GRAPE & WINE ROADSHOW

Bendigo Seminar

Wednesday 14th August, 2013

AWRI

Pepper and Spice in Shiraz: what influences rotundone levels in wines?

Leigh Francis

Morning Tea

GRAPE & WINE ROADSHOW

Bendigo Seminar

Wednesday 14th August, 2013

Does soil and vine nutrient status affect wine quality?
Mark Krstic

Using MLF to accentuate wine aroma and flavour
Eveline Bartowsky

Carboxymethylcellulose and important tool for white wine tartrate stabilization
Eric Wilkes

Lunch

GRAPE & WINE ROADSHOW

Bendigo Seminar

Wednesday 14th August, 2013

VESDA – The new risk assessment tool for smoke taint

Ricky James, DEPI Victoria

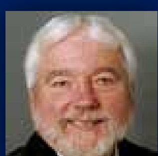
Afternoon Tea

GRAPE & WINE ROADSHOW

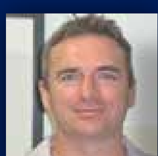
Bendigo Seminar

Wednesday 14th August, 2013

Using the timing of MLF inoculation to optimise your winemaking
Eveline Bartowsky



Causes and management of slow and stuck fermentations
Paul Henschke



Features of the AWRI website and closing comments
Mark Krstic

A W R I

The Australian Wine Research Institute

Pepper and spice in Shiraz: what influences rotundone levels in wines?

Leigh Francis

Tracey Siebert

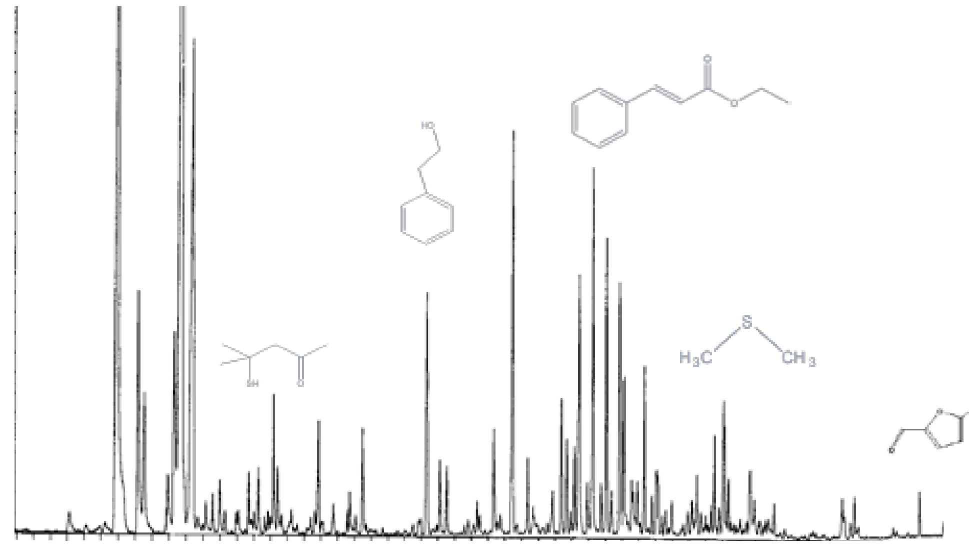
Mark Solomon

Gerard Logan (University of Auckland)

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

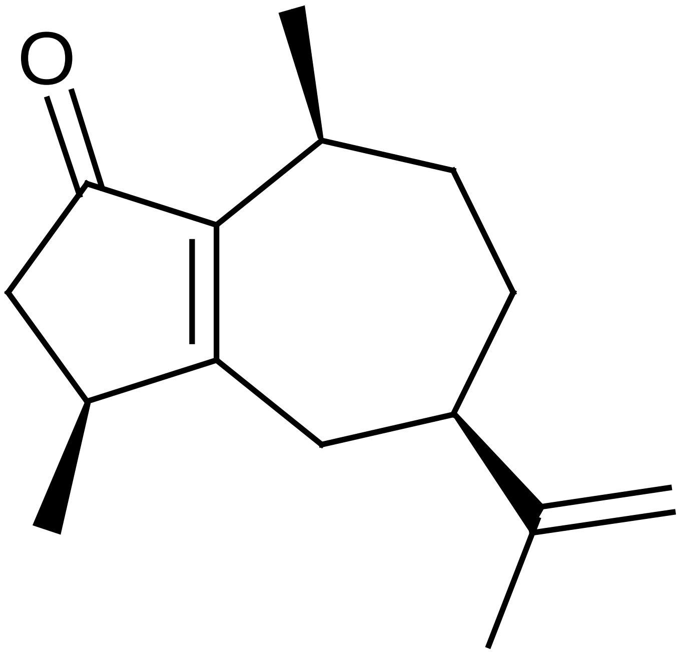
Gas chromatography-mass spectrometry

The Australian Wine Research Institute



(-)-Rotundone

The Australian Wine Research Institute



- Identity confirmed with reference compound (Symrise)

Cyperus rotundus, nut grass weed

- ^{1}H and ^{13}C NMR, ORD
- GC-MS-O, co-injections
- Qua DA

By GC-MS-O, rotundone was established as the principal aroma impact compound for pepper aroma in grapes and wine.

Wood, C.; Siebert, T. E.; Parker, M. et al. *J. Agric. Food Chem.* **2008**, 56, 3738-3744
Siebert, T. E. et al. *J. Agric. Food Chem.* **2008**, 56, 3745-3748

How potent is rotundone?

The Australian Wine
Research Institute

aroma detection threshold

8 ng/L in water

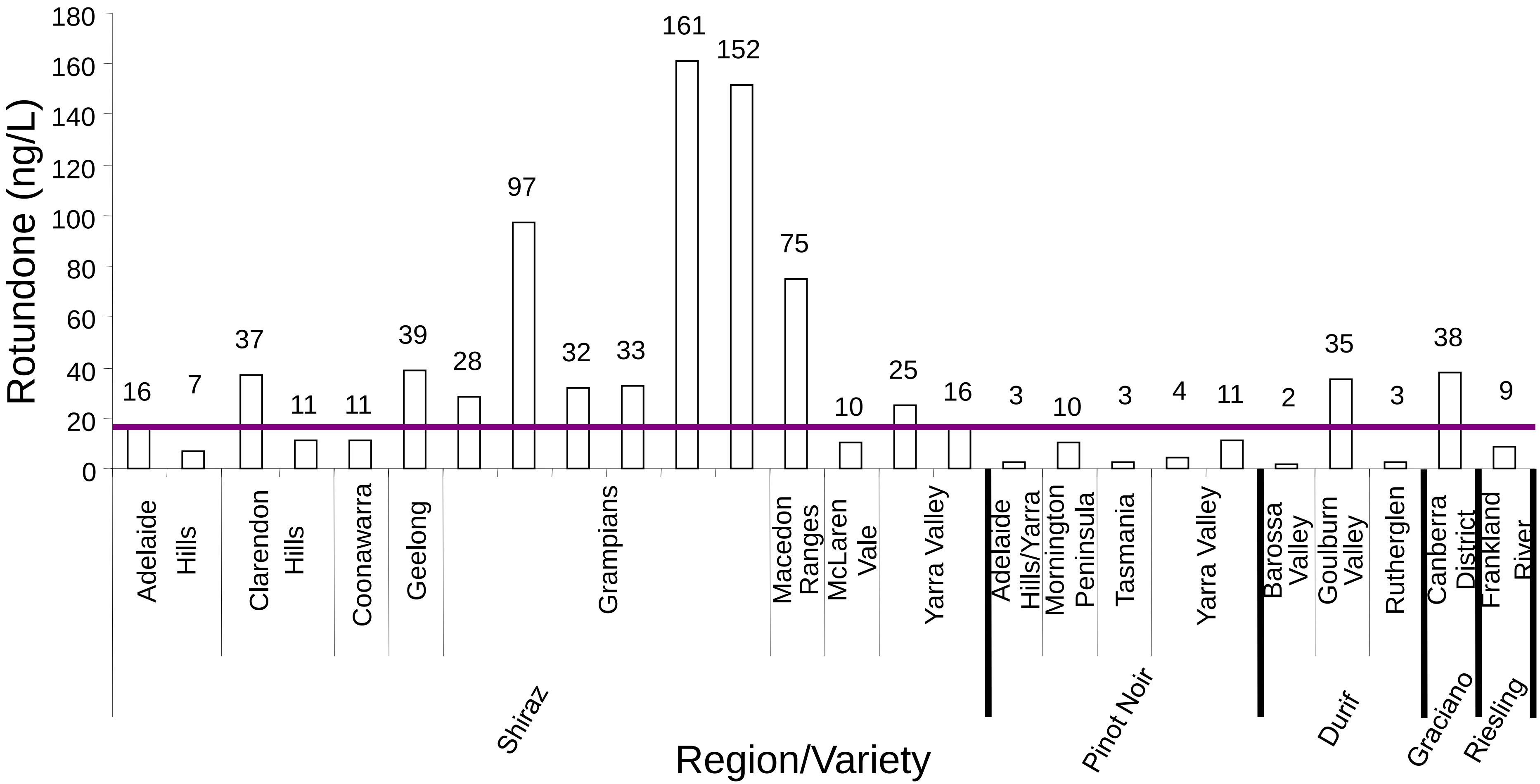
16 ng/L in red wine

20 to 25% of the panellists were anosmic to rotundone

Wood, C.; Siebert, T. E.; Parker, M. et al. *J. Agric. Food Chem.* **2008**, 56, 3738-3744

Rotundone in Australian wines

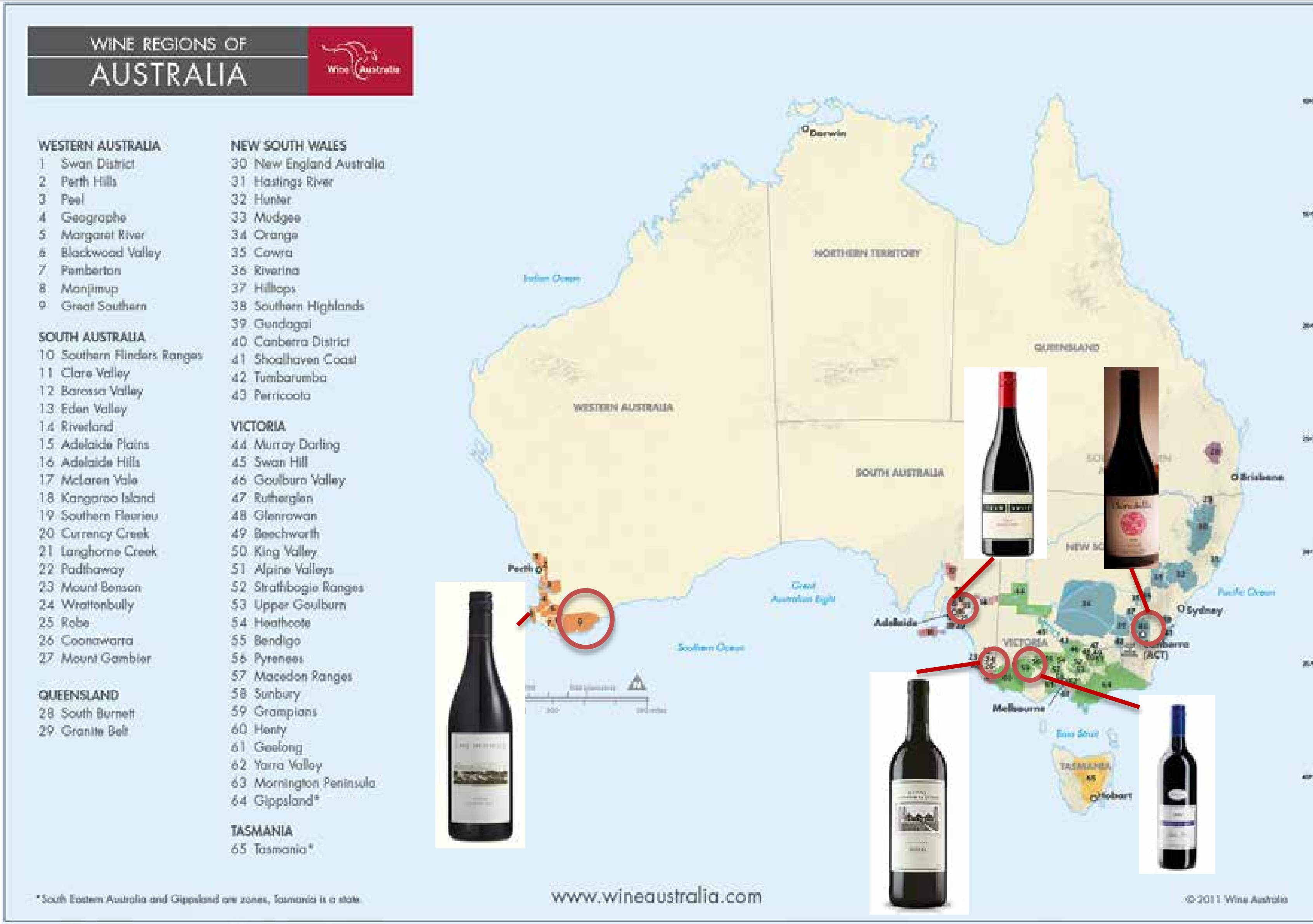
The Australian Wine Research Institute



AWRI TR #180 (June 2009)

Australian cool climate Shiraz

The Australian Wine Research Institute



New Zealand

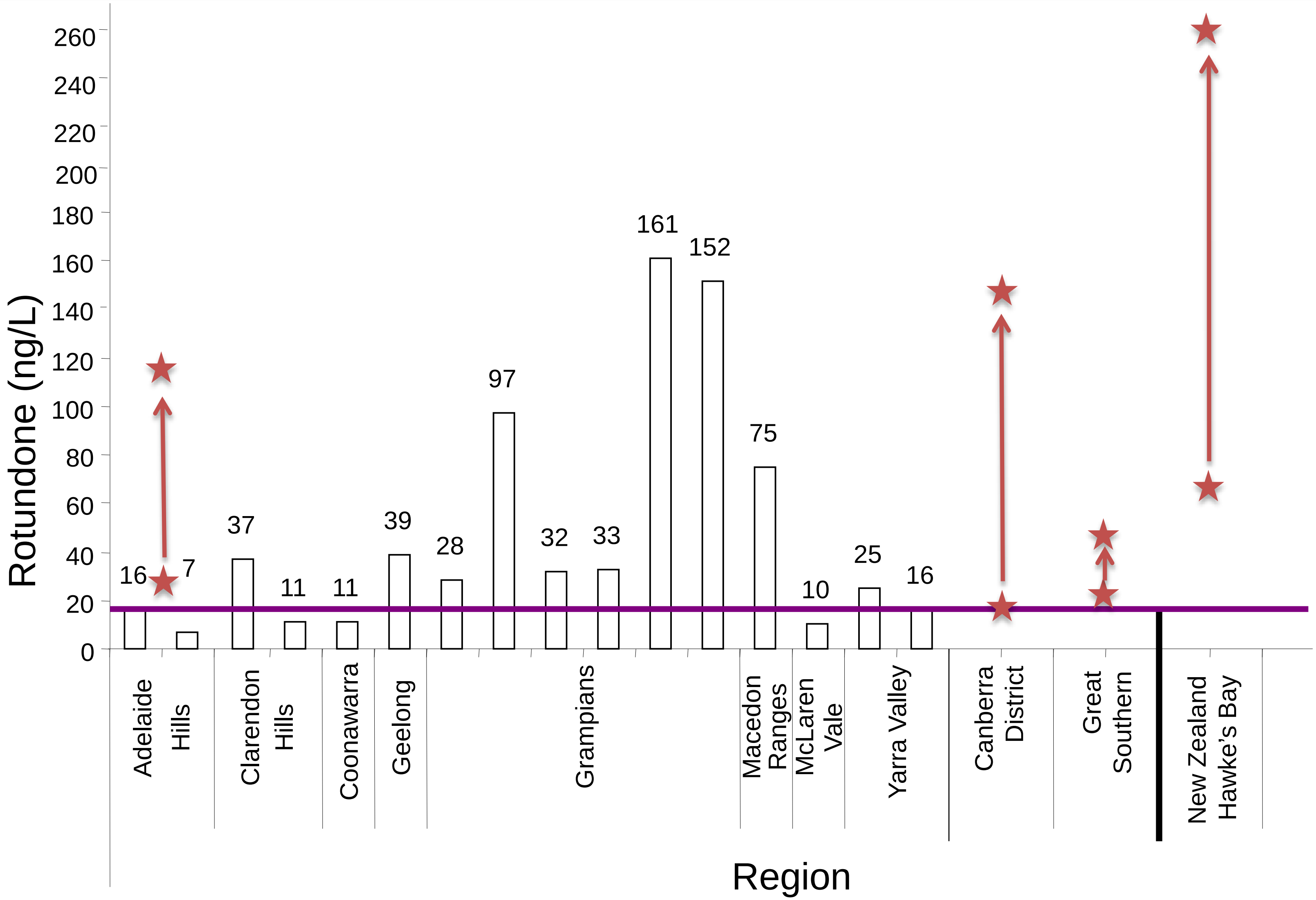
The Australian Wine Research Institute

Gimblett Gravels (400 Ha), Hawke's Bay, New Zealand

- 39°37' S, 176°44' E
- 1435 GDD (Base 10°C) (17 year average)
- 803mm rainfall (21 year average)
- 2188 hours of sunshine/year
- 14.5°C mean temperature all year
- Omahu Gravel Soil
- Maritime with a little continentality

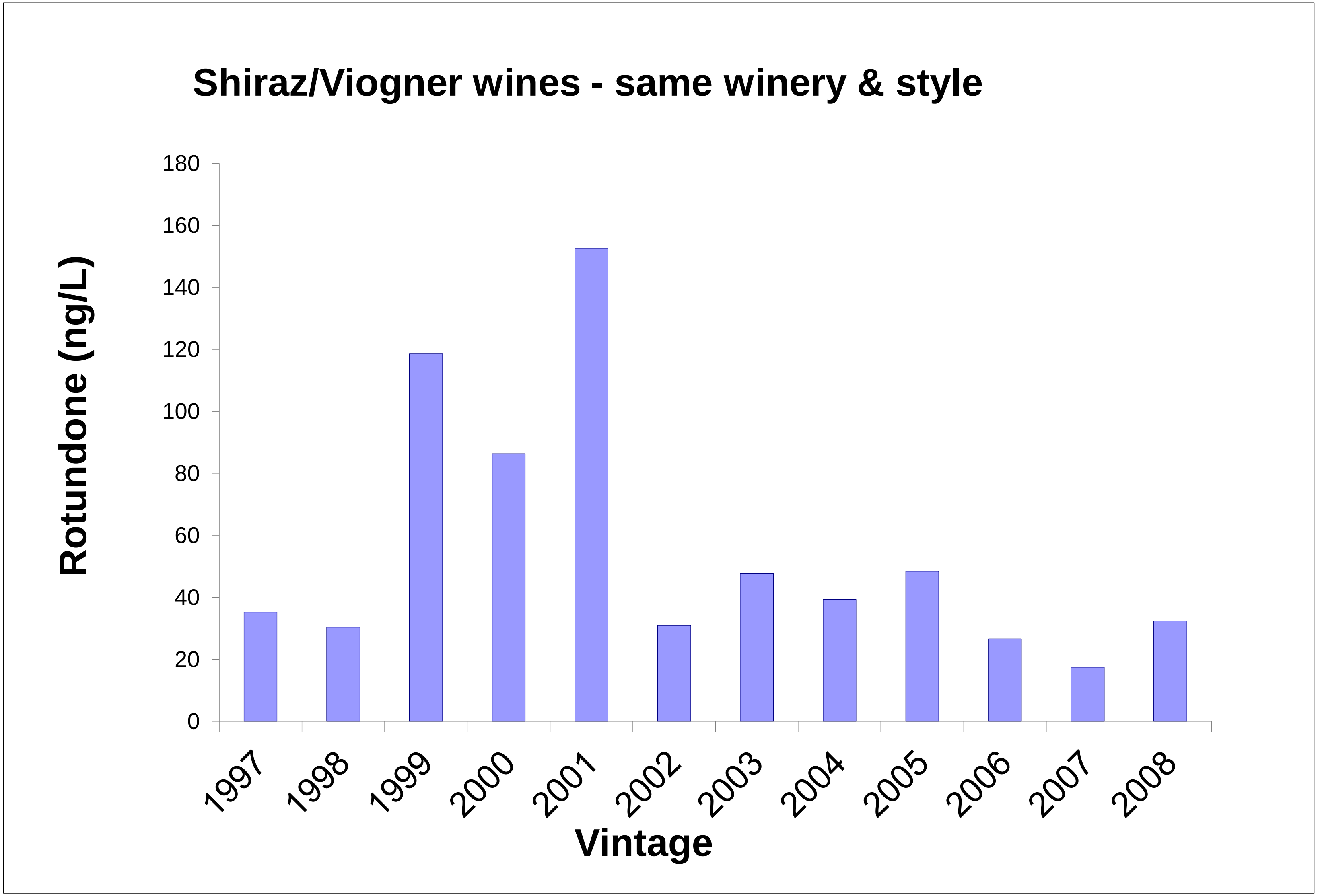
Rotundone in other commercially available Shiraz wines

The Australian Wine Research Institute



Variability across vintages: Canberra District

The Australian Wine Research Institute



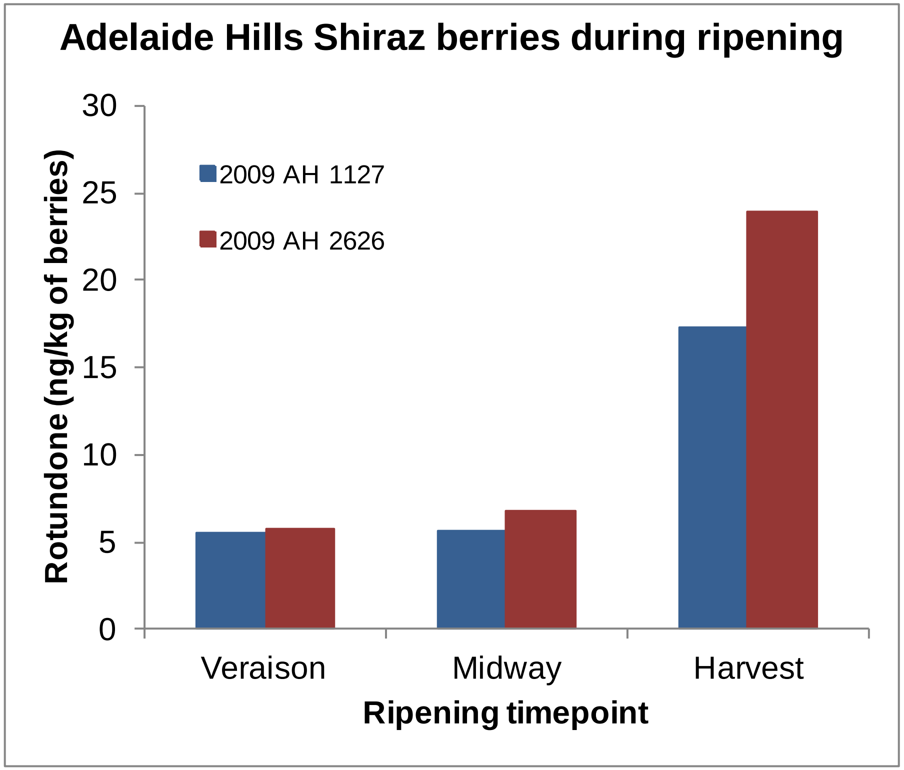
Rotundone is only present in the skin

The Australian Wine Research Institute

Photograph by Eric Wilkes

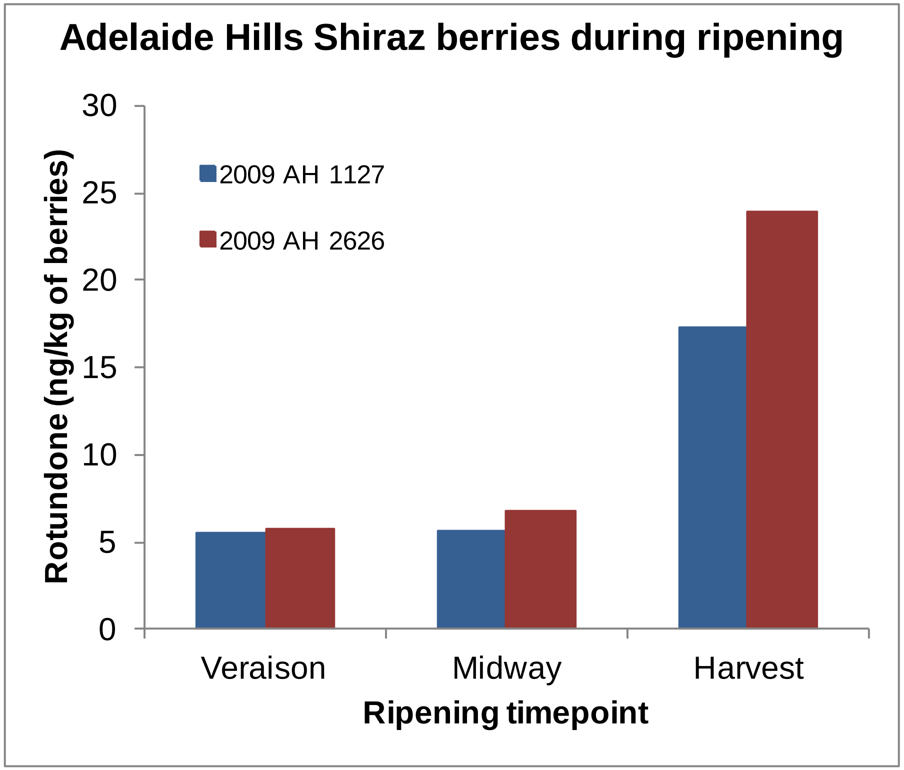
Rotundone increases during late stage ripening

