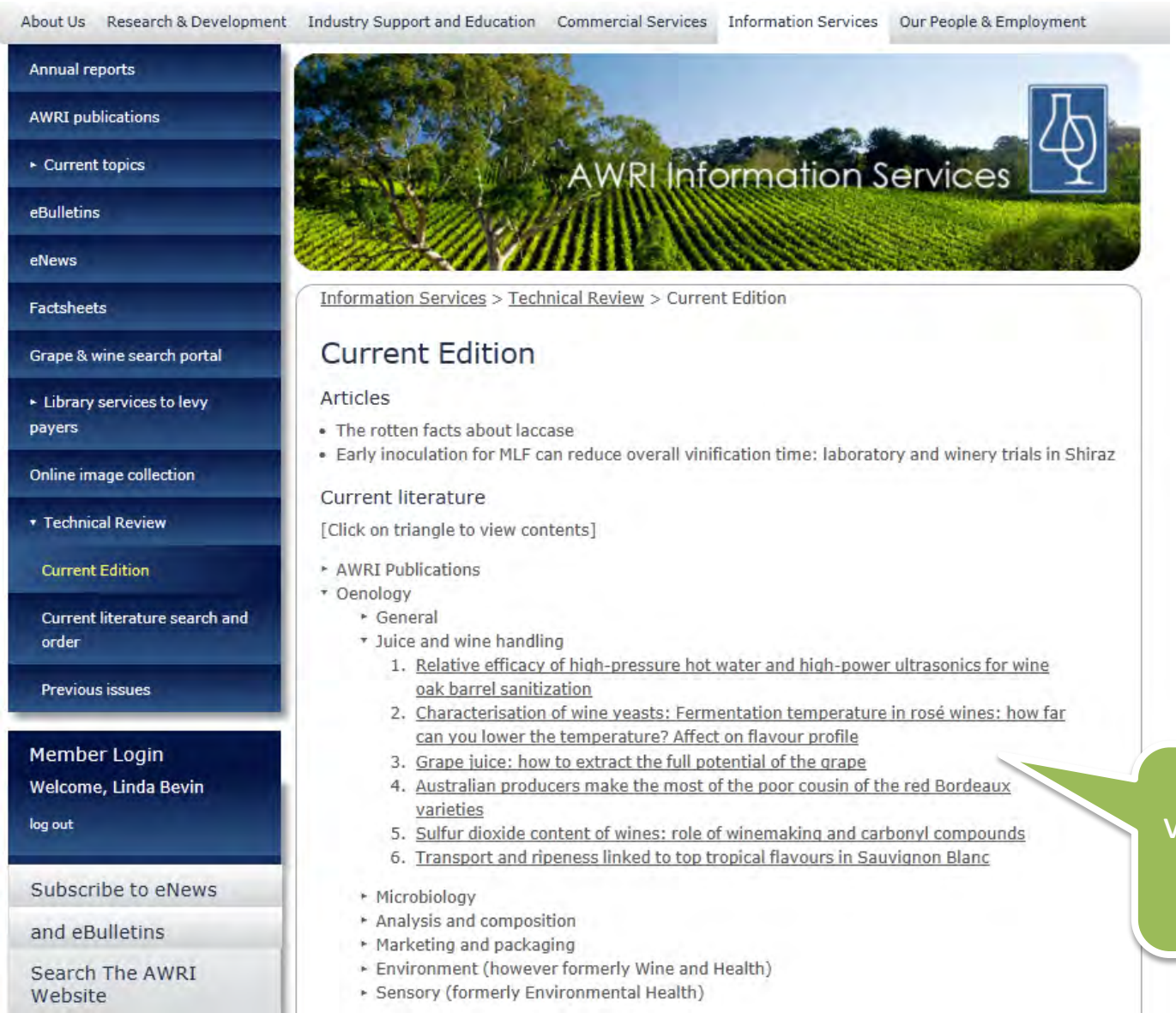
Suggestions / questions / comments? email the calculator services staff