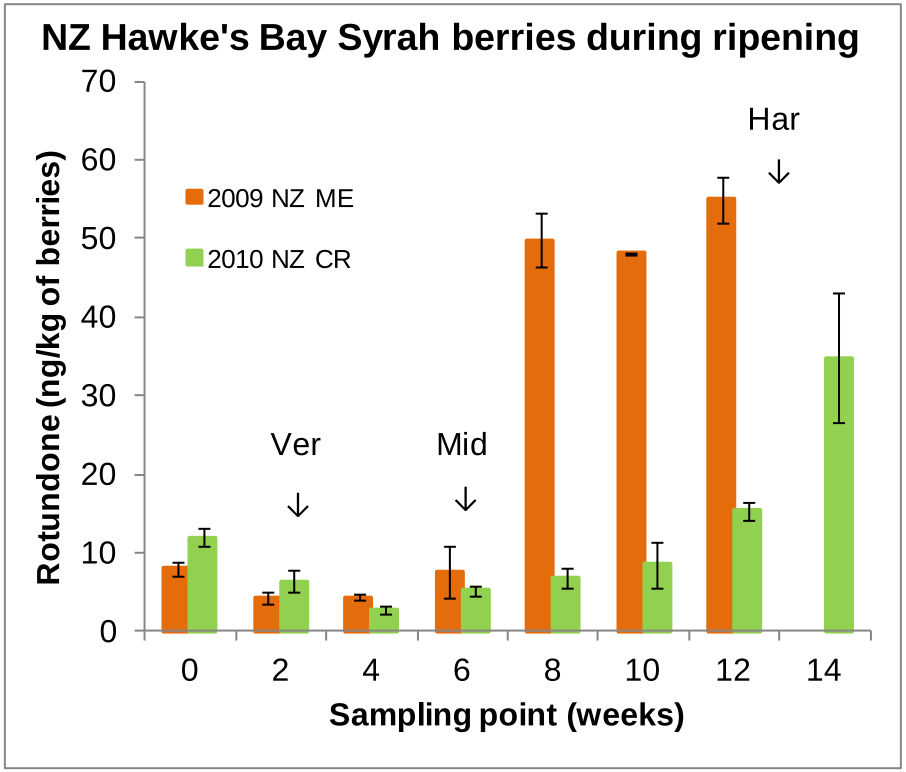
The Australian Wine Research Institute



Rotundone increases during late stage ripening

The Australian Wine Research Institute





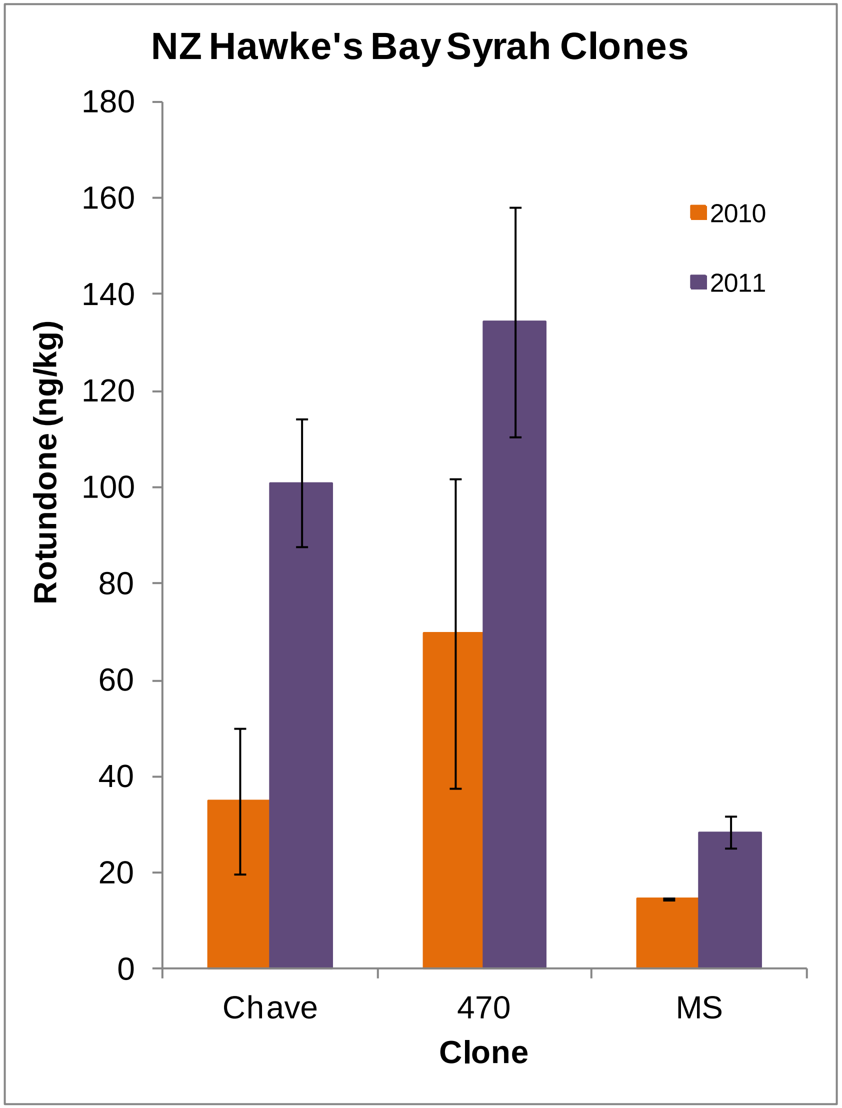
Does vine management affect rotundone levels?

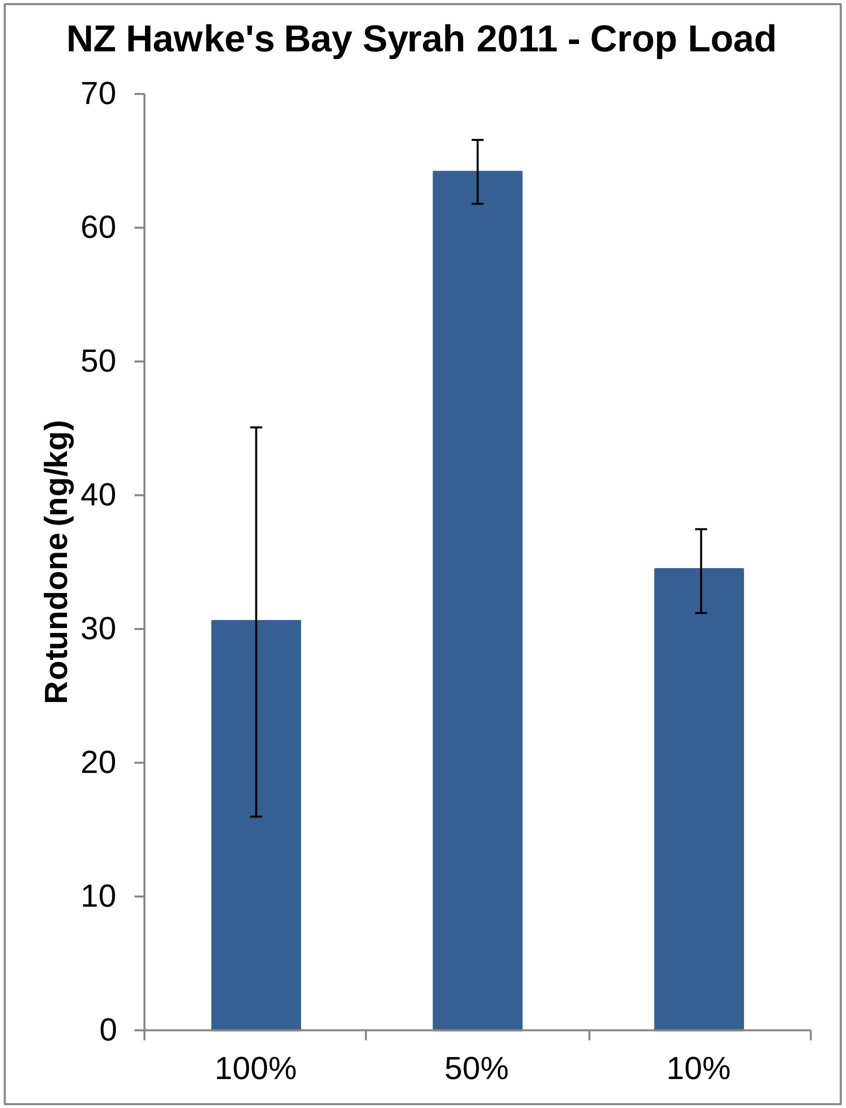
The Australian Wine Research Institute

- Fruit exposure
- Leaf removal time
- Crop load
- Vine vegetative vigour
- Clones

Clone and crop load

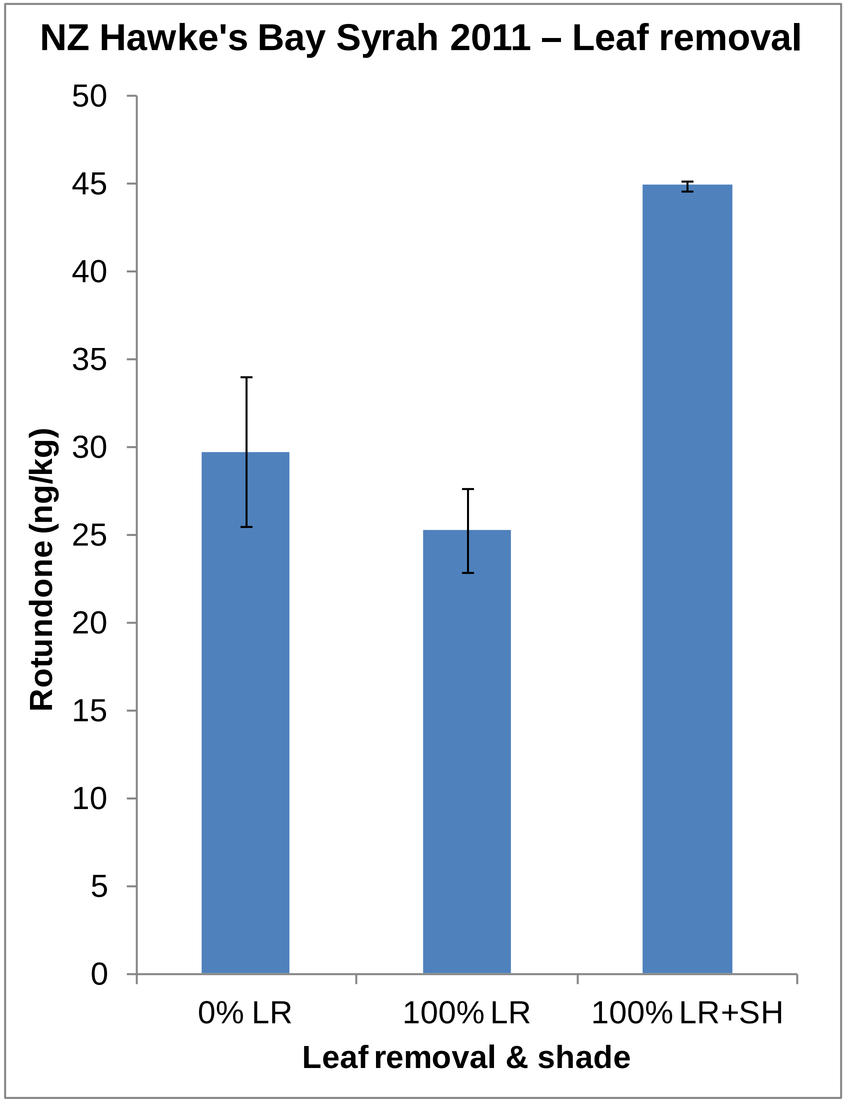
The Australian Wine Research Institute

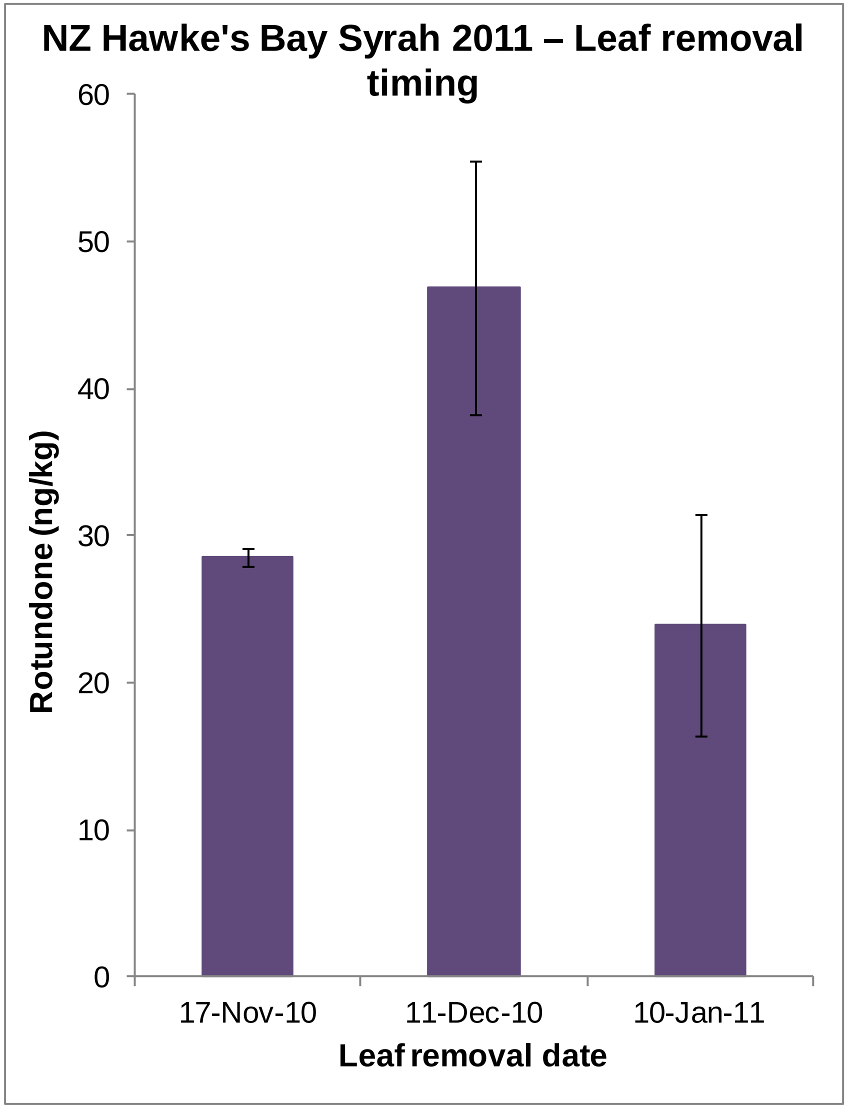




Leaf removal

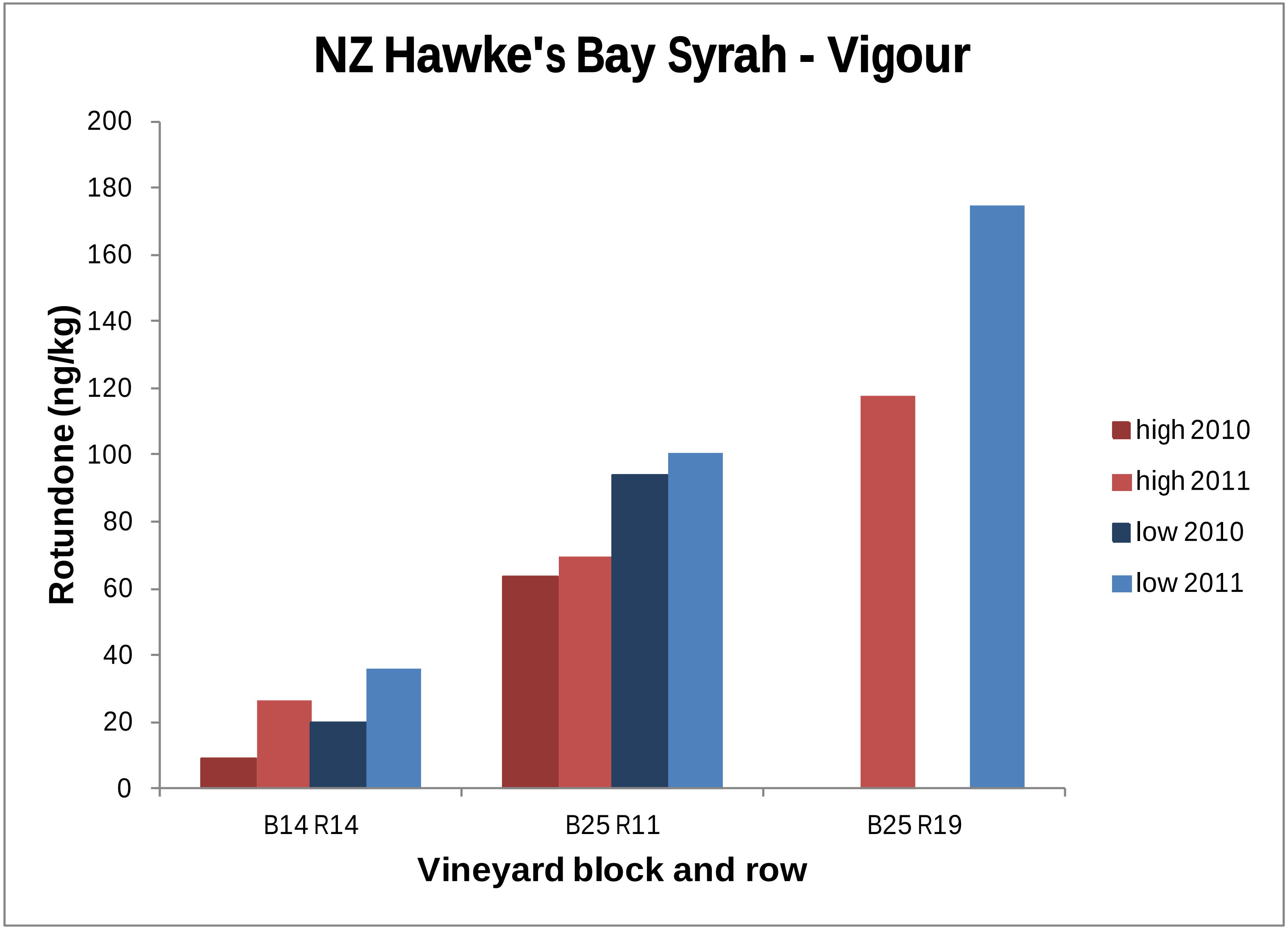
The Australian Wine Research Institute





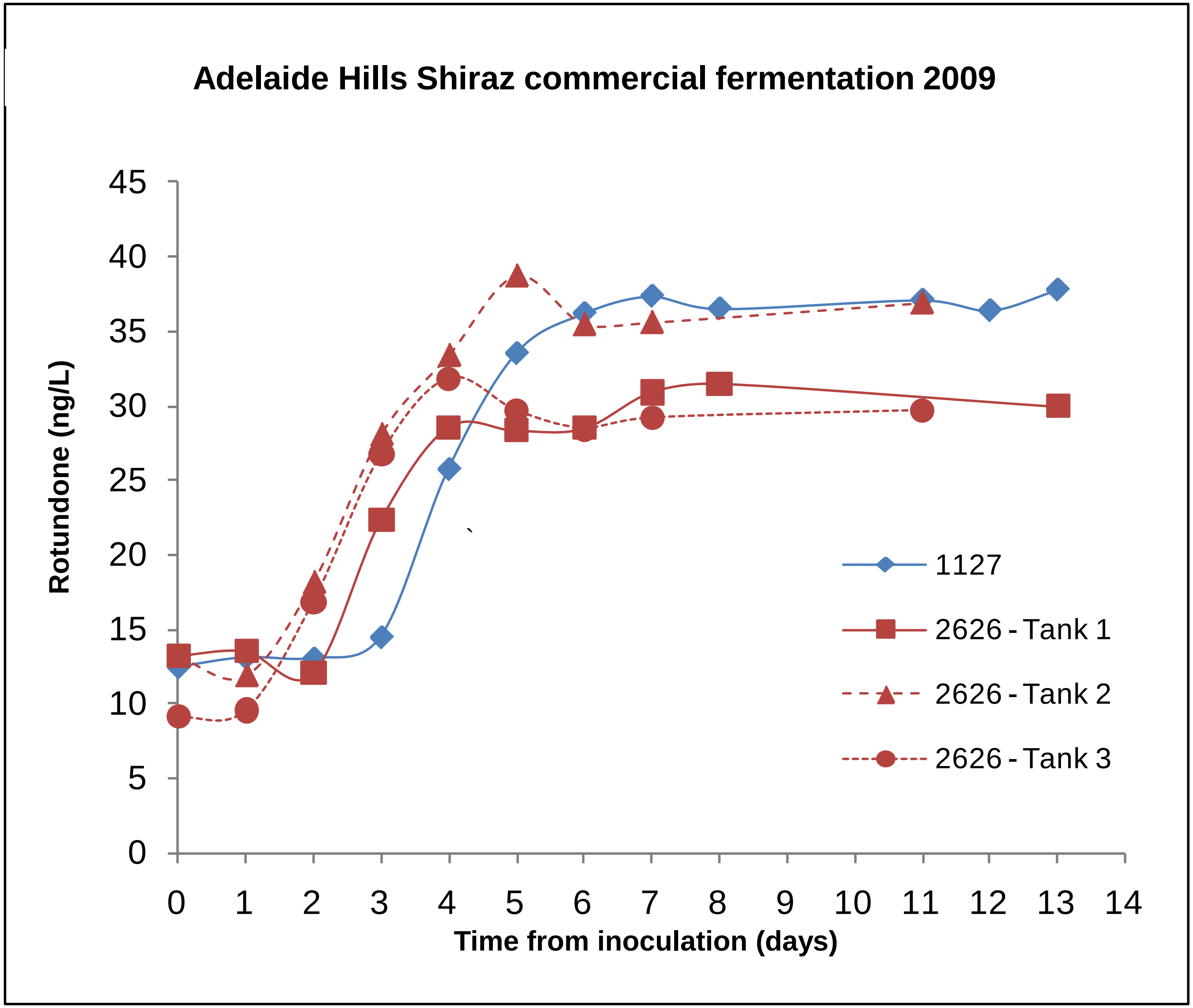
Vigour

The Australian Wine Research Institute



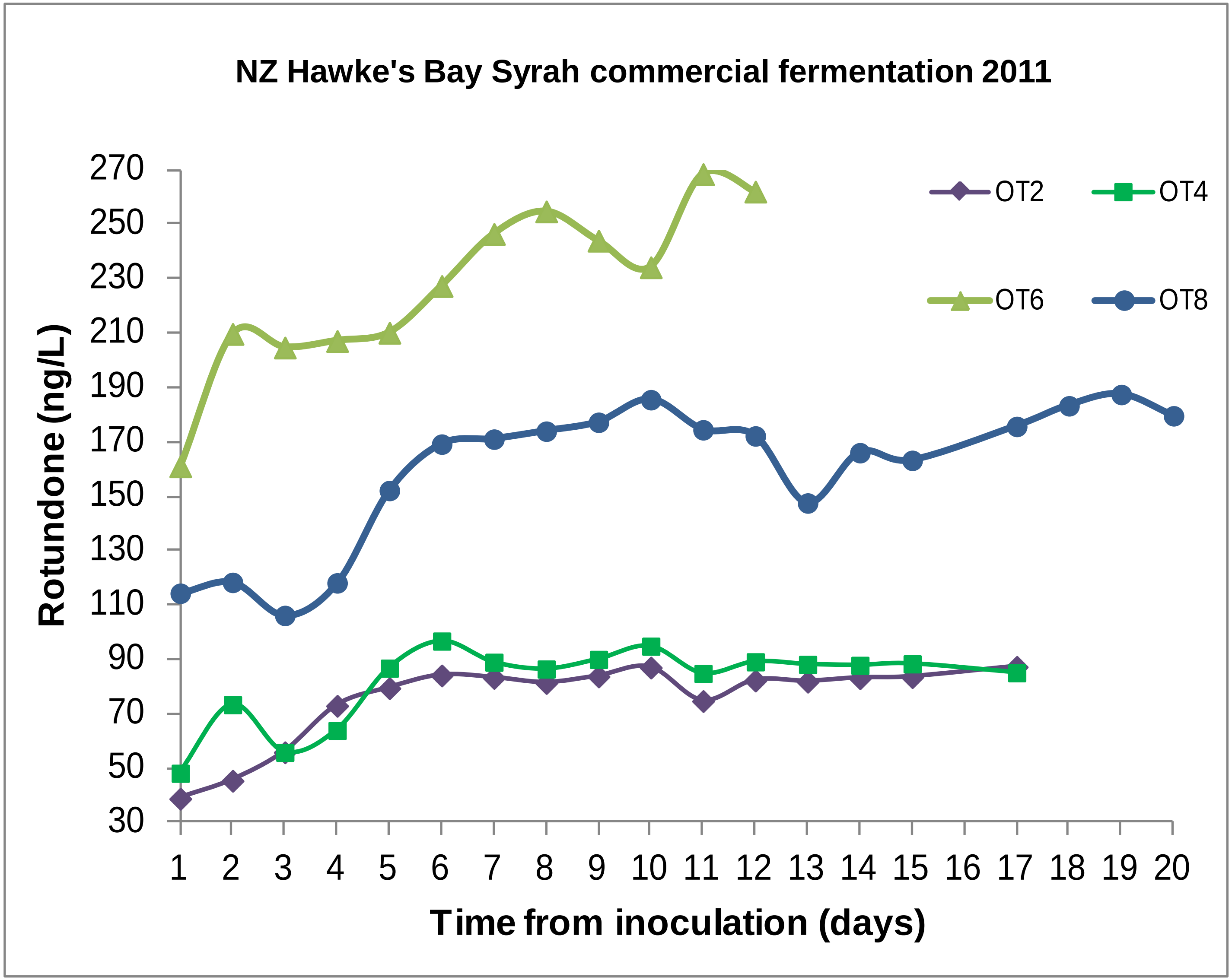
Rotundone extraction during winemaking

The Australian Wine Research Institute



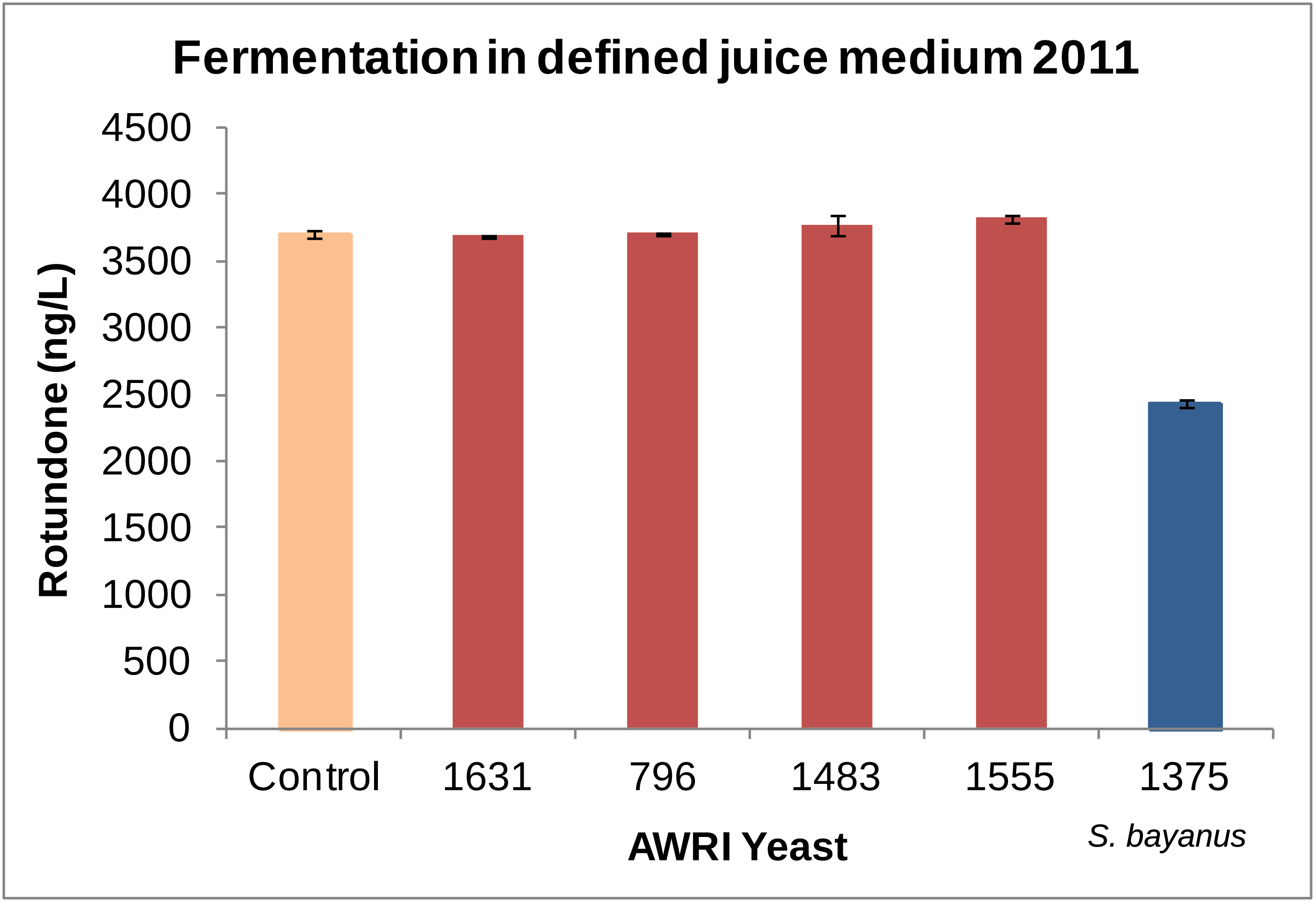
Rotundone extraction from berries during winemaking

The Australian Wine Research Institute



Can yeast affect rotundone levels during fermentation?

The Australian Wine Research Institute



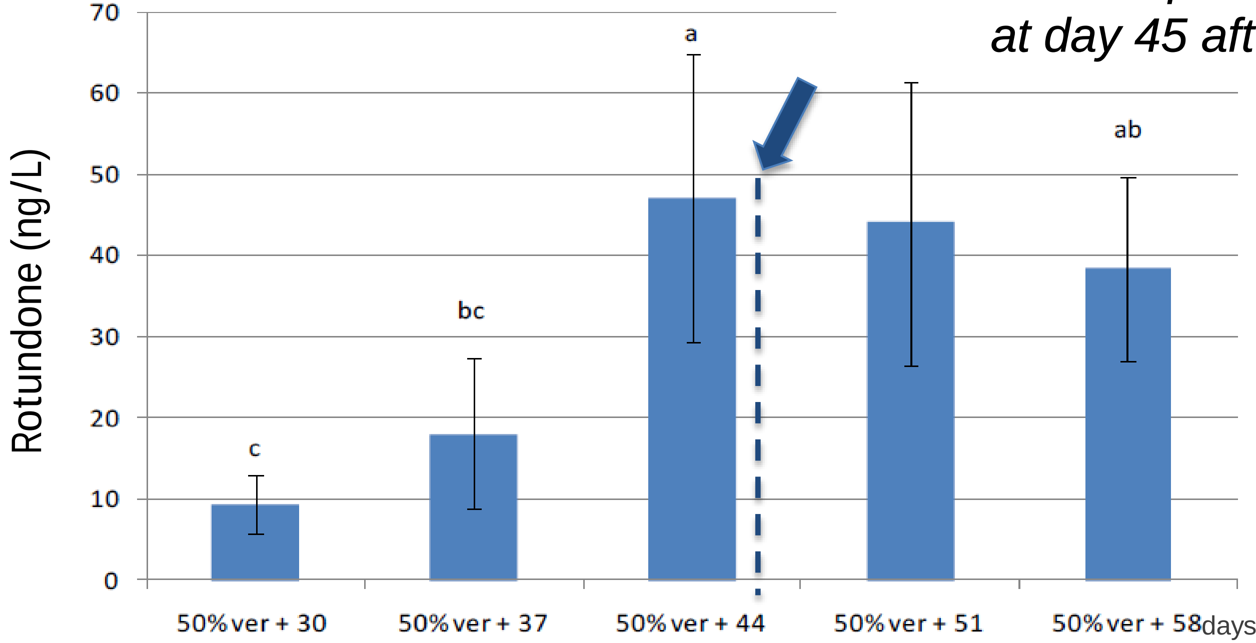
Rotundone in French Pyrenees wines

Olivier Geffroy, IFV Sud-Ouest

The Australian Wine Research Institute

2011 Duras microvinification at 5 levels of maturity

“Theoretical” optimum picking date at day 45 after veraison



INSTITUT FRANÇAIS DE LA VIGNE ET DU VIN

IFV viticulture trials:	***2011***	***2012***
Irrigation / Elicitor / crop load	43-48 ng/L	29-36 ng/L
Control	37 ng/L	27 ng/L
Leaf removal	12 ng/L	12 ng/L

Conclusions and future directions

The Australian Wine Research Institute

- Viticulture parameters affected rotundone levels: Picking date, clone, vigour, leaf removal & crop load
- Why does rotundone occur in Shiraz more often than other cultivars?
- Can rotundone be modulated during winemaking?

Acknowledgements

The Australian Wine Research Institute

- Darryl Catlin, Winemaker, and the winery and laboratory staff of Shaw and Smith Wines
- Frank van de Loo, Mt Majura Vineyard
- Jim Lumbers, Lerida Estate and Lumbers Consulting
- Dr Ayalsew Zerihun, Curtin University of Technology
- Nathan Scarlett, Dan Buckle, Damien Sheehan (Mt Langi Ghiran), Allen and Andrea Hart (Treasury), Inca Pearce, Martin Wirper (Orlando), Sue Hodder (Wynns Coonawarra Estate)
- Symrise, Germany

AWRI

- Mango Parker, Claudia Wood
- Flavour & Sensory Teams
- Radka Kolouchova

- The University of Auckland & EIT Hawke's Bay
- Mission Estate Wines
- Craggy Range Vineyards

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

gwrdc
GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

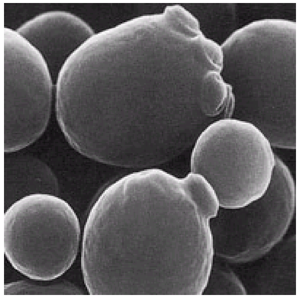
The AWRI, a member of the Wine Innovation Cluster in Adelaide, research is financially supported by Australia's grape growers and winemakers through their investment body the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

A W R I

The Australian Wine
Research Institute

Does soil and vine nutrient status affect wine quality?

Mark Krstic



Does soil nutrient status affect wine aroma and flavour?

- in popular press, the 'terroir effect' is often attributed to specific minerals that are alleged to confer typicity to wine

- soils with rock appear to elicit allusions of minerality

Geological influence as a fantasy of the taster

" But what separates Beechworth from so many other regions, …., is minerality. It's there, you can see it, with minerals glistening in the sun—slate and shale and great boulders of granite…..

While some disagree, you can taste minerality and it's there in the wines"

Jeni Port, The Age

Feb 2012

What are the facts?

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

What are the facts?

- Some wine is said to be reminiscent of smell of wet rocks following rain
- Actually is scent of organic compounds released from plants during dry periods and 'captured' by rocks (= petrichor) (Bear and Thomas 1964)

What are the facts?

- What about ‘minerality’ in wine?
  - probably a descriptor for acidity

What are the facts?

The Australian Wine Research Institute

- Rocks affect physical structure of soil and water relations

Does soil nutrient status affect wine aroma and flavour?

- Many studies – no correlation between wine quality and soil content of any nutritive element with exception of N (and salt)

Response to N: summary

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

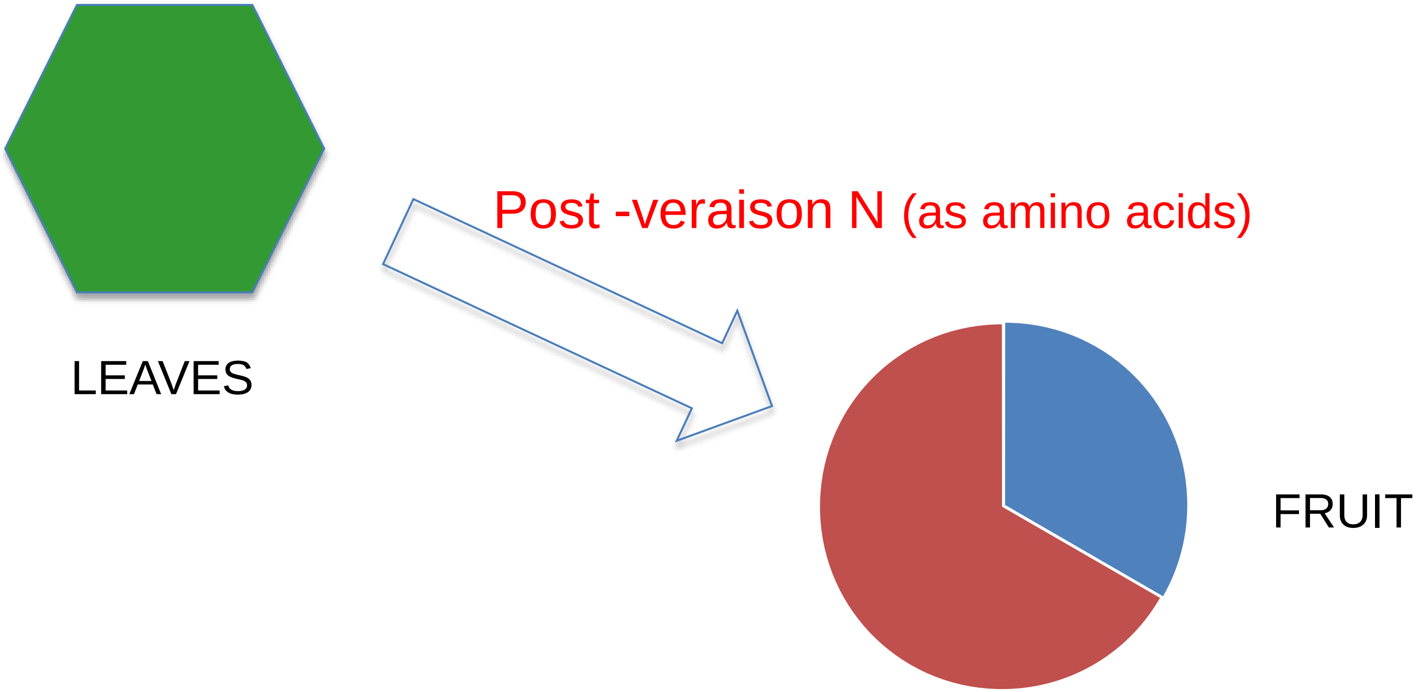
- Of all mineral nutrients, N has greatest effect on growth, yield and fruit composition
  - $\uparrow$ soil N $\rightarrow$ $\uparrow$ photosynthesis $\rightarrow$ $\uparrow$ sugar
- As for water, excess N can have negative effect
  - eg increased canopy size

NITROGEN

- Demand for N greatest from budburst to flowering
  - But most uptake from soil after flowering
  - Overwintering reserves thus very important (like starch)
- 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

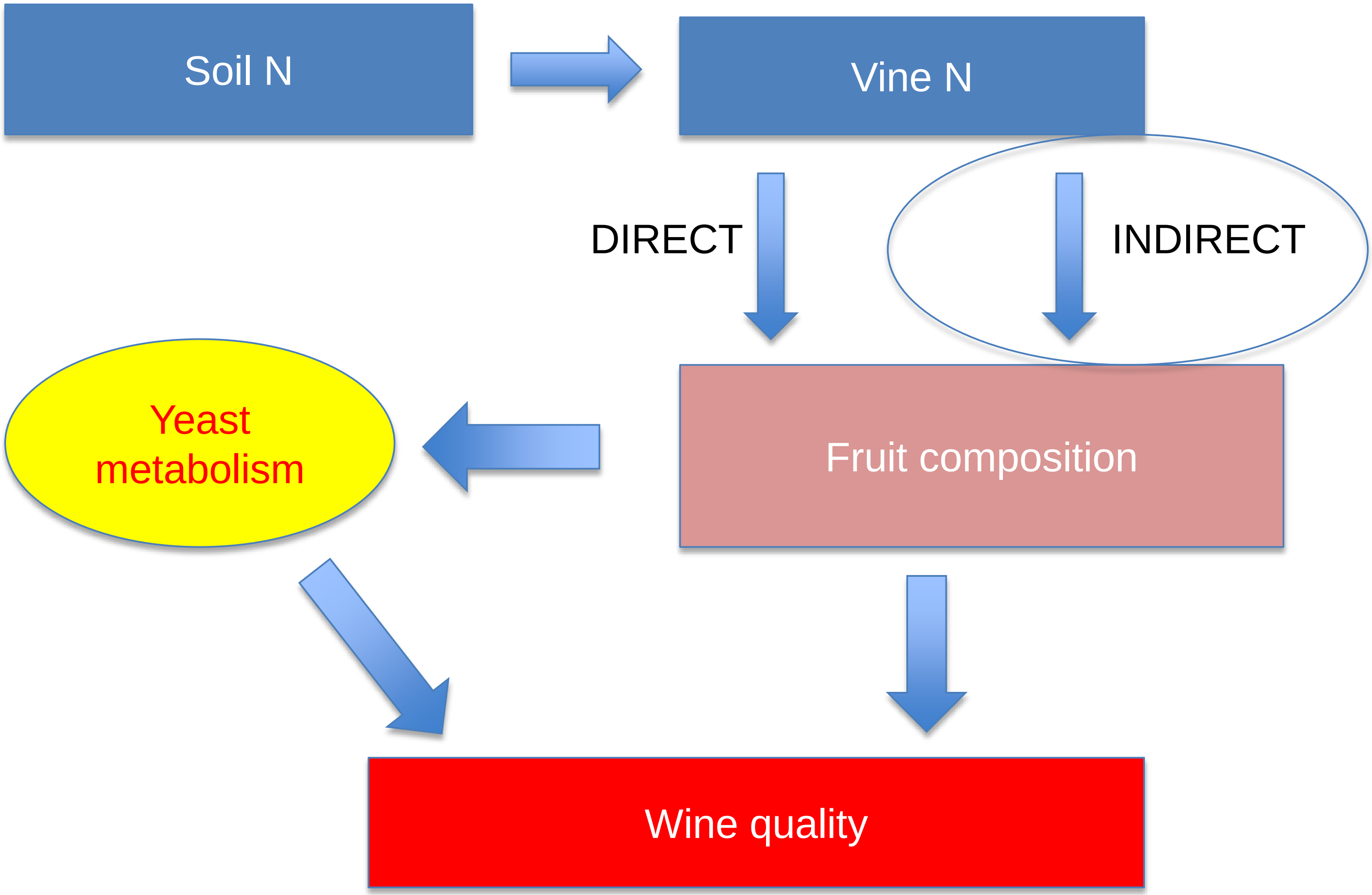


What is effect of N fertilisation on vine performance?

- 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

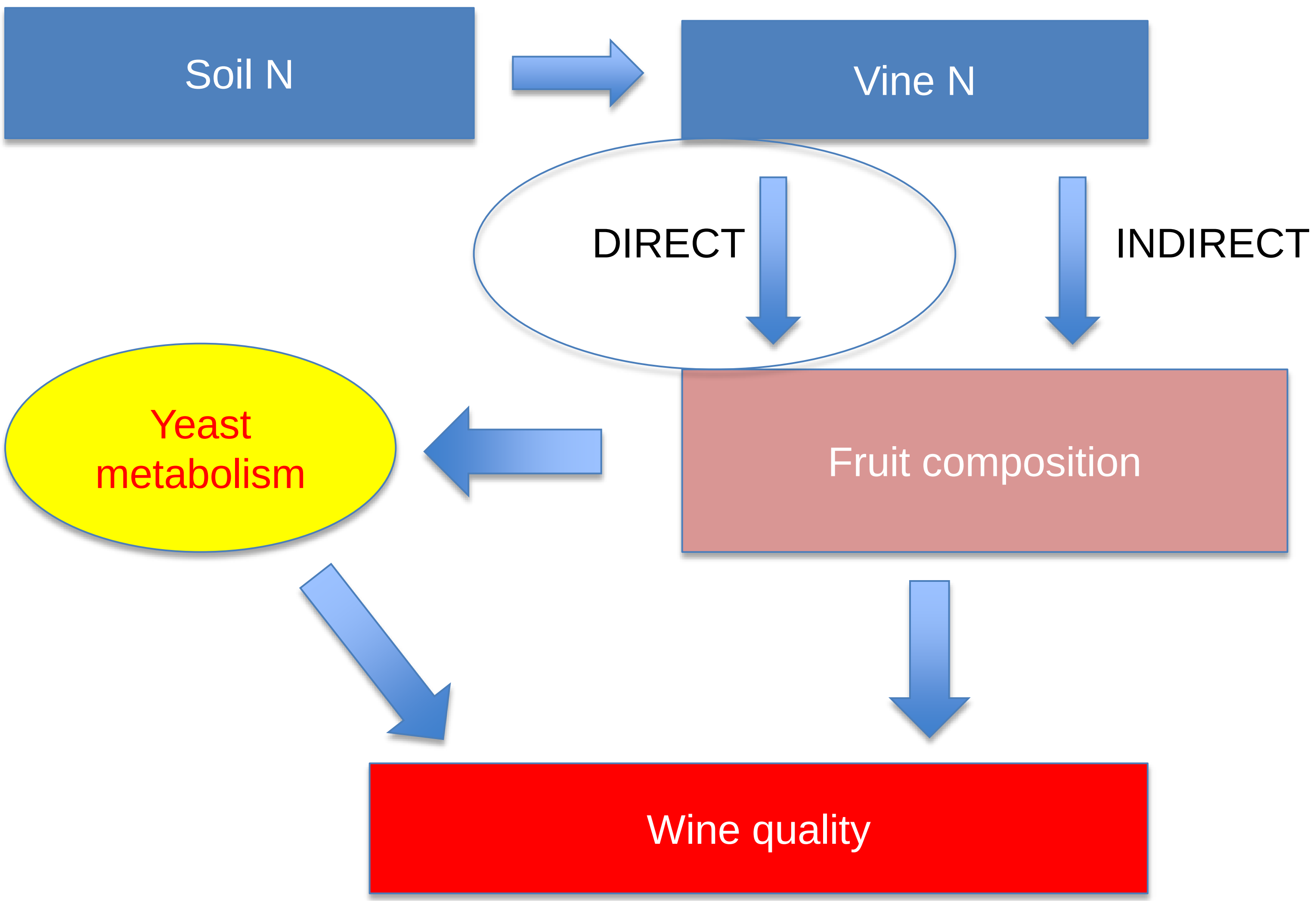
N impact on wine quality: Indirect effect

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

- Also high nitrate → ↑ organic acid production
  ↑ amino acid

Overall effect is decreased phenolics

N fertilisation and grape anthocyanins

- Response to N fertilisation depends on starting point
  - less than adequate level:
    - Ø may increase anthocyanins
  - adequate or more:
    - Ø may decrease anthocyanins

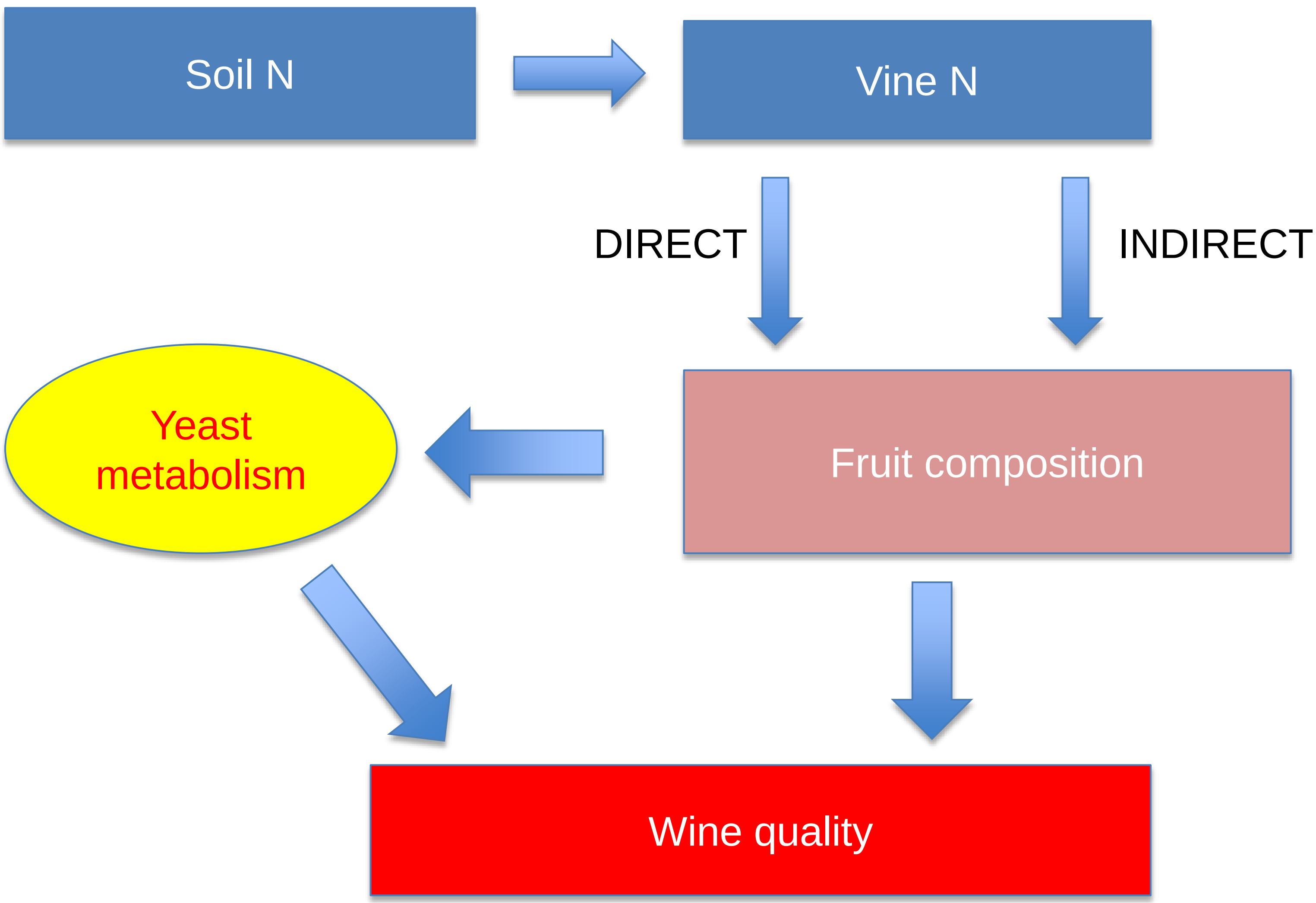
N impact on wine quality

- 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

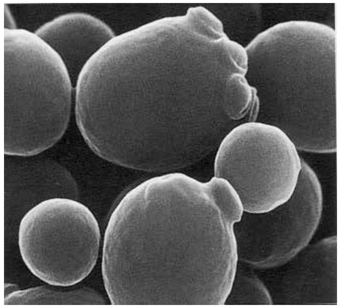
The Australian Wine Research Institute



N and fermentation

The Australian Wine Research Institute

Nitrogen affects



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

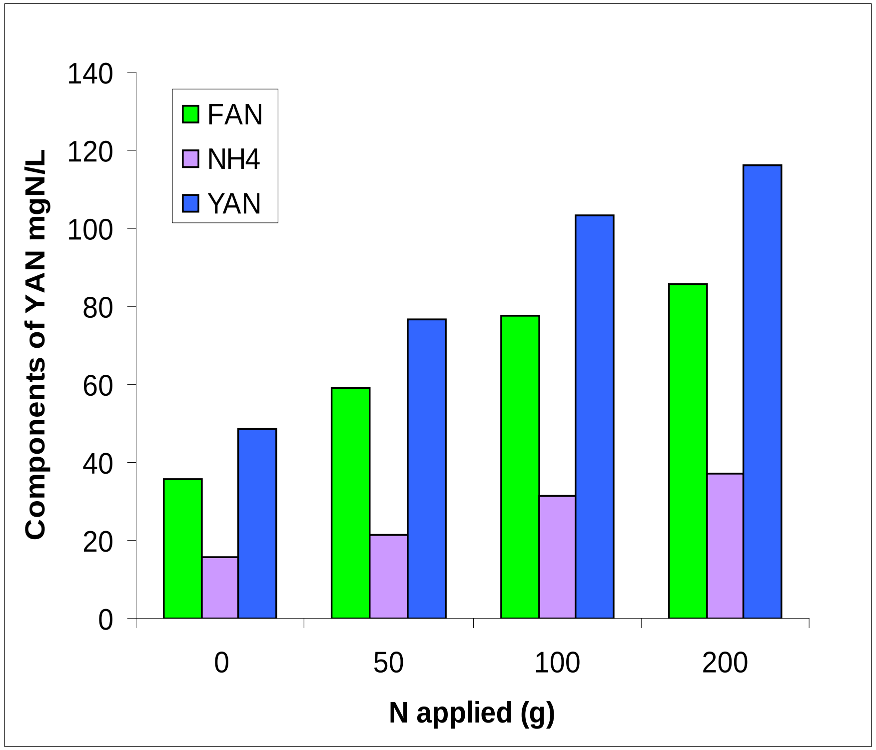
Grape nitrogen: effect on yeast

The Australian Wine Research Institute

- Total Nitrogen in juice is mainly
  - Ammonia
  - Free Amino Acids
- Yeast assimilable N (YAN)
  = free amino N (FAN) + ammonia N (NH_3-N)
- Yeast will use ammonium N initially,
  then most assimilable amino acids
- If YAN too low → stuck or slow ferments