	Approximate standard drinks	
Container volume	750	mL
Alcohol content	14.5	% v/v
Calculate number of standard drinks	8.6	standard drinks

Clear

Information Services

The Australian Wine Research Institute

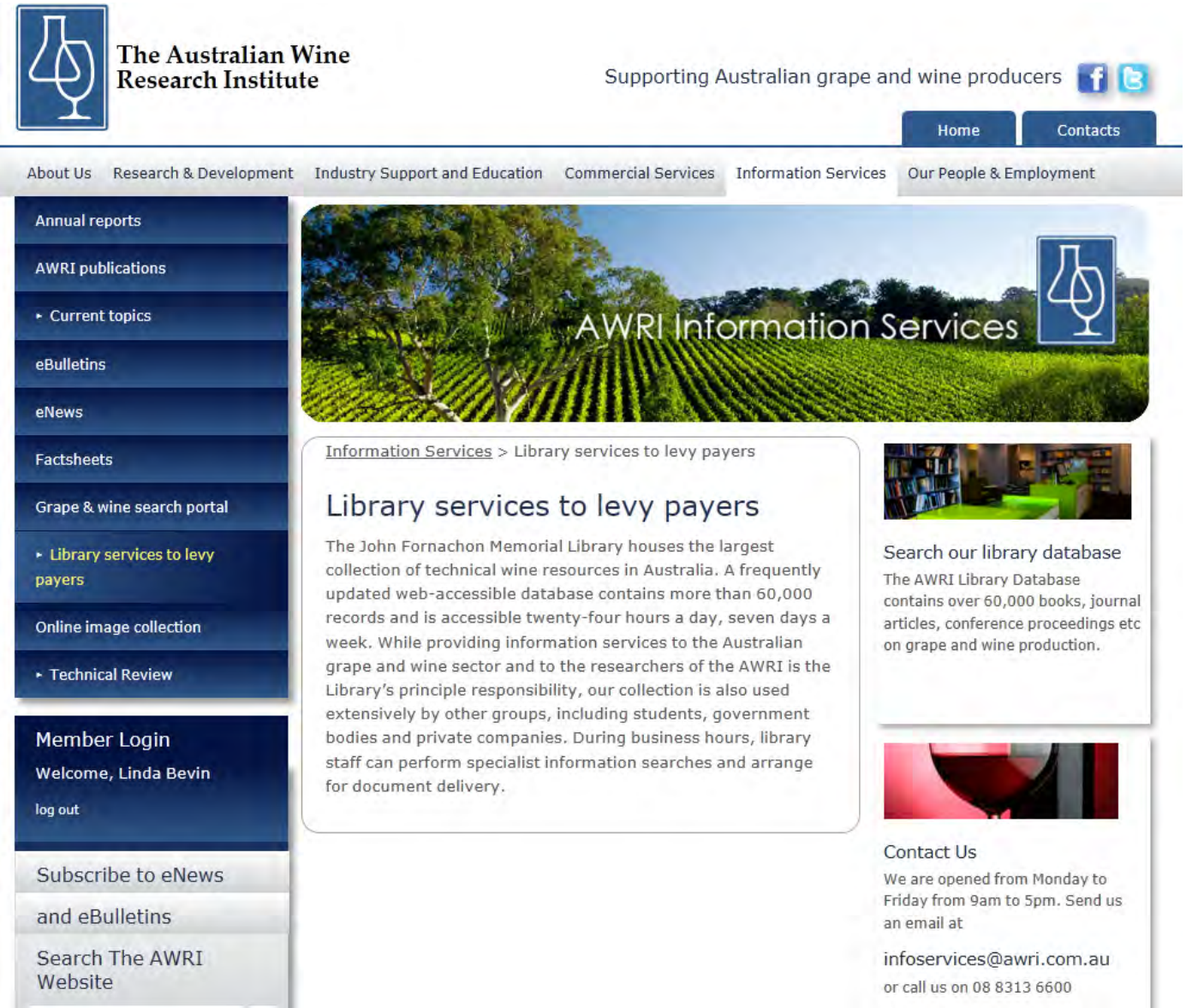


- eBulletins
- eNews
- Online image collection
- Grape and wine search portal
- Factsheets
- AWRI publications
- *Technical Review*

Click on article name to view more information and to order a copy of the article

Library Services

The Australian Wine Research Institute



- Free library service to Australian grape and wine producers
- Over 65,000 books, journal articles, conference proceedings etc
- Online library database
- *Fast response time (1 to 3 days)*

Mobile website

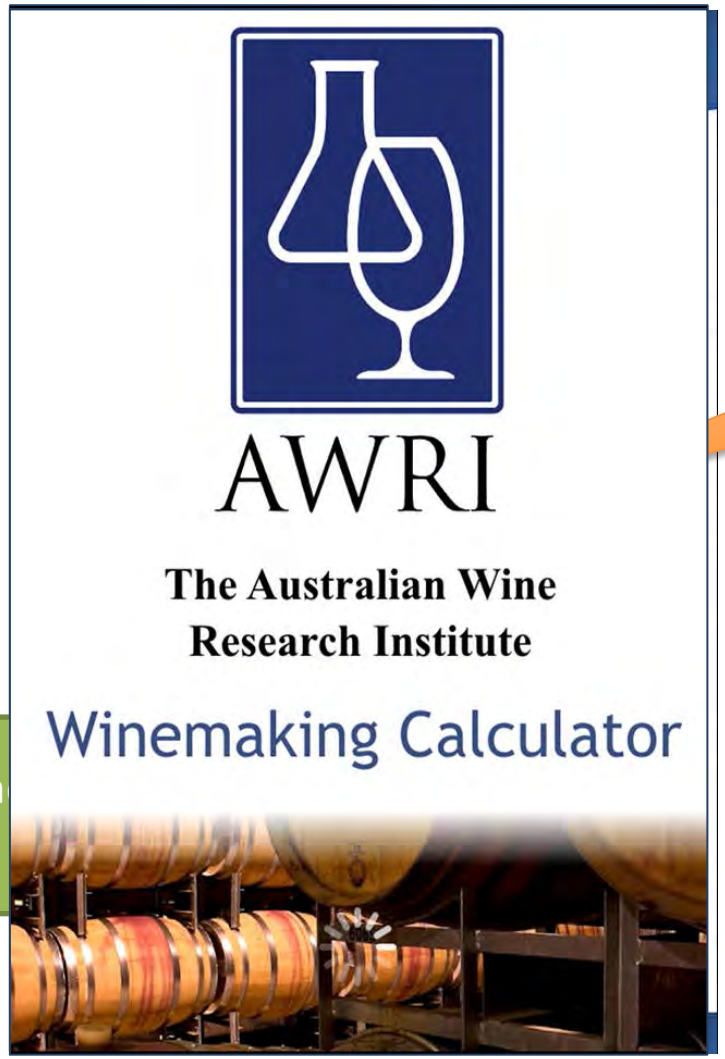
The Australian Wine Research Institute

Mobile-friendly website launched in October 2012.

Provides content to key projects and services offered by the AWRI.

Linked to full website for detailed information.

Winemaking calculator app



Calculators grouped for easy access

Enter the search an
select 'Calculate'

http://www.awri.com.au/industry_support/winemaking_resources/winemaking-calculators-app/

Webinars

The Australian Wine Research Institute

Annual webinar program since 2011

Participate in a live seminar from your desk using a computer with Internet access