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

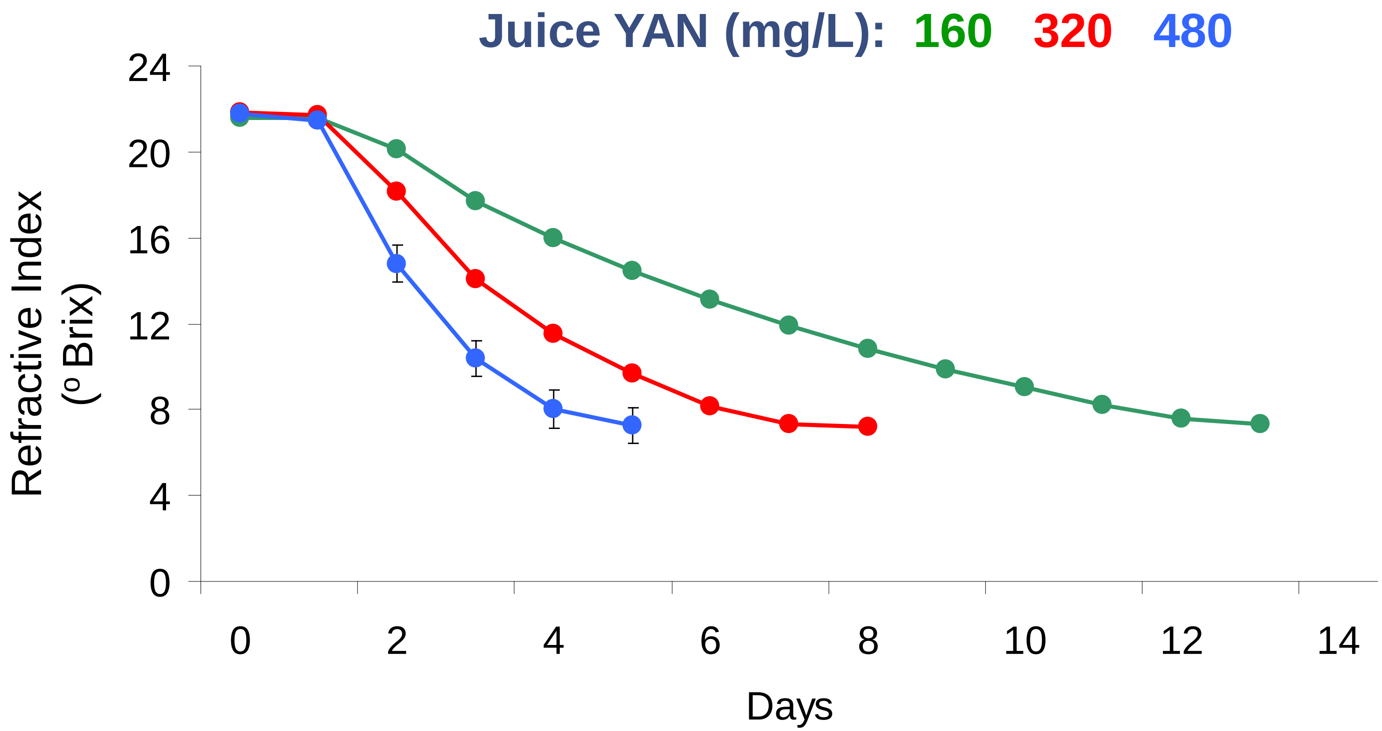
AWRI fermentation study

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


Diego Torrea

Effect of Juice N on Fermentation

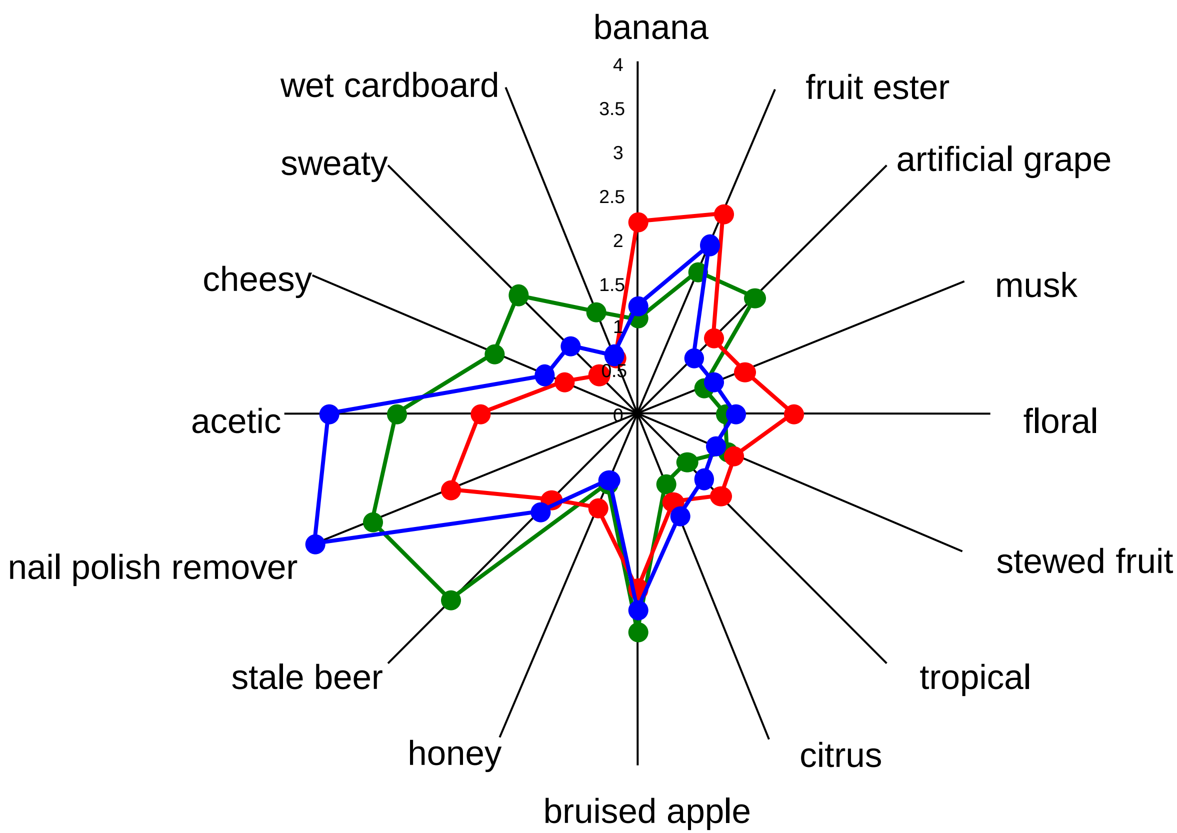
The Australian Wine Research Institute



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

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

Potassium

- High K in juice
  - → decreased concentration of free acids ??partic. tartaric (and ↑ pH)
  - → may decrease rate of degradation of malic acid

What factors determine how much K ends up in juice?

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

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

- v Direct or indirect effect?

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

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 effect s 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

Can DAP addition make up for N deficient grapes?

- Perhaps
- But some evid that not entirely cos C backbone of AA is metab to higher alcs so AA not just source of N

AWRI

The Australian Wine Research Institute

Using MLF to accentuate wine aroma and flavour

Eveline Bartowsky

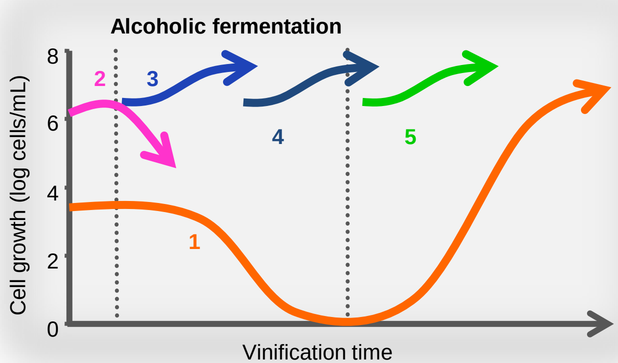
Senior Research Microbiologist

Malolactic fermentation

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

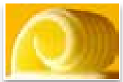
MLF is generally more difficult to manage that AF

It’s all about aroma & flavour

The Australian Wine Research Institute

- Talk will concentrate on sensory aspect of MLF

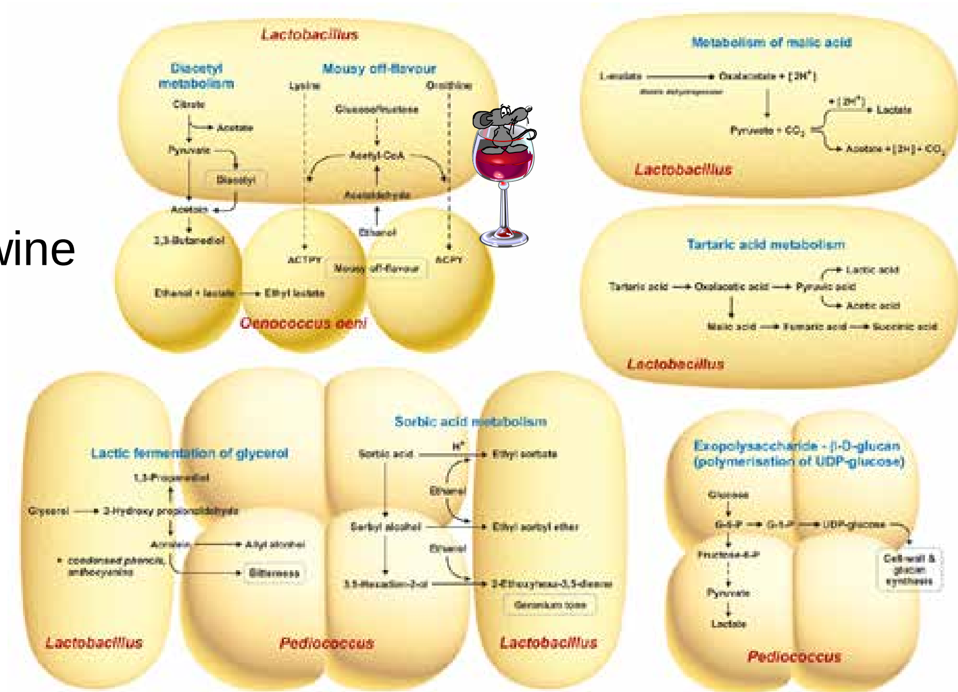
- Sensory



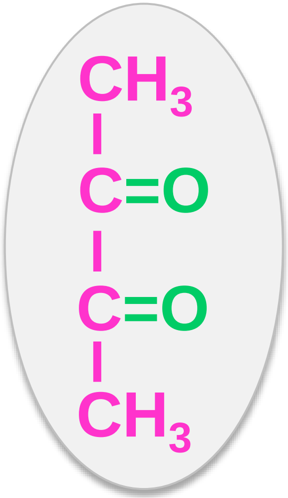
Diacetyl

Berry-fruit characters in red wine

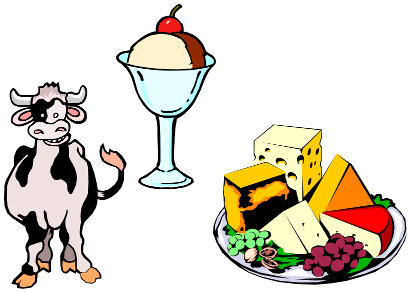
  - Polysaccharides (mouthfeel)



Buttery aroma - Diacetyl



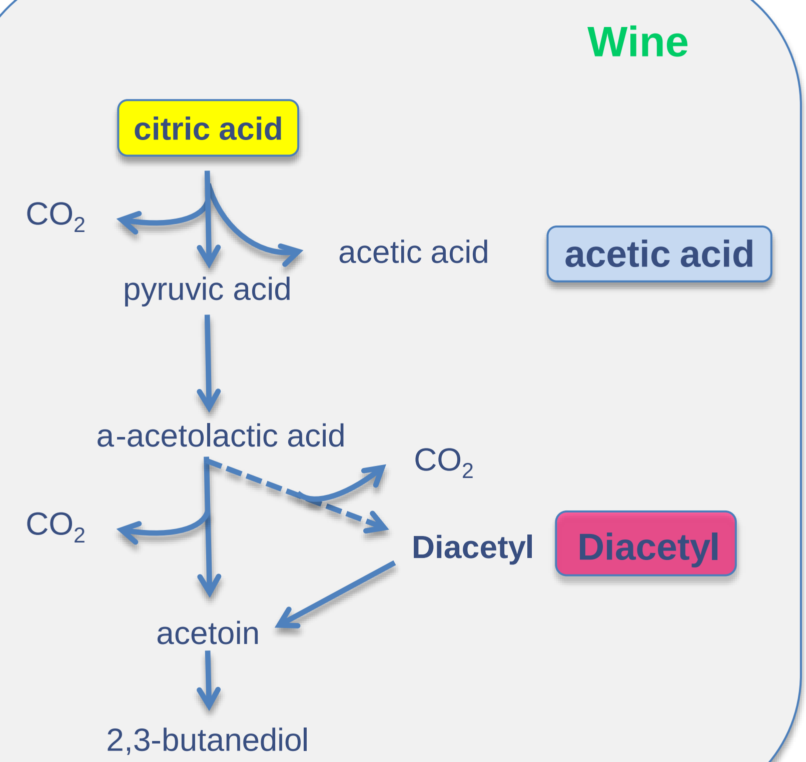
- *O. oeni* during MLF
- Derived from citric acid metabolism
- Aroma
  - buttery, nutty, butterscotch
  - 1 - 4 mg/L = enhance flavour complexity
  - > 5 - 7 mg/L = undesirable buttery aroma
  - Taste threshold
    - Chardonnay 0.2 mg/L
    - Pinot Noir 0.9 mg/L
    - Cabernet Sauvignon 2.8 mg/L



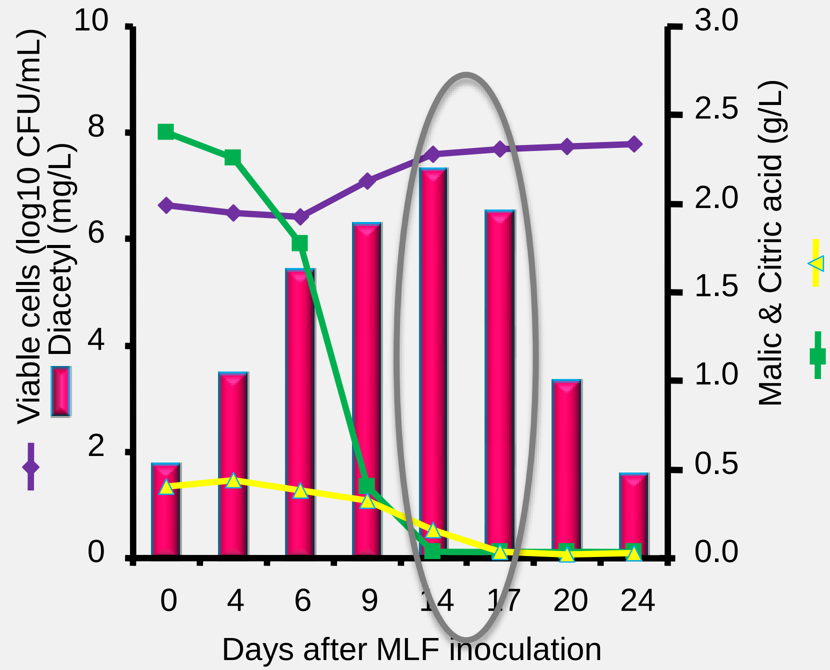
2 important considerations for diacetyl producⁿ

The Australian Wine Research Institute

Pathway



Kinetics

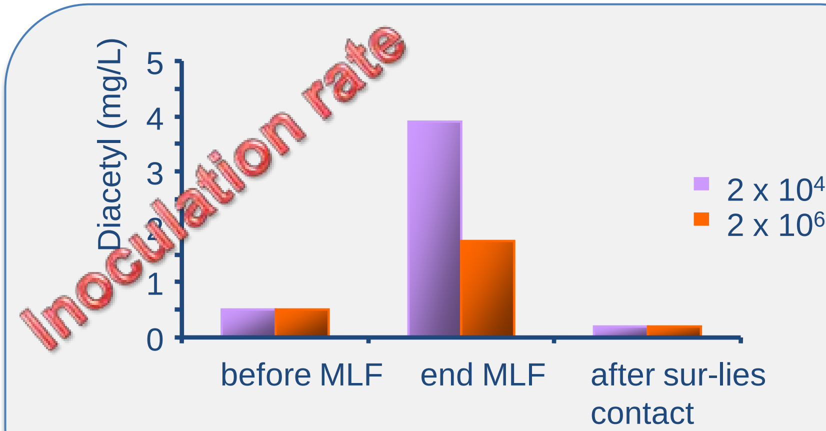


from Bartowsky & Henschke, 2004

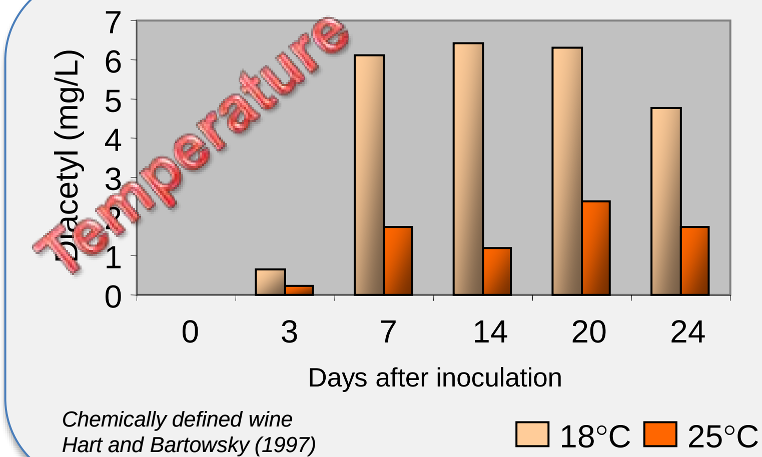
Cabernet Sauvignon, 2000
Barossa & Eden Valley blend
Strain III (12.5 % alcohol)

Many factors influence Diacetyl

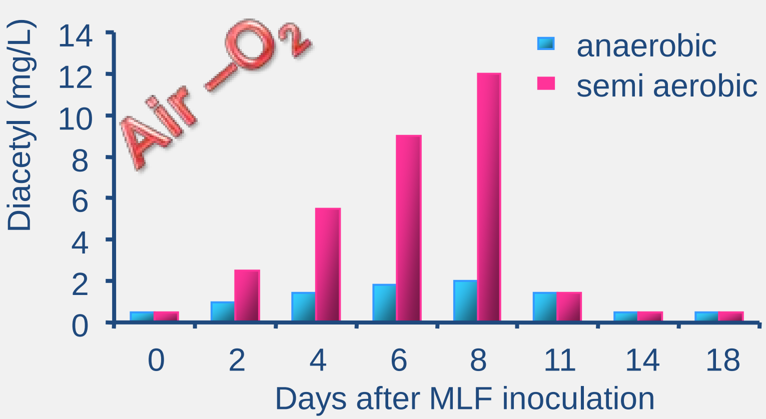
The Australian Wine Research Institute



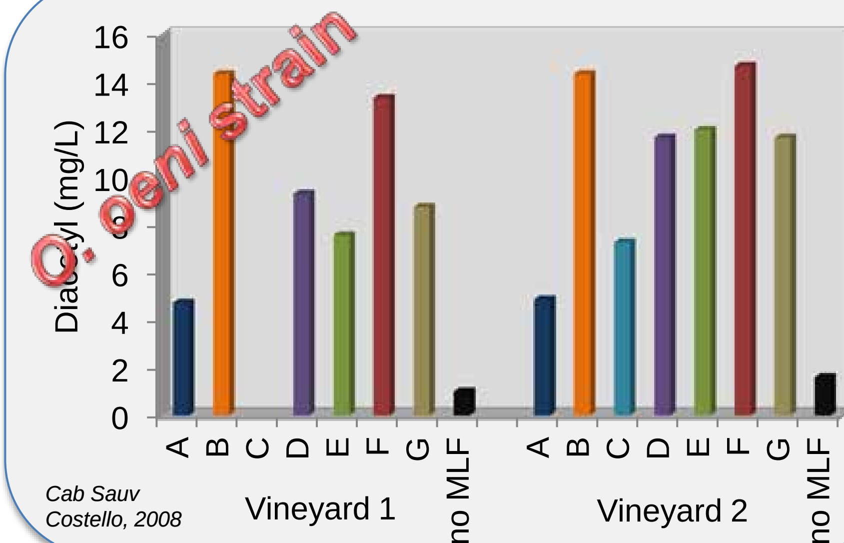
Pinot Noir
Adapted from Krieger et al. (2000)



Chemically defined wine
Hart and Bartowsky (1997)



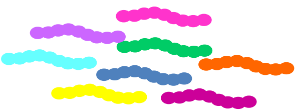
Chardonnay
Adapted from Nielsen & Richelieu (1999)

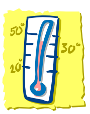


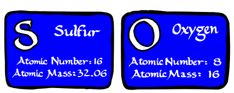
Cab Sauv
Costello, 2008

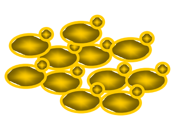
Winemaking parameters & diacetyl

The Australian Wine Research Institute

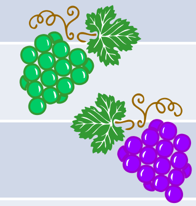
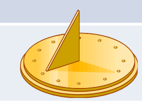
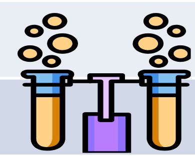








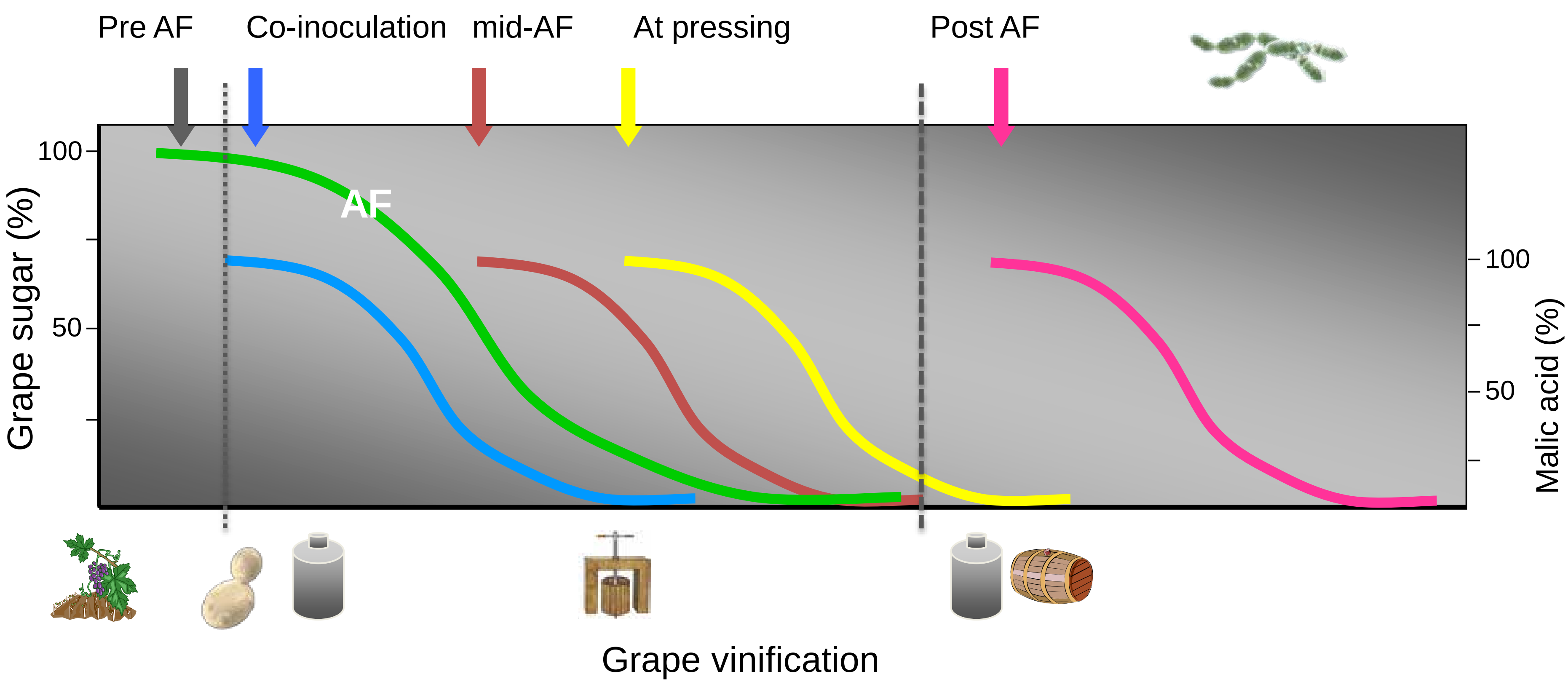

Variable		Effect on Diacetyl
O. oeni strain		Variable
Wine type	White	Lower
	Red	Higher
Inoculation rate	10^4	Higher
	10^6	Lower
Fermentation time	Longer MLF	Higher
Temperature	18˚C	Higher
	25˚C	Lower
SO_2		Binds to diacetyl
Aeration (O_2)	Air	Higher
	Anaerobic	lower
Yeast lees	Long contact	Lower
pH	Lower	May favour production

AF + MLF inoculation regime

The Australian Wine Research Institute

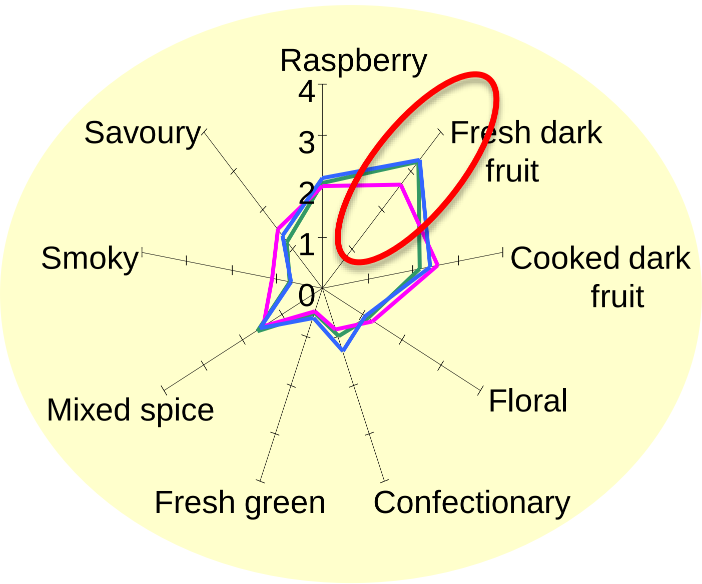
- Time point of bacterial inoculation can influence the wine composition and sensory attributes of red and white wines

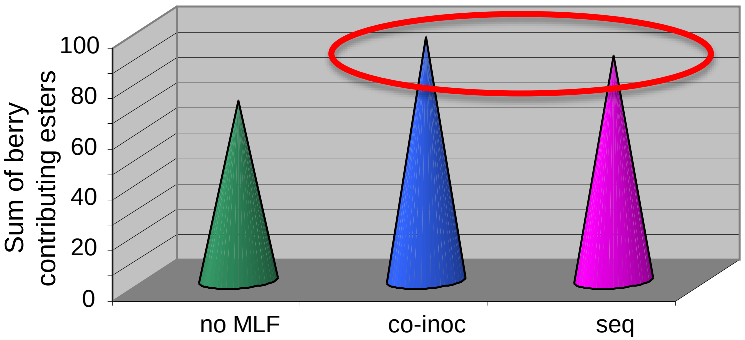


AF/MLF - fruity characters in red wine

The Australian Wine Research Institute

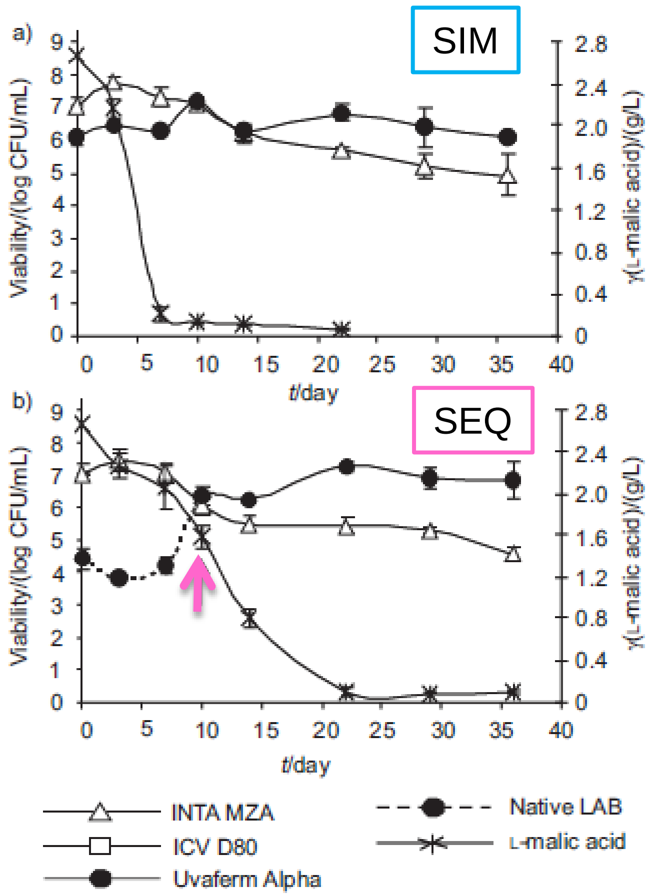
- Esters associated with berry fruit attributes
  - Summation of berry fruit esters





Cabernet Sauvignon
2006
Bordertown

AF/MLF - fruity characters in red wine



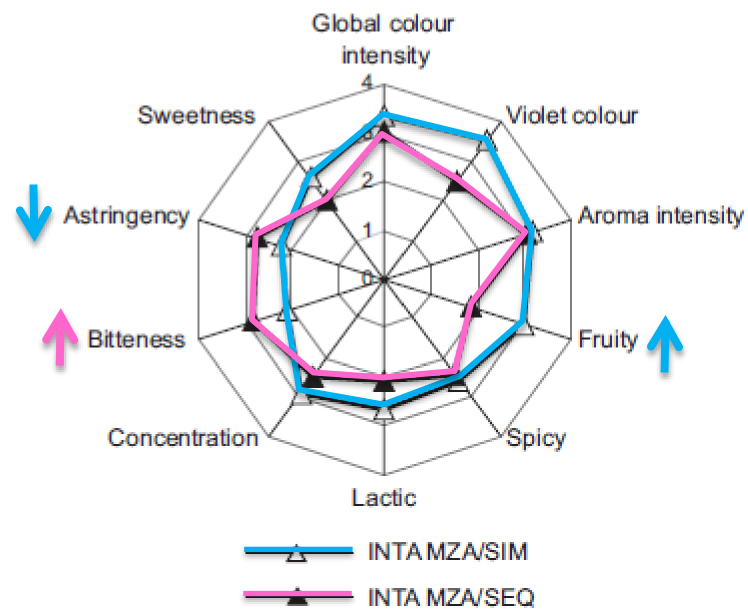


Fig. 5. Sensory descriptors of Malbec wines from must B_{05} fermented with *S. cerevisiae* strain (INTA MZA) and *Oenococcus oeni* strain (Uvaferm Alpha) in simultaneous (SIM) and sequential (SEQ) inoculations

Malbec (2005)
Mendoza

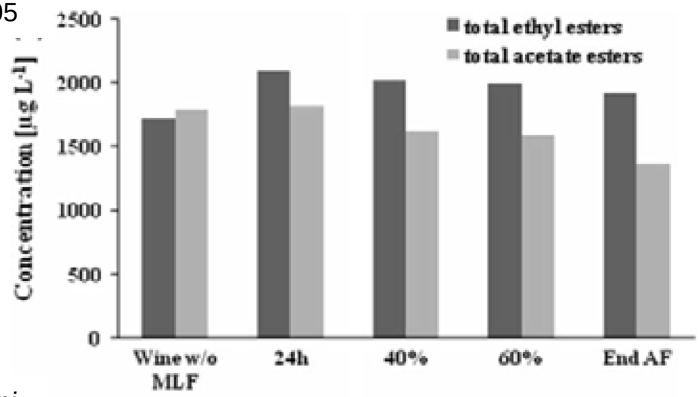
pH 3.6, TA 7.2 g/L
273.5 g/L reducing sugar
2.67 g/L L-malic acid
126 mg/L YAN

Massera et al 2009 Fd Technol Biotechnol

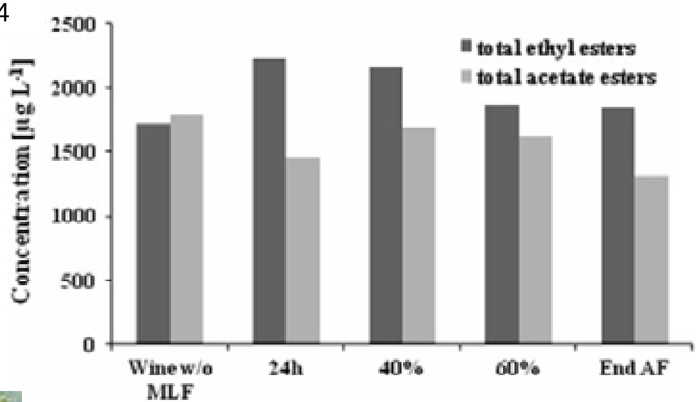
AF/MLF – white wine

The Australian Wine Research Institute

O. oeni R1105

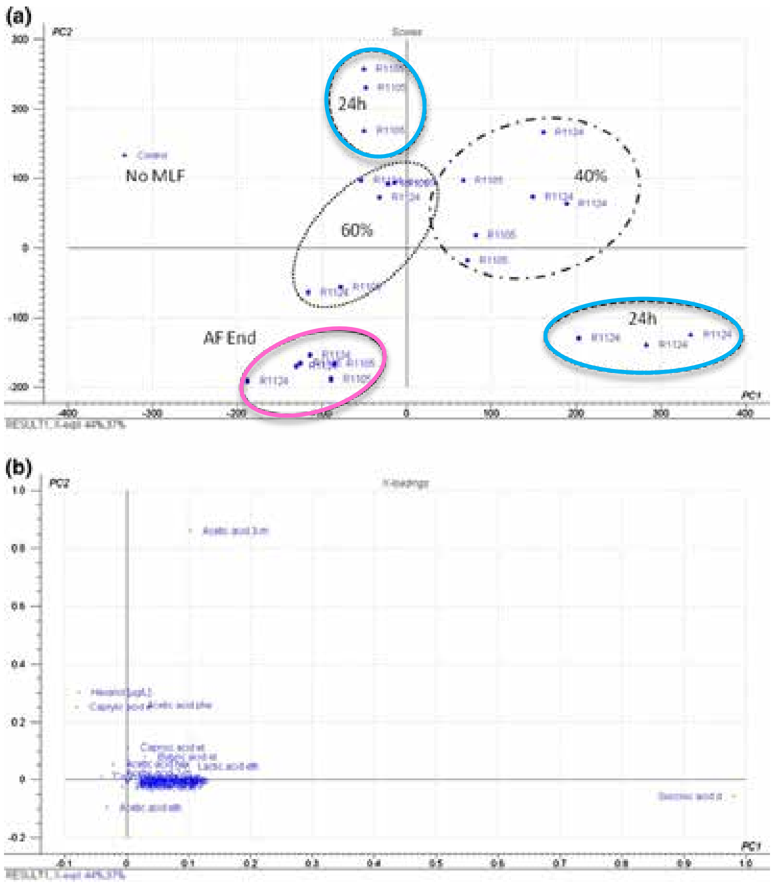


O. oeni R1124



Riesling (2010)
Rheingau

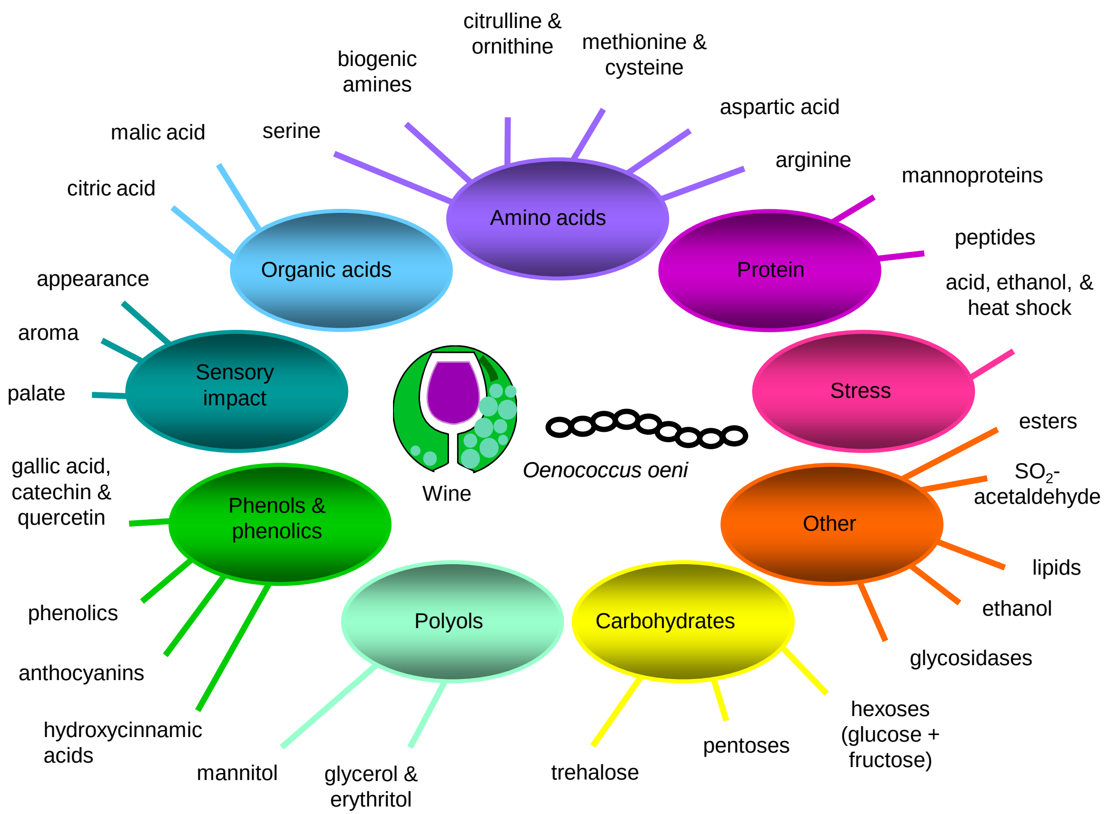
pH 3.1, TA 15 g/L
218.1 g/L reducing sugar
6.5 g/L L-malic acid



Knoll et al. 2012 Wrld J Microbiol Biotechnol

Bacterial metabolism

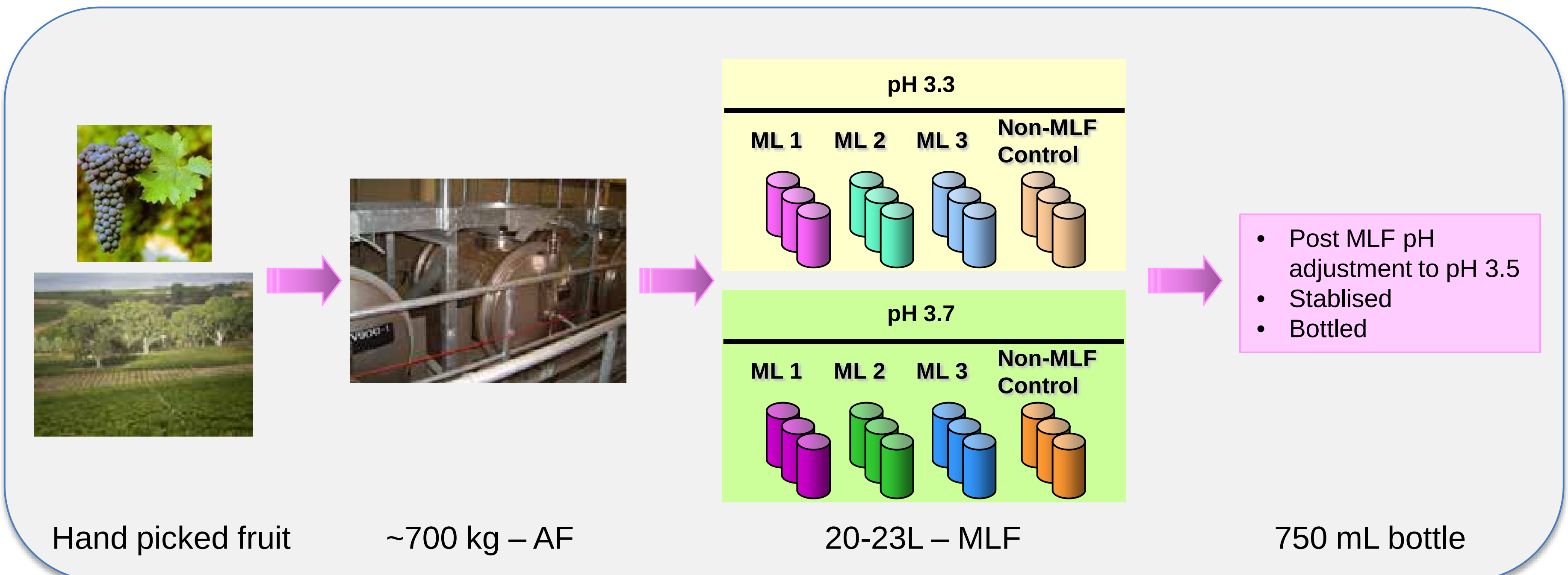
- Factors affecting bacterial metabolism during MLF
  - Wine composition
  - pH



Influence of pH

The Australian Wine Research Institute

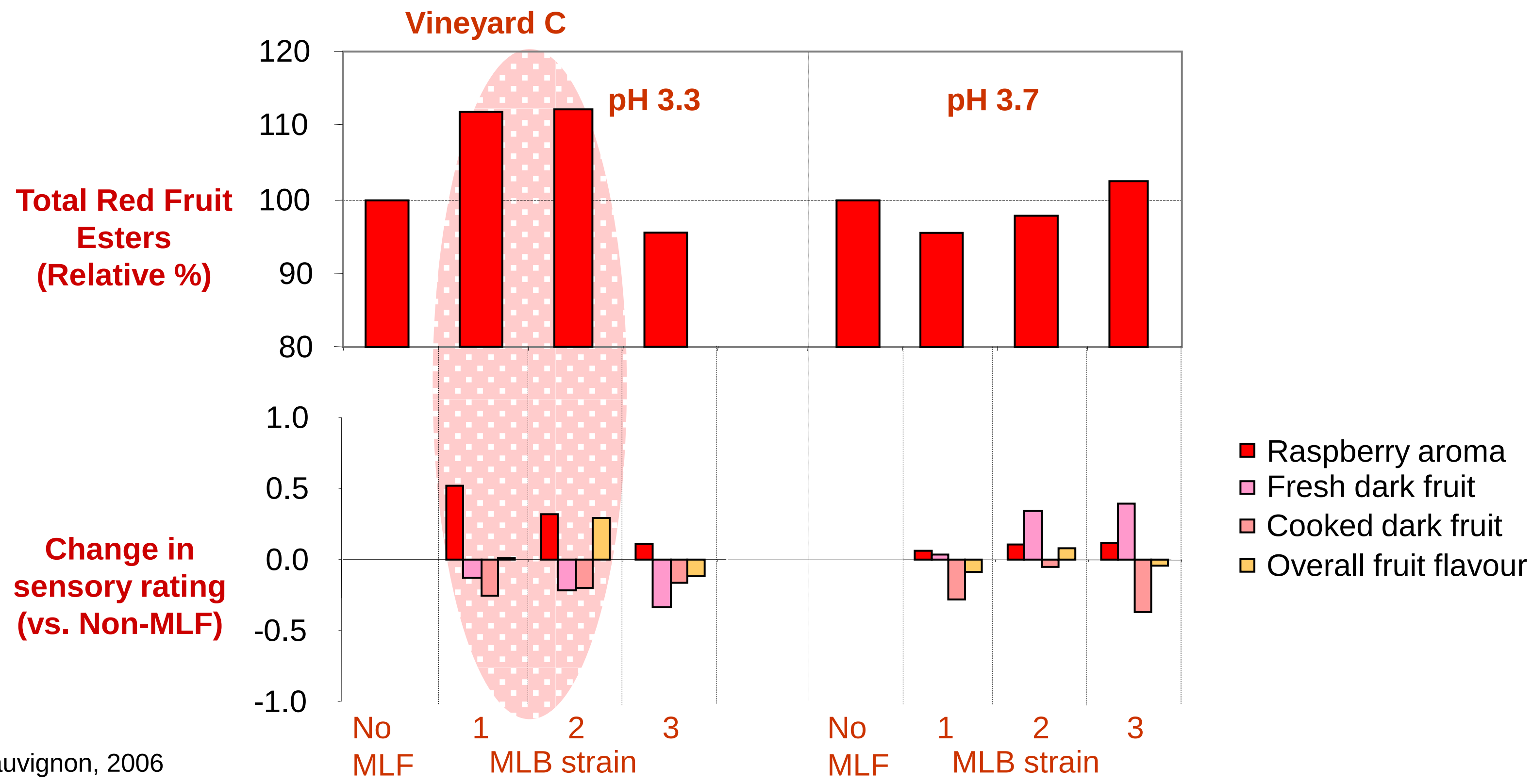
- Influence of wine pH during MLF
- Effect of MLF & ML strains on the development of berry & fruity sensory attributes



Costello et al. 2012 AJGWR

Fruity characters in red wine

The Australian Wine Research Institute

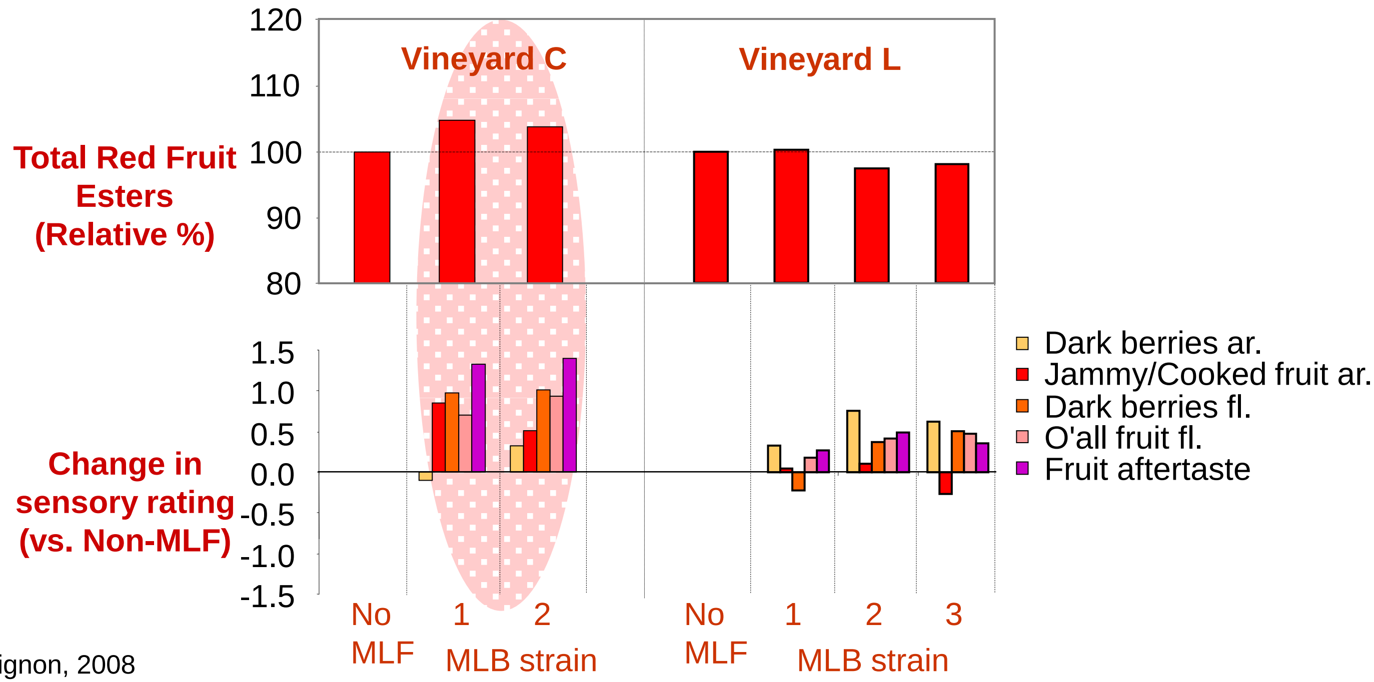


Cabernet Sauvignon, 2006

- *pH influences bacterial metabolism*
- *Increased total red fruit esters correlates with increased berry & fruity Sensory attributes*

Fruity characters in red wine

The Australian Wine Research Institute



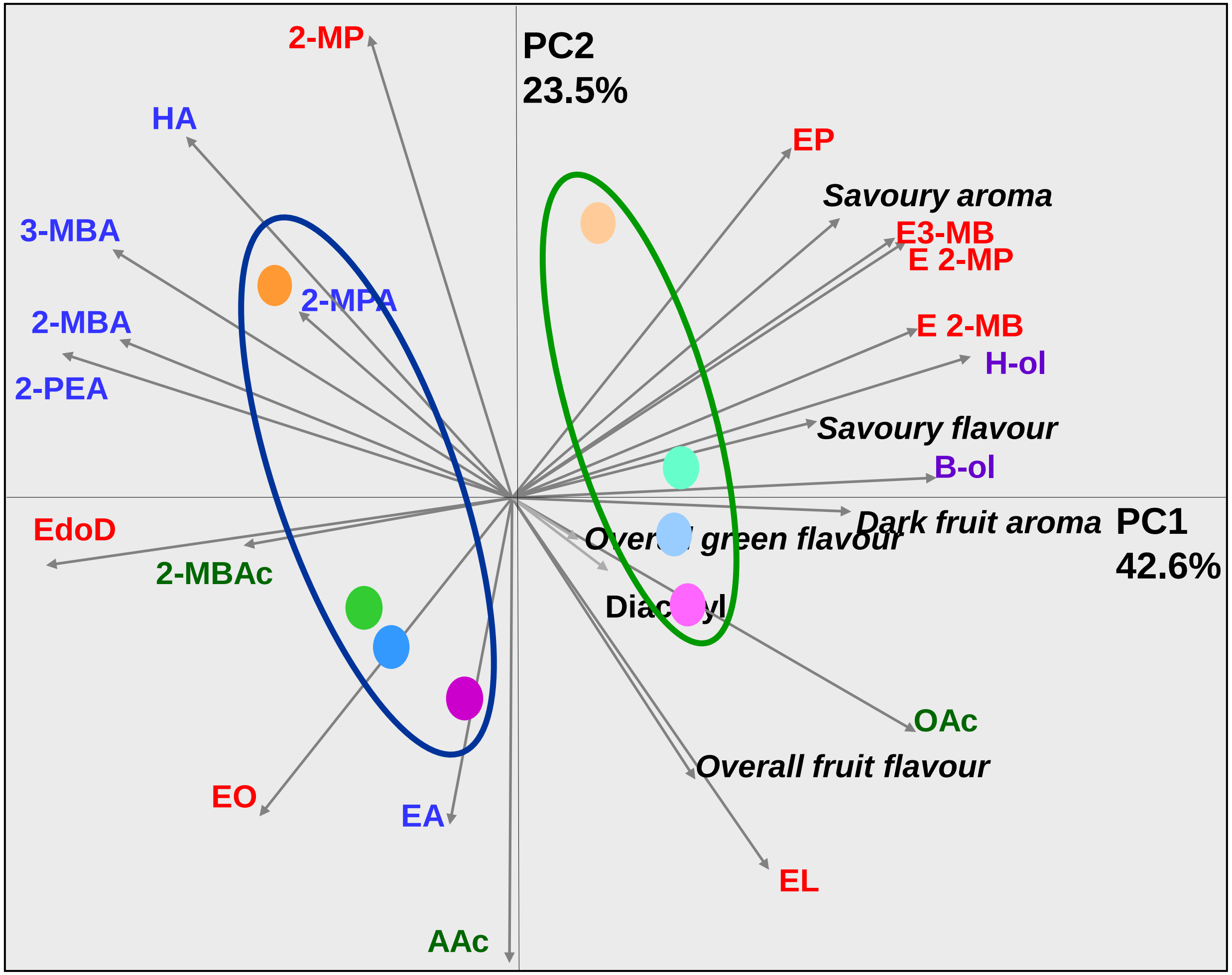
Cabernet Sauvignon, 2008

- *Consistency with ML strains & vineyard over vintages*
- *Differences between vineyards*

from Costello et al, 2012

Wine pH affects *O. oeni* metabolism

The Australian Wine Research Institute



Limestone Coast

pH 3.3

No MLF

MLF

pH 3.7

No MLF

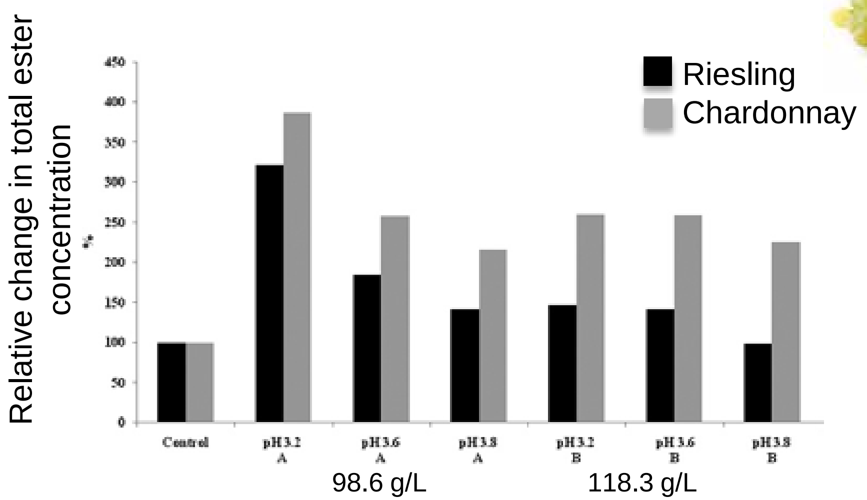
MLF

Costello et al. 2012 AJGWR

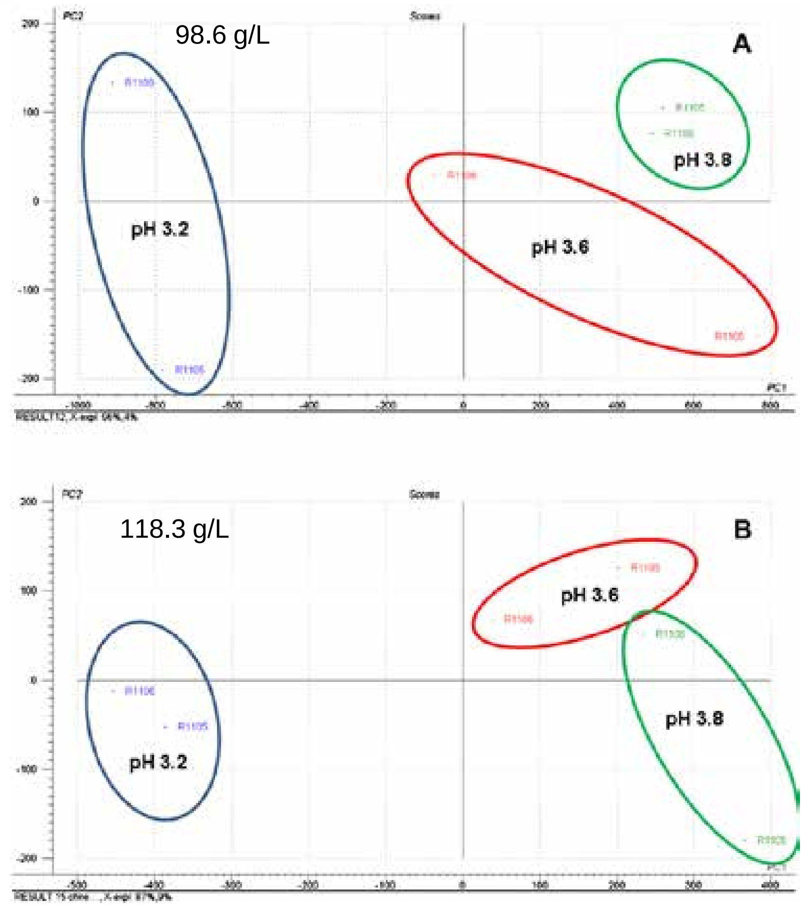
Cabernet Sauvignon, Limestone Coast 2006