Weekly session consisting of 20 min presentation and 20min Q&A

The 2013 Program features 23 webinars

http://www.awri.com.au/industry_support/courses-seminars-workshops/webinars/

2013 webinar program

Presentation	Description	Presenter	Date	Register
Optimising your laboratory for the best results	Laboratories are a critical, and often expensive, part of modern wine production. This webinar will highlight a number of areas that are important to not only ensure results are accurate, but to achieve them in an efficient and cost effective manner. Some of the topics that will be discussed include basic lab quality systems; LIMS; lab design; lean systems and troubleshooting common laboratory issues.	Eric Wilkes (The AWRI)	23/07/2013	Register
Strategies for reducing alcohol levels in wine	The AWRI has taken a holistic approach to the development of strategies for the reduction of alcohol concentration in wine. Several viticultural and fermentation practices show considerable promise for the production of good quality reduced-alcohol wines. This session will present our latest findings and point to the need to evaluate a combinatorial approach to reducing alcohol concentration in wine.	Cristian Varela (The AWRI)	30/07/2013	Register
The latest on CMCs	Carboxymethylcellulose is becoming an important part of the winemaker's tool box for white wine tartrate stabilisation. However, like all wine additives, there is more to the successful use of CMCs than sales brochures might suggest. This webinar will look at how CMC works; when it is appropriate to use; what precautions you need to take and the best ways to test the wine when using it.	Eric Wilkes (The AWRI)	6/08/2013	Register
Till death do us part: Cell death in the grape berry as a quality measure	TBA	Steve Tyerman (The University of Adelaide)	20/08/2013	Register
Climate influence and trends for the wine industry	TBA	Darren Ray (Bureau of Meteorology)	27/08/2013	Register

http://www.grapeandwineevents.com.au/home

The Australian Wine Research Institute

australian grape & wine events calendar

event search | events calendar | locations | events | members log-in | contact us

Date	Event
14 May 2013	AWRI Hunter Valley Seminar *Mercure Resort Hunter Valley, Pokolbin NSW*
14 May 2013	New Technologies in Grapegrowing and Winemaking *Treasury Wine Estates vineyards, Padthaway SA*
15 May 2013	AWRI Barossa Adapting to difficult vintages workshop *Vine Inn, Nuriootpa SA*
21 May 2013	AWRI Clare Adapting to difficult vintages workshop *The Artisan Table, Clare SA*
21 May 2013	AWRI Langhorne Creek and Adelaide Hills Seminar *Langhorne Creek Football Clubrooms, Langhorne Creek SA*
22 May 2013	Regional Smoke Taint Update *Gum San Chinese Heritage Centre, Ararat VIC*
23 May 2013	GWRDC #INseries workshop - China Insights: McLaren Vale
23 May 2013	Regional Smoke Taint Update *Yarra Glen Memorial Hall, Yarra Glen VIC*
24 May 2013	GWRDC #INseries workshop - China Insights: Barossa
24 May 2013	Regional Smoke Taint Update *Oxley Shire Hall, Oxley VIC*
27 May 2013	GWRDC #INseries workshop - China Insights: Hunter Valley
28 May 2013	GWRDC #INseries workshop - China Insights: Yarra Valley
30 May 2013	GWRDC #INseries workshop - China Insights: Margaret River
30 May 2013	Margaret River Wine in Sydney *The Barnet Long Room, Customs House, Circular Quay NSW*

Complete the survey & access presentations online

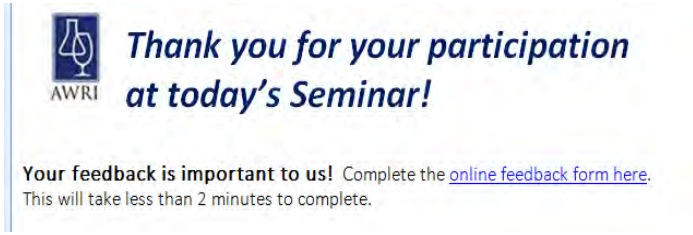
The Australian Wine Research Institute

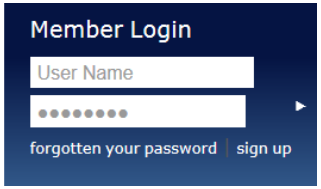
Complete online feedback (link in email)

Redirected to AWRI Website

Log in

Save to USB





Instructions will be emailed after today's seminar

Thank you for your participation today!