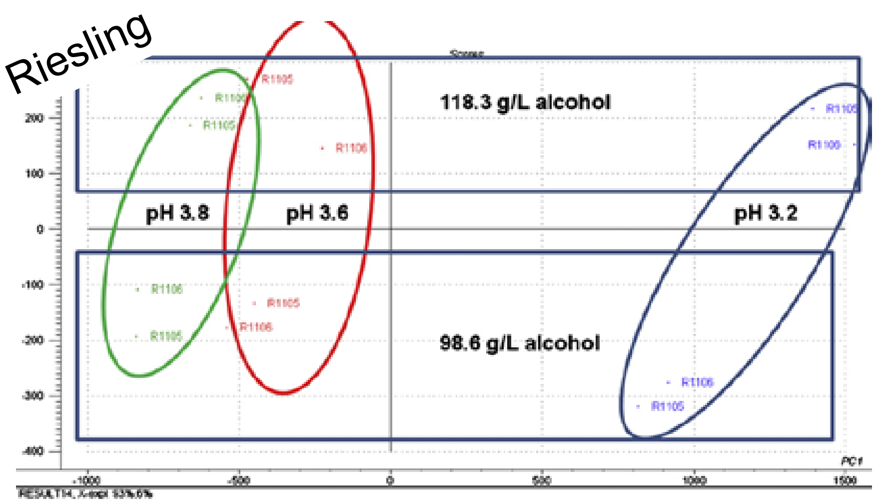
pH affects *O. oeni* metabolism

The Australian Wine Research Institute



Chardonnay



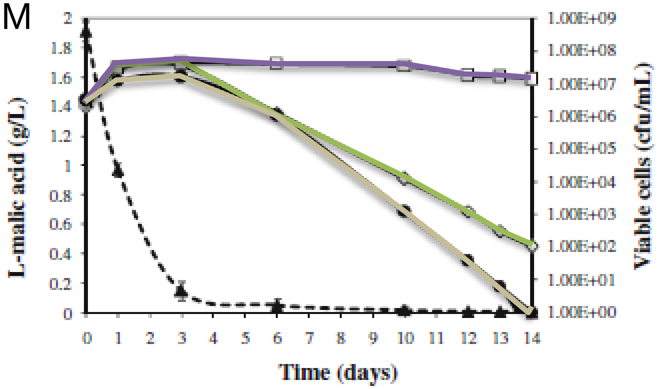


Knoll et al 2011 Fd Sci & Technol

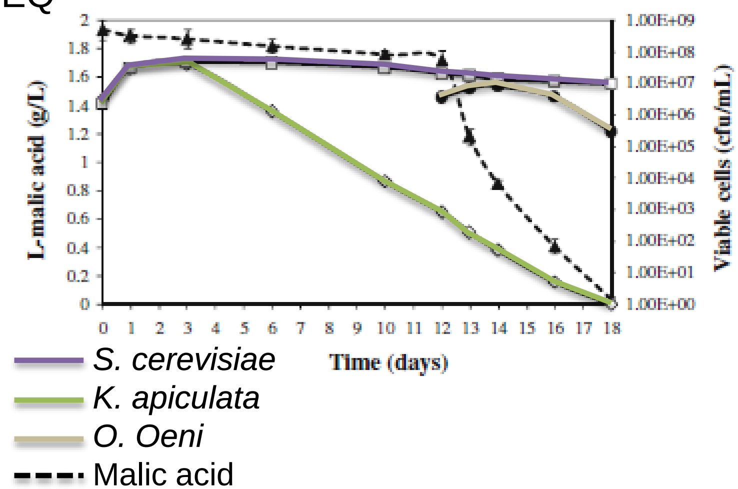
Yeast and bacteria

The Australian Wine Research Institute

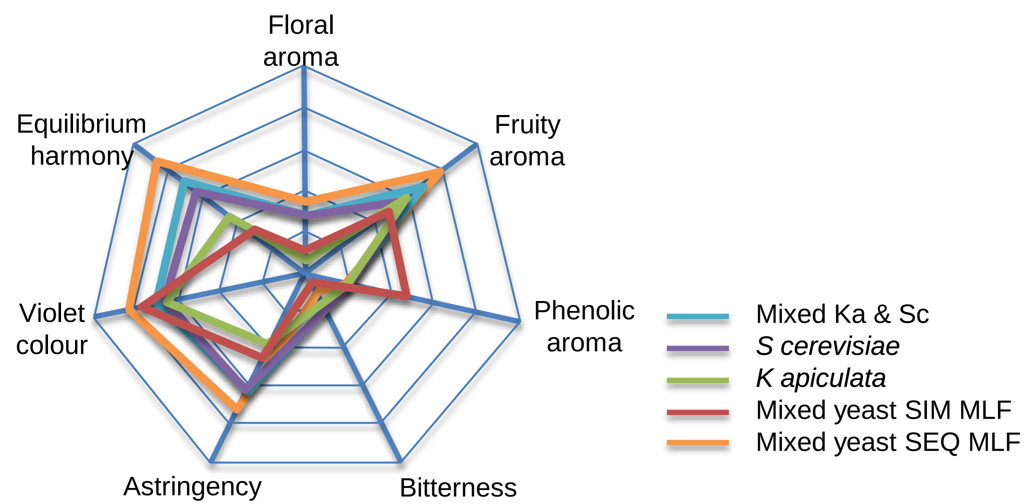
SIM



SEQ



		K	S	K+S	K+S+O	K+S+O
Residual sugar	g/L	20.84	0.72	081	086	075
Ethanol	% v/v	8.82	13.91	13.56	12.97	13.38
VA	g/L	0.79	0.45	0.58	1.23	0.61
pH		3.81	3.83	3.81	3.92	4.05
TA	g/L	5.27	5.91	6.22	6.79	4.90
Malic acid	g/L	1.89	1.76	1.81	0.04	0.02
Glycerol	g/L	7.98	8.55	8.43	8.27	8.16
Acetaldehyde	mg/L	37.83	56.54	52.35	17.76	48.14
Colour intensity		1.60	1.62	1.59	1.52	1.70
Colour hue		1.24	1.19	1.22	1.20	1.15



Malbec (2009)
Argentina

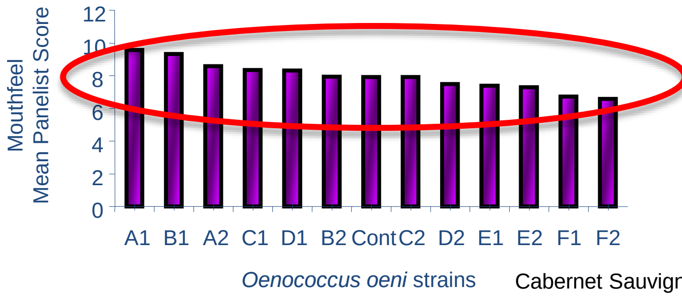
pH 4.0, TA 4.7 g/L
245 g/L reducing sugar
1.97 g/L L-malic acid
125 mg/L YAN

Mendoza et al 2011 J Ind Microbiol Biotechnol

Palate and MLF

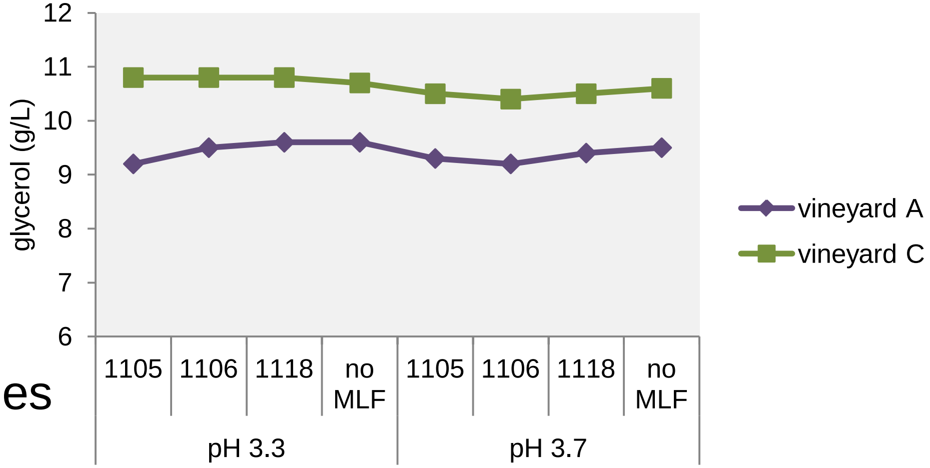
The Australian Wine Research Institute

- MLF can influence the palate of wine



Cabernet Sauvignon, 1998, NY State, USA
Richardson et al., 1999

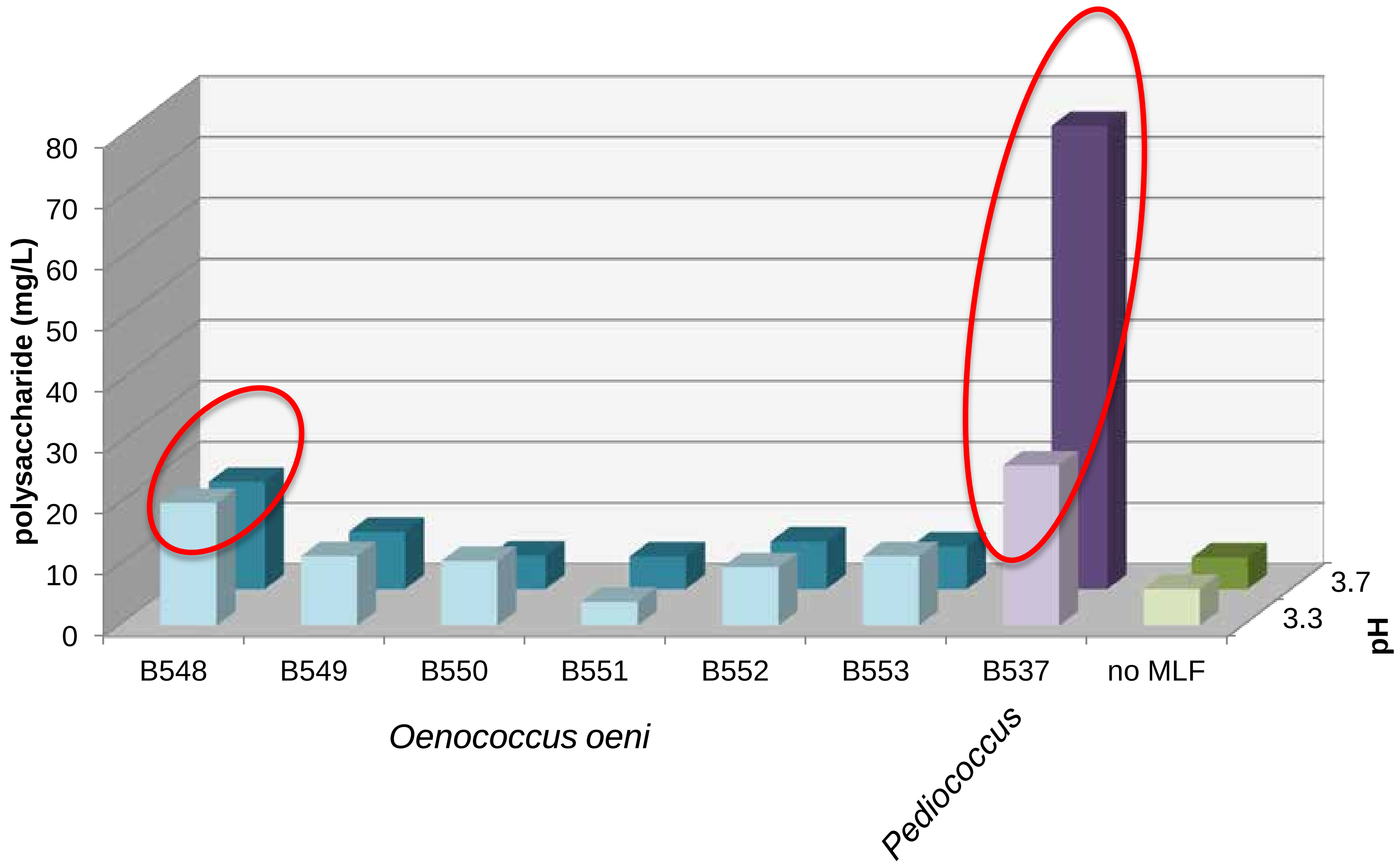
- Associated with volume and viscosity
  - Glycerol



  - Exopolysaccharides
- Recent studies
  - Some strains of *O. oeni* have the genes for exopolysaccharide production

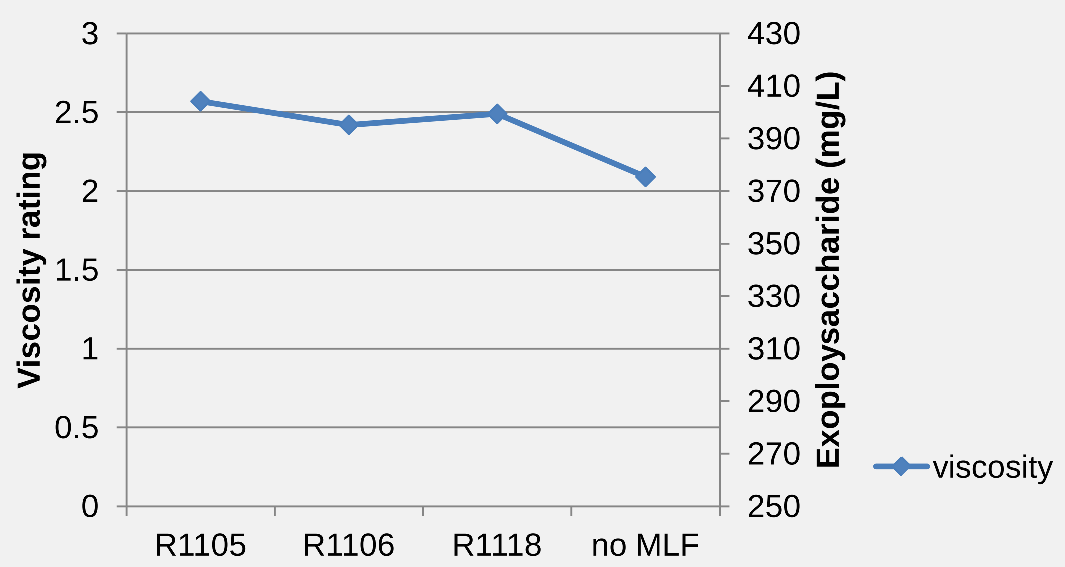
Can *O. oeni* produce exopolysaccharides?

The Australian Wine Research Institute



Sensory & [exopolysaccharide]

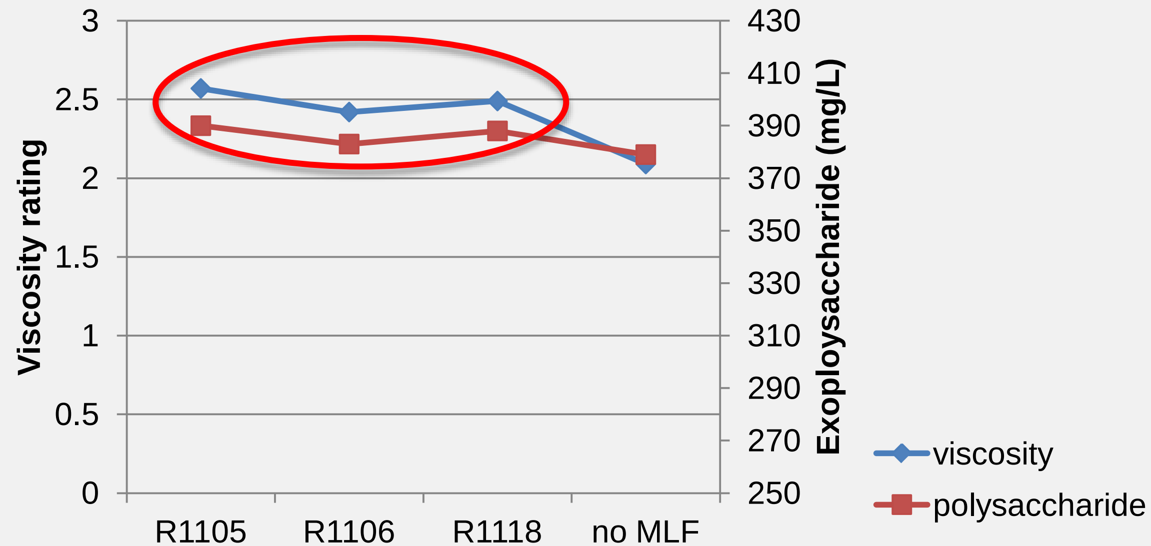
The Australian Wine Research Institute



Cabernet Sauvignon
Vineyard A
Costello, 2006

Sensory & [exopolysaccharide]

The Australian Wine Research Institute



Cabernet Sauvignon
Vineyard A
Costello, 2006

- O. oeni *strains can produce exopolysaccharides*
- *Correlates with viscosity of wine*

MLF: wine aroma & flavour – What can we do?

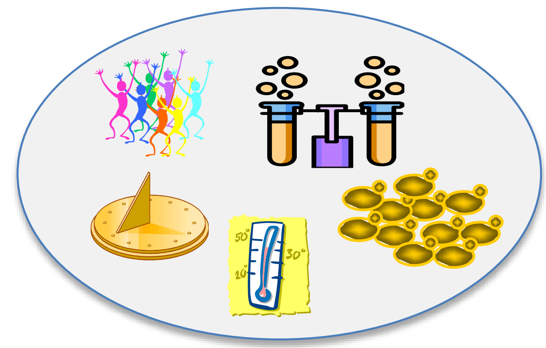
The Australian Wine Research Institute

ü pH can influence bacterial metabolism

- Ø affects wine aroma and flavour

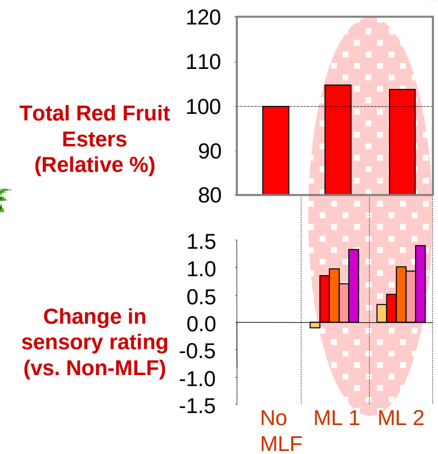
ü Diacetyl – buttery attribute

- § Can be managed through winemaking practices



ü Berry & fruity characters in red wine

- § Strain
- § Lower pH



v Mouthfeel

- § Exopolysaccharide production

Ø *MLF can be used as a means to influence wine style.*

Acknowledgments

The Australian Wine Research Institute

- AWRI Wine Biosciences

  MLF Team
  - Caroline Abrahamse
  - Peter Costello
  - Jane McCarthy

- Wineries: kind donation of grapes & wine for research
- Lallemand: support for berry-fruit research

LALLEMAND

- 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

Cold Stability, CMCs and other crystallization inhibitors.

Dr Eric Wilkes
Group Manager Commercial Services

AWRI COMMERCIAL SERVICES
SO MUCH MORE THAN A GREAT LAB

Tartrate instability

The Australian Wine Research Institute

“The deposit is harmless, but the customers reaction might not be”.......potassium hydrogen tartrate......

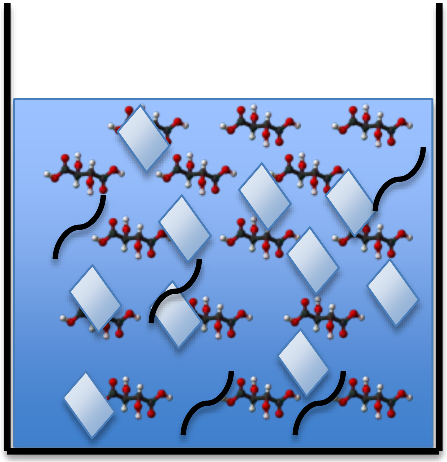
Bryce Rankine, 1989

Cold stability, what is it?

The Australian Wine Research Institute

- ***Cold stability** is essentially a wines ability to resist the precipitation of tartrates.*

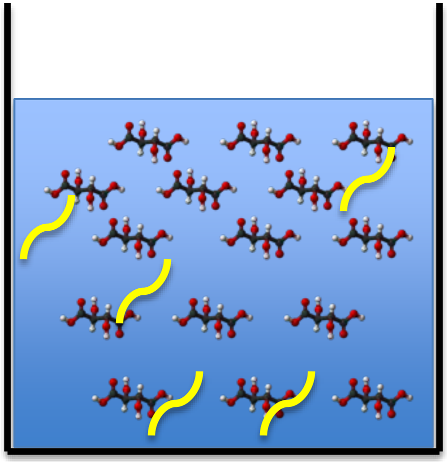
- Components in wine (crystallization inhibitors) help prevent the tartrate from precipitating.
- As the wine matures or undergoes winemaking processes the levels of these inhibition compounds can change, allowing tartrate to precipitate.
- This can happen even after traditional cold stabilization.



Wine cold stabilisation methods

The Australian Wine Research Institute

- Elimination/reduction of precursor compounds (e.g. potassium, bitartrate):
  - Traditional slow cold stabilization
  - Rapid contact stabilization
    - Batch
    - Continuous
  - Ion-exchange
  - Membrane processes
    - Electrodialysis



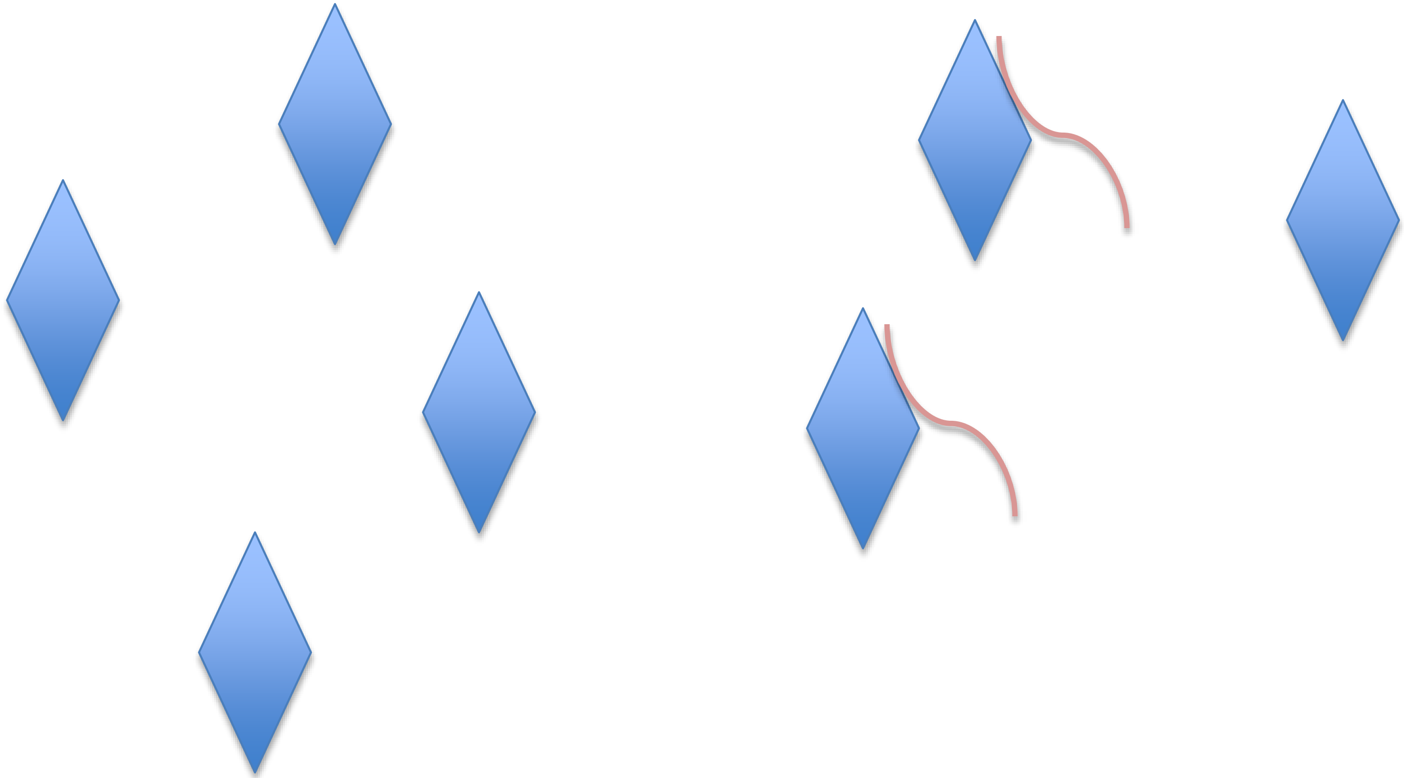
- Crystallisation inhibitors:
  - Metatartaric acid
  - Yeast mannoproteins
  - Carboxymethylcellulose (CMC)

Crystallization inhibitors

The Australian Wine
Research Institute

How do they work

- They block potassium bitartrate crystal nucleation and growth by binding with one of the crystal faces preventing further growth and the appearance of visible crystals.



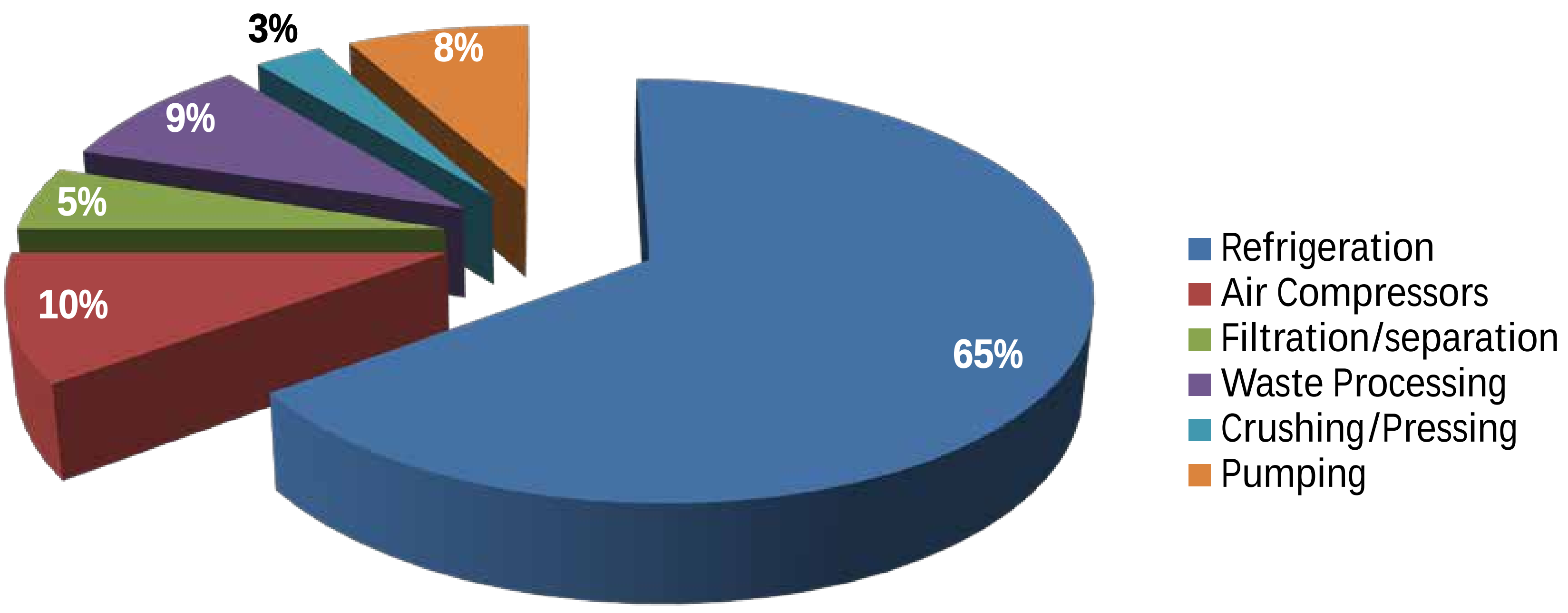
Why use crystallization inhibitors?

The Australian Wine Research Institute

Less impact on wine pH/TA than traditional stabilization by tartrate elimination.

Labour and time savings.

Lower energy impacts than traditional refrigeration.



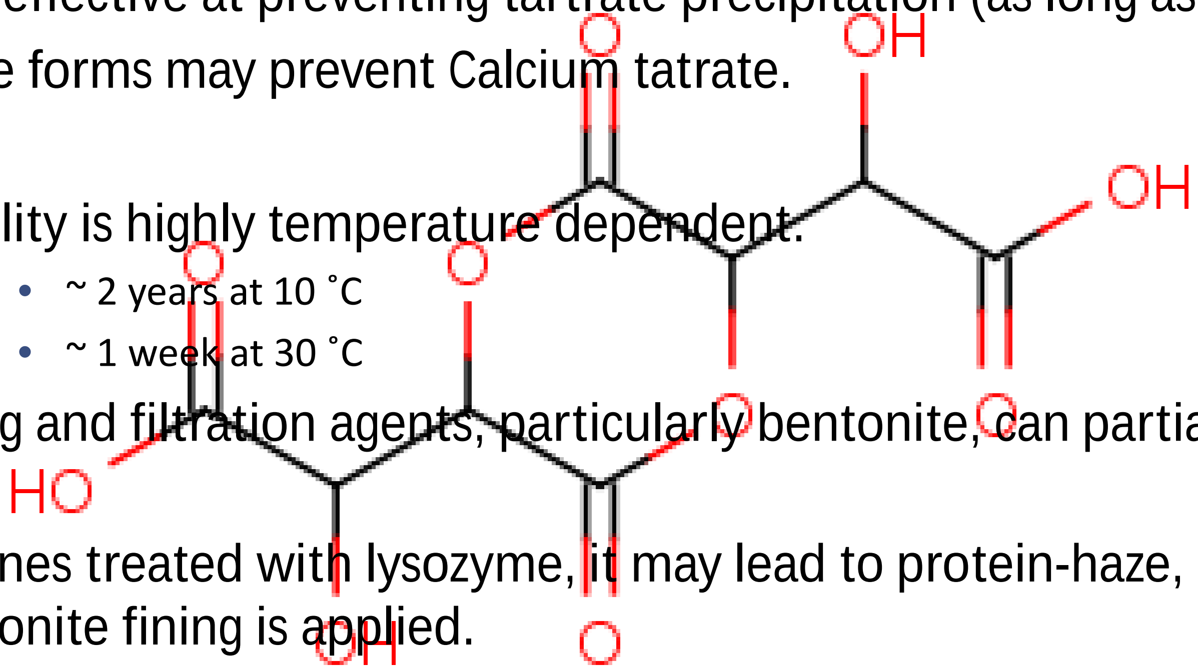
Metatartaric acid

The Australian Wine Research Institute

- First used in Europe in 1950s.

Polymeric structure produced by heating of tartaric acid to 160 °C.

- ✔ Very effective at preventing tartrate precipitation (as long as it is there).
- ✔ Some forms may prevent Calcium tatrate.



- ✖ Stability is highly temperature dependent.
  - ~ 2 years at 10 ˚C
  - ~ 1 week at 30 ˚C
- ✖ Fining and filtration agents, particularly bentonite, can partially remove it.
- ✖ In wines treated with lysozyme, it may lead to protein-haze, even if bentonite fining is applied.

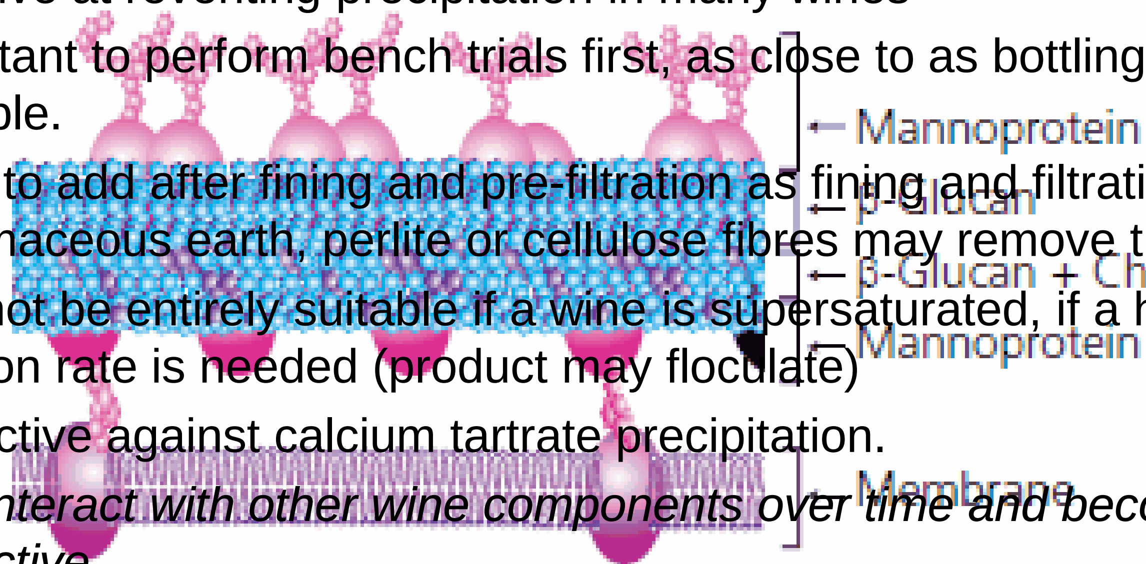
Yeast mannoproteins

The Australian Wine Research Institute

- Derived from wine - a specific fraction is extracted from yeast cell walls by enzymatic hydrolysis

Yeast Cell Wall

- ✔ Much more stable than metatartaric acid to warm temperatures.
- ✔ Effective at reventing precipitation in many wines
- ✖ Important to perform bench trials first, as close to as bottling as possible.
- ✖ Need to add after fining and pre-filtration as fining and filtration using diatomaceous earth, perlite or cellulose fibres may remove them.
- ✖ May not be entirely suitable if a wine is supersaturated, if a high addition rate is needed (product may flocculate)
- ✖ Ineffective against calcium tartrate precipitation.
- ✖ *May interact with other wine components over time and become ineffective.*



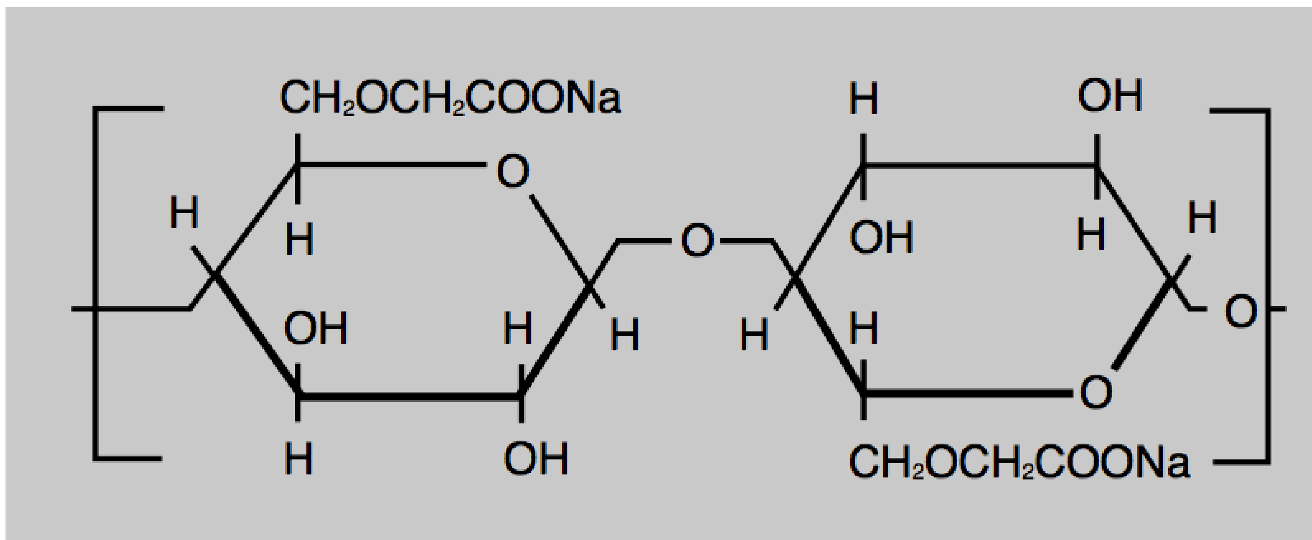
Carboxymethylcellulose

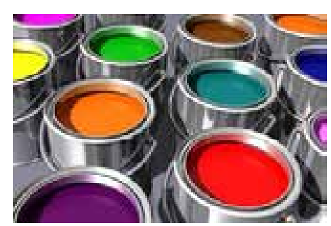
The Australian Wine
Research Institute

What is it?

- Polymer synthesized by the alkali-catalyzed reaction of cellulose.

E466

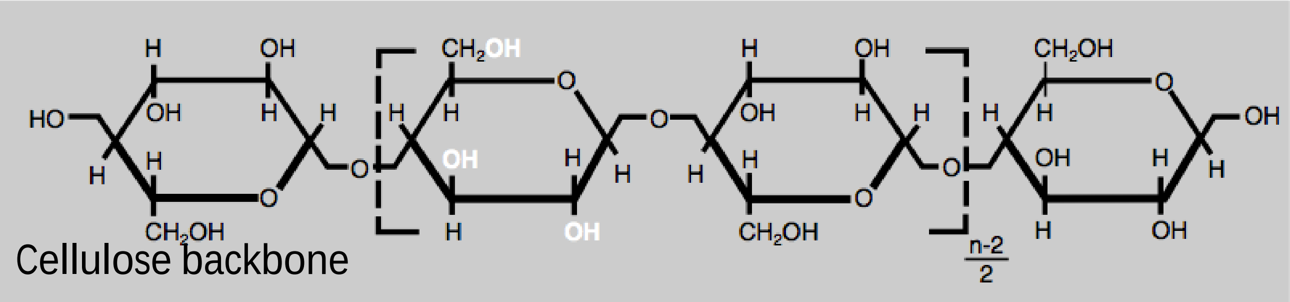




What differences are there?

Substitution rates

- Number of -OH groups substituted by carboxymethyl groups.
- OIV specification is 0.6 to 0.95.



Cellulose backbone

Polymer length

- Impacts solubility and viscosity.
- OIV between 17 and 300 kiloDaltons.

Filtration

The Australian Wine Research Institute

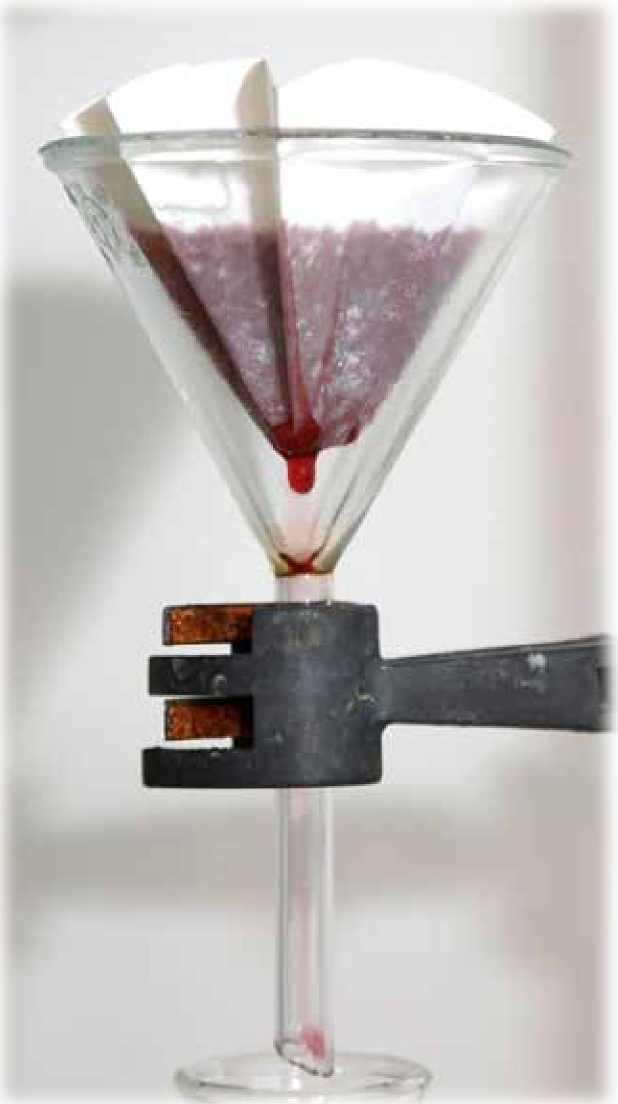
CMC's don't instantly integrate with the wine!

They can take 2 to 7 days to fully integrate (depending on temperature and CMC).

Most trials have suggested that if allowed to fully integrate there is very little impact on filterability.

Important to leave this time before cellar (and tasting) operations.

A bigger issue may be actually getting them to dissolve in the first place. Some real advantages to using liquids!



Colour impacts

The Australian Wine Research Institute

Cellulose and its derivatives react with tannins (including pigmented tannins) and can precipitate out colour. As such CMC's are not recommended for reds.

Colour drop out not always apparent immediately, often only occurring after time at low temperature.

Even without significant colour dropout can get hazes.

Can be used with some rose but need to do trials first.

Haze formation

Protein can crosslink with CMC's to form hazes.

This can happen post filtration and be temperature linked.

Wines to be treated with CMC ***must*** be protein stable.

Some literature has raised issues with certain metal ions also leading to cross linking and hazes. Only an issue for di and tri-valent species (eg, copper and iron) but no confirmed reports of this in wine.

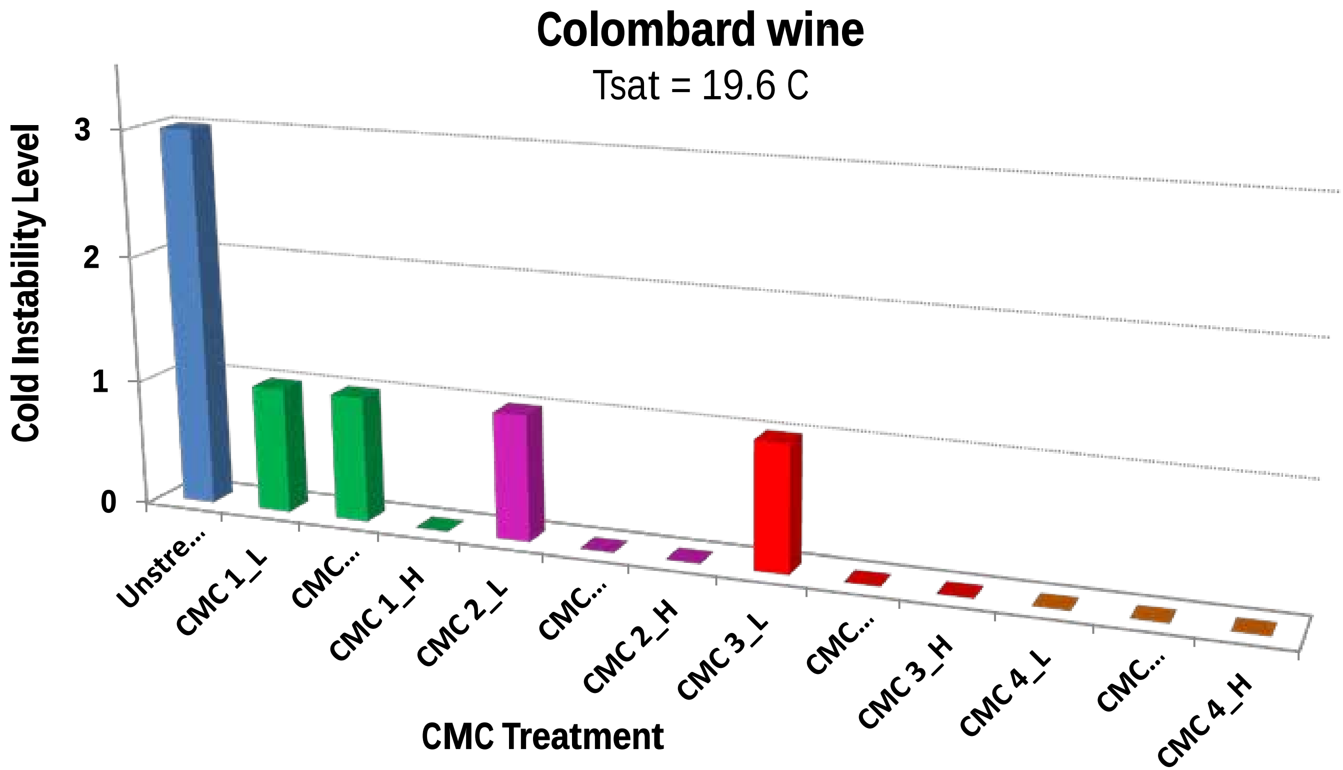
Wine style and age

The Australian Wine Research Institute

Trials to date have given positive results for all wine styles tested.

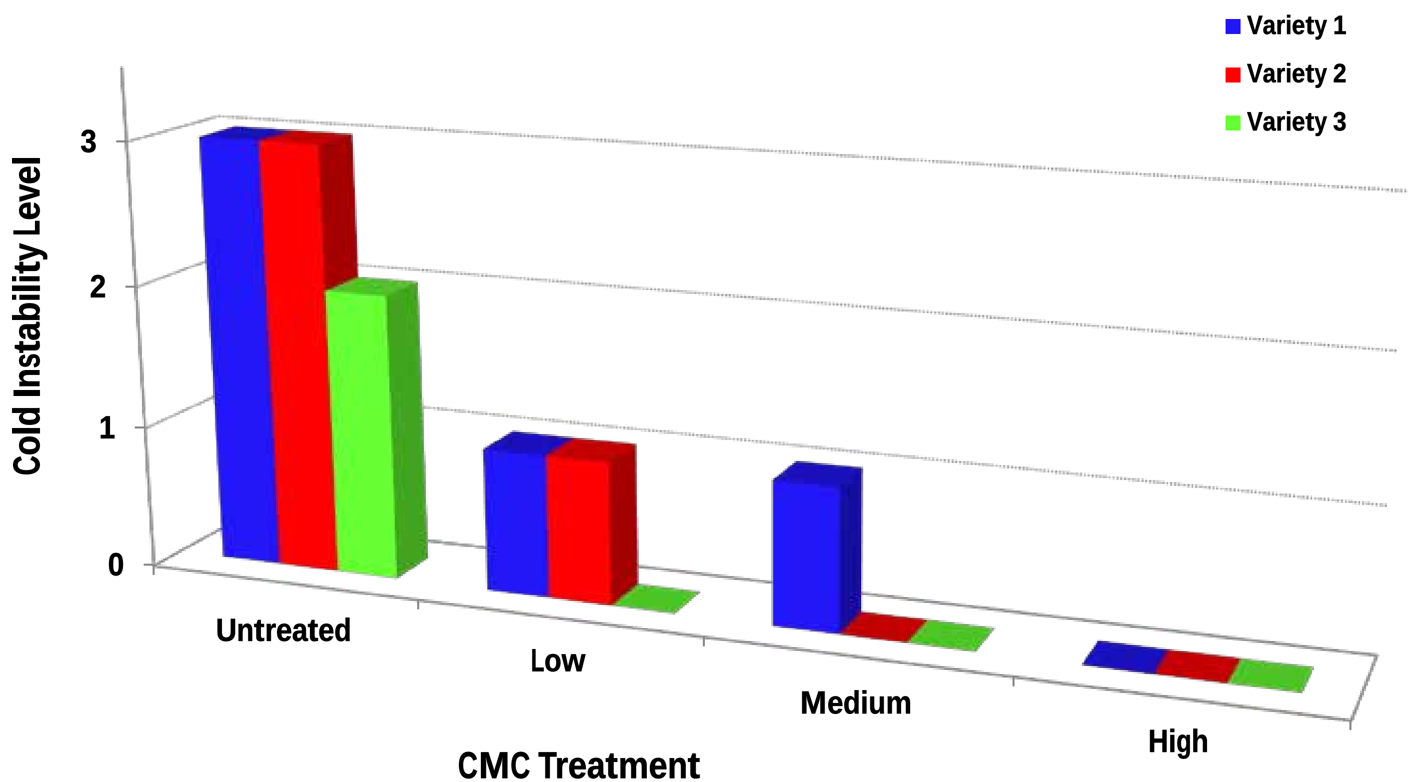
Some question with younger wines with very high T-sat.

Also some evidence that in very young wines other compounds may be interacting with CMC's removing them from the equation.



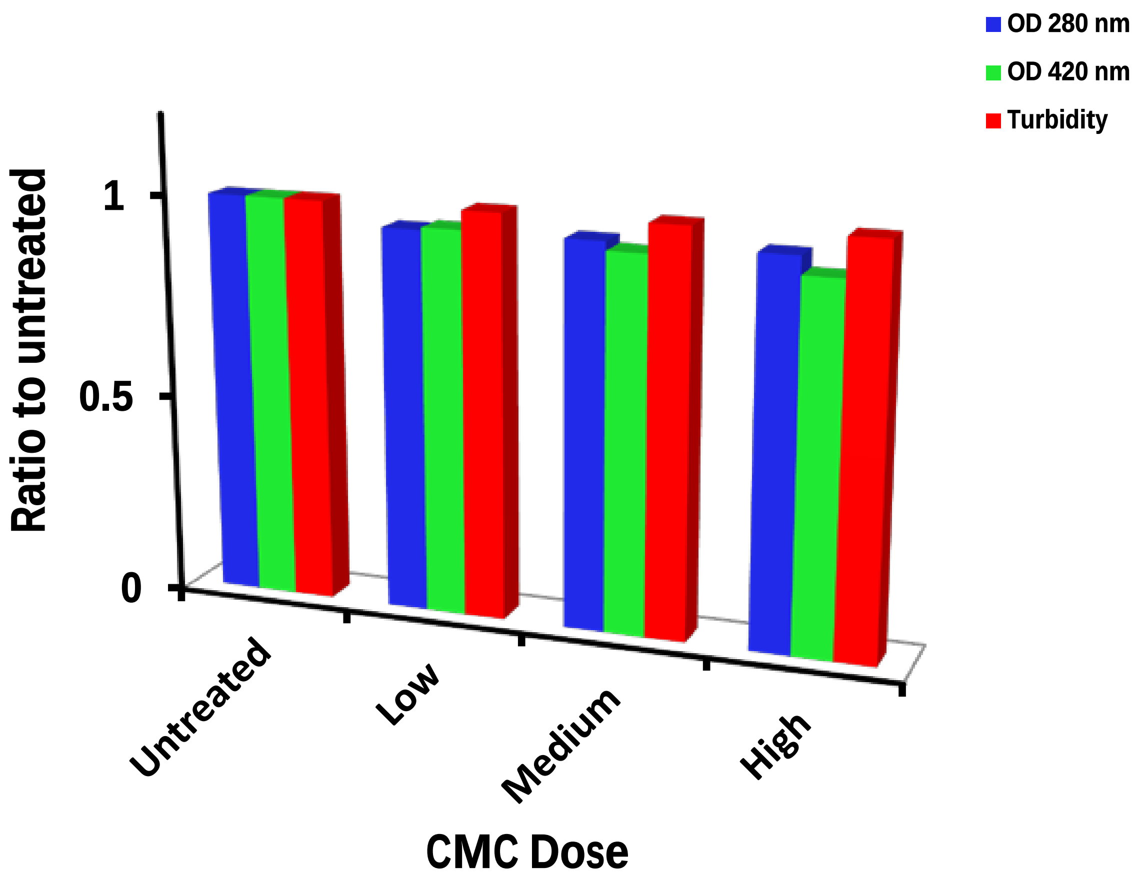
Variety impact on CMC effectiveness

The Australian Wine Research Institute



Effects of CMC on white wine colour and turbidity

The Australian Wine Research Institute



What else?

The Australian Wine Research Institute

Calcium stability

- Trials published to date suggest that CMC's don't appear to be particularly effective in the prevention of calcium tartrate instability.
- This may because of the different crystal structure of CaT.

Flavour impacts

- There are reports that CMC's can impact wine mouth feel.
- Highly wine and CMC dependent.
- Make sure trials give time for full integration.

Testing

- Saturation temp gives no indication of CMC induced stability but does give an indication of suitability.
- Brine test does work.
- Mini contact can be impacted depending on seeding rates.

CMC summary

The Australian Wine Research Institute

1. They can work!

2. Best used when packaging ready (cellar bright and protein stable).
3. Need 2 to 7 days post treatment before filtration.
4. Wines should have a Sat-Temp in the region of <20.
5. Some wine styles may have other components that could reduce the effectiveness of a given dose of CMC.
6. Not a great idea for reds that you want to keep colour stable and haze free.
7. Must choose a CMC that is workable for your cellar operations.
8. Need to adjust testing regimes.

Questions?

The Australian Wine Research Institute

COMMERCIAL SERVICES

VESDA- Developing tools to assist land mangers and industry.

Ricky James- Centre for Expertise in Smoke Taint Research.
DEPI, Rutherglen.

Department of Environment and Primary Industries
State Government Victoria

Overview

Tools for Industry

Tools for land managers.

Smoke taint research relatively new so nothing fit for purpose.

How much smoke????

Determine the relative impacts of controlled burning and wildfire.

•Evaluation of smoke detection monitoring as a tool for measuring smoke intensity and duration of presence and therefore exposure to fruit.

What we know/what we want to know???

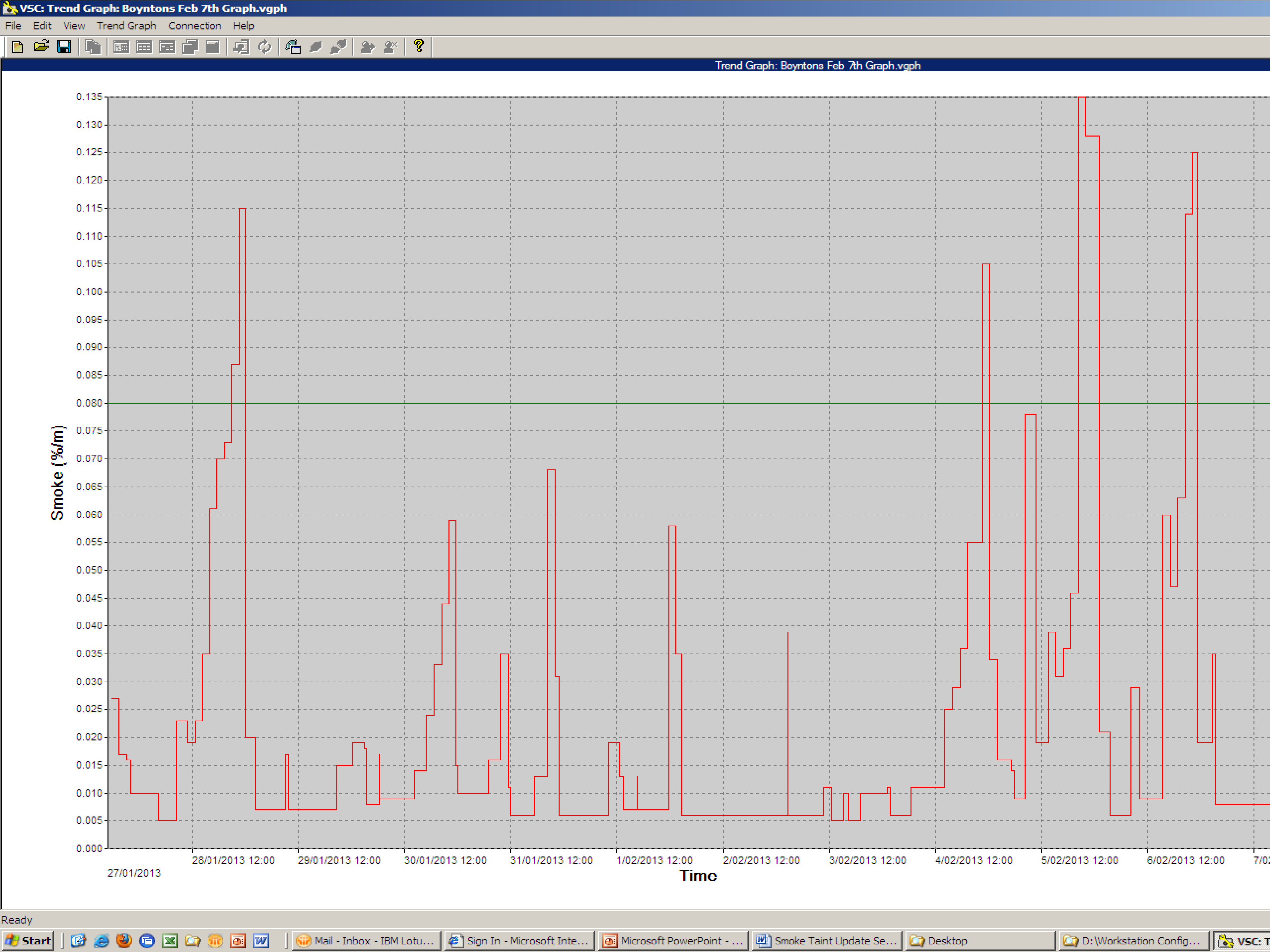
Level of smoke taint is a combination of-

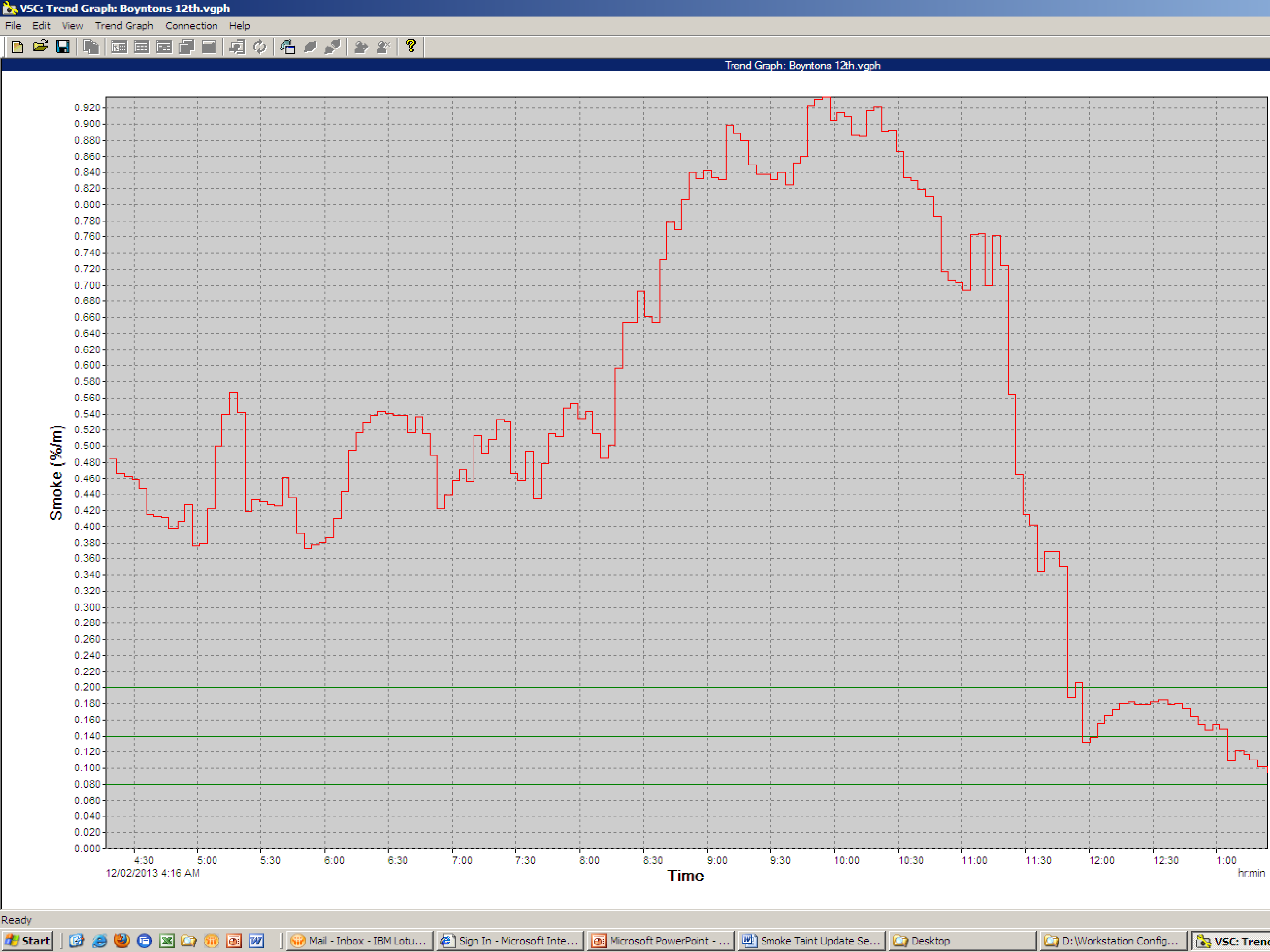
•Intensity of smoke- just like wine, very subjective, need to put a number on it.

•Duration of exposure-how long has the smoke been in the vineyard?

VESDA

- Very Early Warning Aspirating Smoke Detection
- Early warning alarm systems for sealed electrical and telecommunications cabinets.
- Retro fit units to be used in external environment to monitor smoke in vineyards.
- Ability to objectively measure smoke intensity over time and log this data over extended periods and multiple smoke events.


VSC: Trend Graph: Boyntons Feb 7th Graph.vgph
File
Edit
View
Trend Graph
Connection
Help
Trend Graph: Boyntons Feb 7th Graph.vgph
Smoke (%/m)
0.135
0.130
0.125
0.120
0.115
0.110
0.105
0.100
0.095
0.090
0.085
0.080
0.075
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
27/01/2013
28/01/2013 12:00
29/01/2013 12:00
30/01/2013 12:00
31/01/2013 12:00
1/02/2013 12:00
2/02/2013 12:00
3/02/2013 12:00
4/02/2013 12:00
5/02/2013 12:00
6/02/2013 12:00
Time
Ready
Start
Mail - Inbox - IBM Lotu...
Sign In - Microsoft Inte...
Microsoft PowerPoint - ...
Smoke Taint Update Se...
Desktop
D:\Workstation Config...


VSC: Trend Graph: Boyntons 12th.vgph
File Edit View Trend Graph Connection Help
Trend Graph: Boyntons 12th.vgph
Smoke (%/m)
0.920
0.900
0.880
0.860
0.840
0.820
0.800
0.780
0.760
0.740
0.720
0.700
0.680
0.660
0.640
0.620
0.600
0.580
0.560
0.540
0.520
0.500
0.480
0.460
0.440
0.420
0.400
0.380
0.360
0.340
0.320
0.300
0.280
0.260
0.240
0.220
0.200
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
4:30
5:00
5:30
6:00
6:30
7:00
7:30
8:00
8:30
9:00
9:30
10:00
10:30
11:00
11:30
12:00
12:30
1:00
12/02/2013 4:16 AM
Time
hr:min
Ready
Start
Mail - Inbox - IBM Lotu...
Sign In - Microsoft Inte...
Microsoft PowerPoint - ...
Smoke Taint Update Se...
Desktop
D:\Workstation Config...
VSC: Trend

Positives and Negatives

•+ Affordable price for industry- approx $2500

•+ Logs intensity and duration

•+ Simple installation and data collection

•+ Real time data to monitor controlled trials.

•+ Local production, knowledge and experience.

•- Not ‘fit for purpose’. External conditions.

•- False positives- dust, moisture, Winnie Blues

•- Very sensitive- logs every change in concentration

•- Correlations with EPA air Quality data.

Next Steps

- Adjust software to enable more suitable and reliable data to be collected.
- Correlation between Obs/m and visual horizon data.
- Ability to create a network across a region when best opportunity arises
- Monitor numerous locations in the one region to compare smoke intensity, duration and affect on fruit.

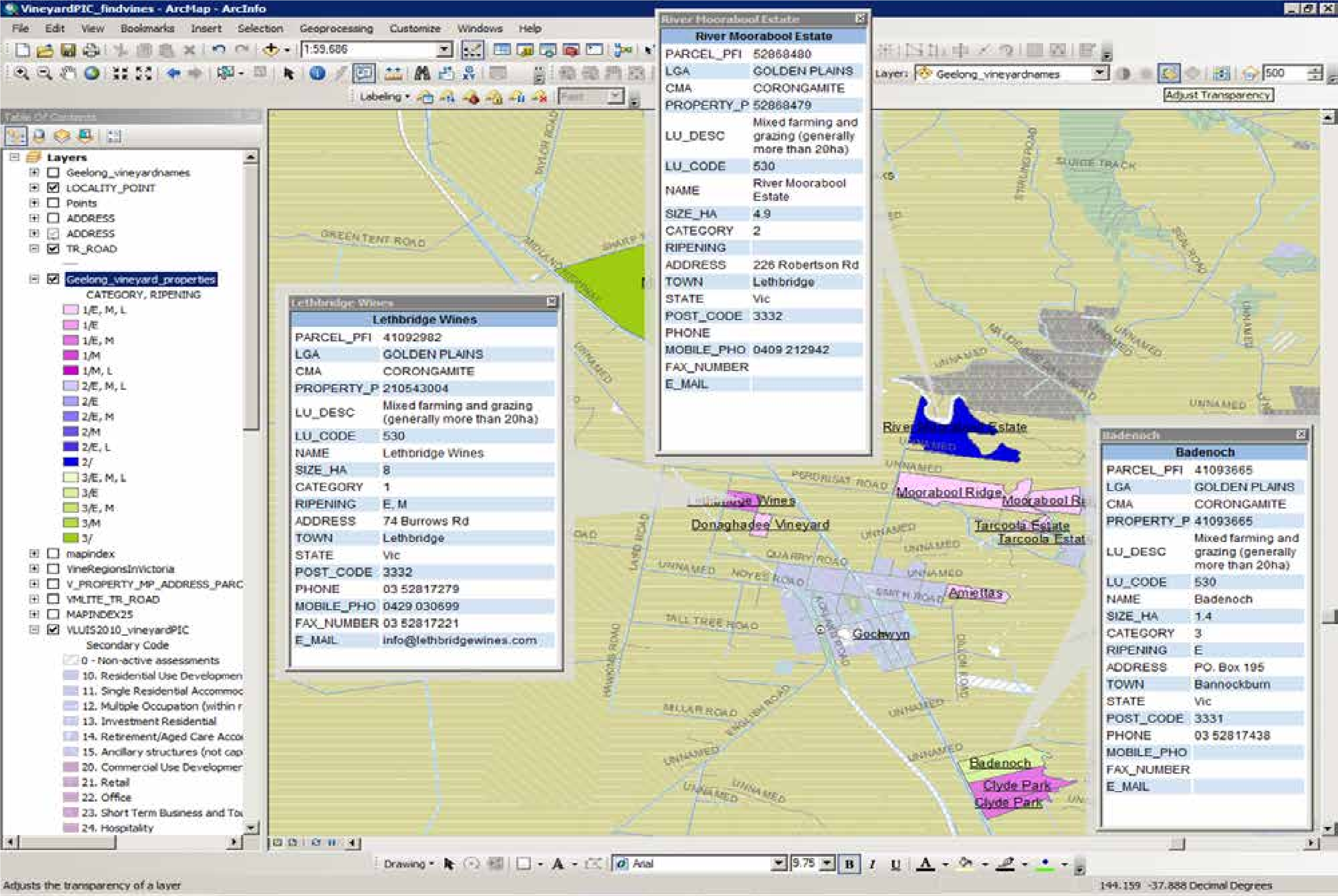
Who, What and Where??

Project Management Plan- Objective 6

Develop and evaluate a risk assessment tool to enable industry and land managers to determine suitable burning periods based on varietal sensitivity and grapevine development.

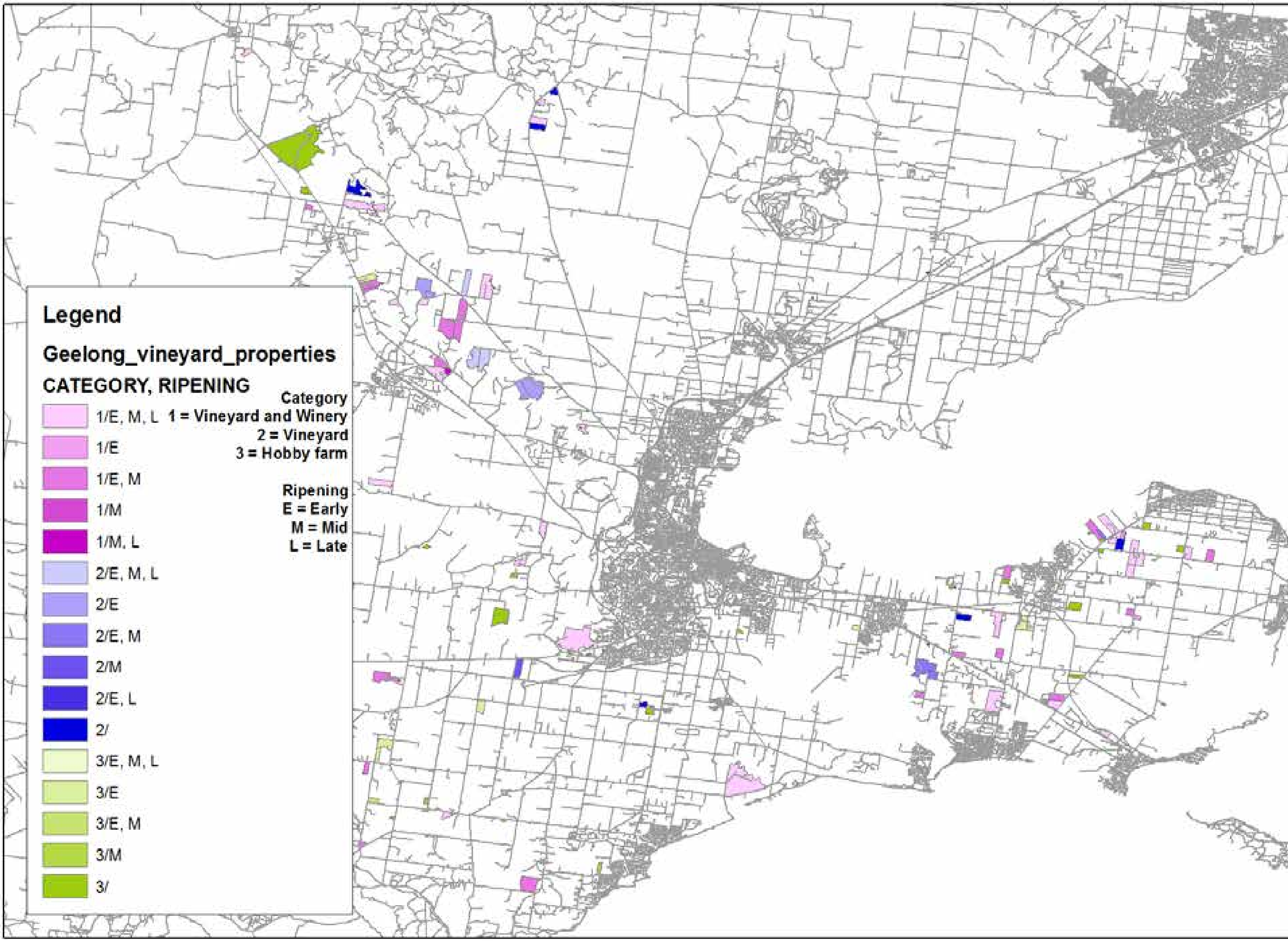
Fit for purpose mapping for land managers and industry

- VLUIS- Victorian Land Use Information Survey
- Biosecurity Victoria- PIC Codes
- DEPI- Fire Management
- Victorian Wine Industry
- DAFWA- STAR Model



Department of
Environment and
Primary Industries

State Government Victoria



Legend
Geelong_vineyard_properties
CATEGORY, RIPENING
1/E, M, L
1/E
1/E, M
1/M
1/M, L
2/E, M, L
2/E
2/E, M
2/M
2/E, L
2/
3/E, M, L
3/E
3/E, M
3/M
3/
Category
1 = Vineyard and Winery
2 = Vineyard
3 = Hobby farm
Ripening
E = Early
M = Mid
L = Late

Wine Related Research @ DEPI

Smoke Taint- Mark Downey

Tannin measurements in Winegrapes and resulting wines- Rachel Kilmister

Impacts of global warming on grape phenology, vine growth and grape quality- Rachel Kilmister

Soil Health- Ian Porter and Jacky Edwards

Phenology – Veraison
Heated Chamber @ +2 DegC.

23/12/11 | 29/12/11 | 4/1/12 | 20/1/12

Questions???

AWRI

The Australian Wine Research Institute

Using the timing of MLF inoculation to optimise your winemaking

(Will I get a quicker MLF?)

(How can I use MLF on sensory attributes?)

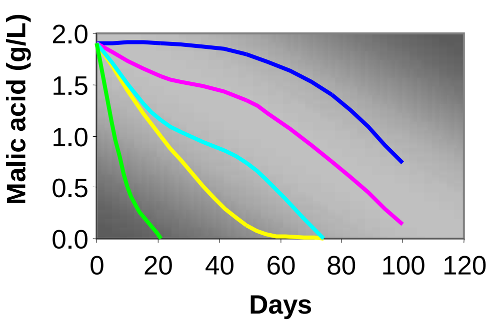
Eveline Bartowsky

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



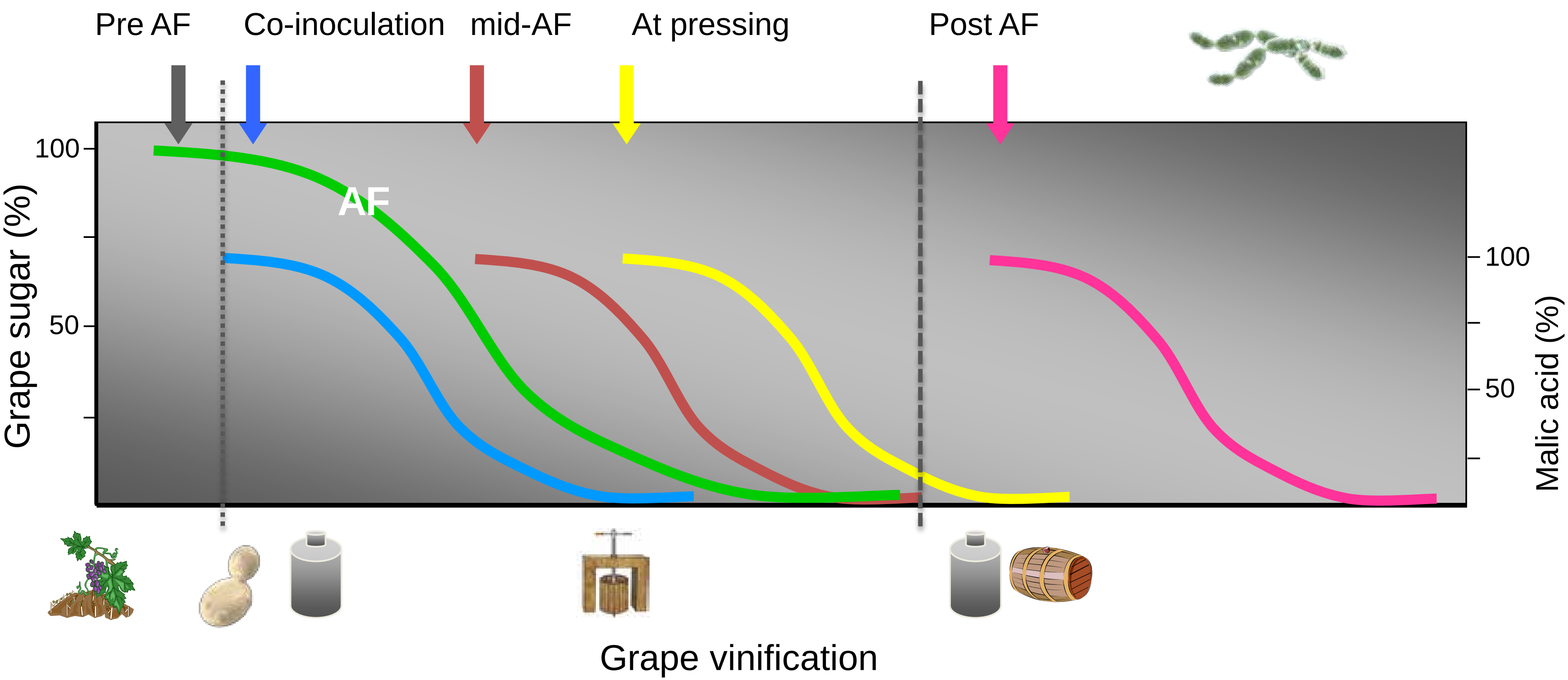
- Sensory impact
  - Buttery character
  - - fruity & ¯ vegetative characters
  - Improved mouthfeel

- 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 inocul^{n} ?

The Australian Wine
Research Institute



What are my options? *Considerations*

The Australian Wine Research Institute

With AF (co-inoculation/simultaneous)	Concerns
More nutrients available	Acetic acid production
EtOH & SO_2 at lower concentration	Antagonistic problems with yeast & bacteria
Could be more rapid	May lead to yeast arrest

At pressing (co-inoculation)	
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?

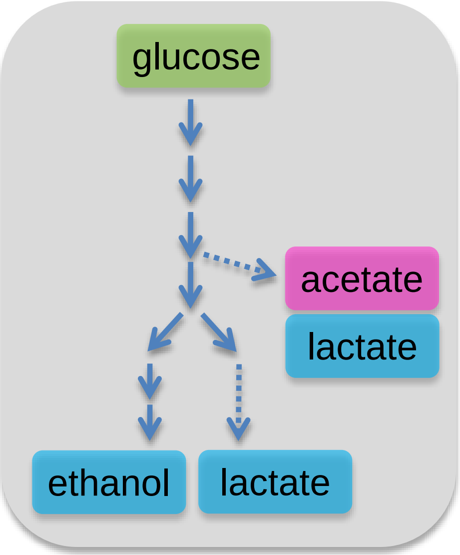
Co-inoculation concerns

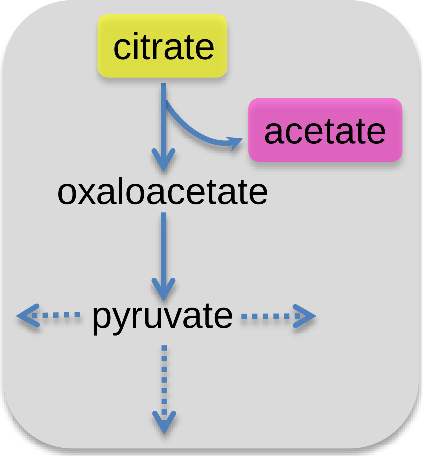
- VA production by the bacteria during AF
  - Very much linked to metabolism and grape must pH

pH & *O. oeni* metabolism

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)

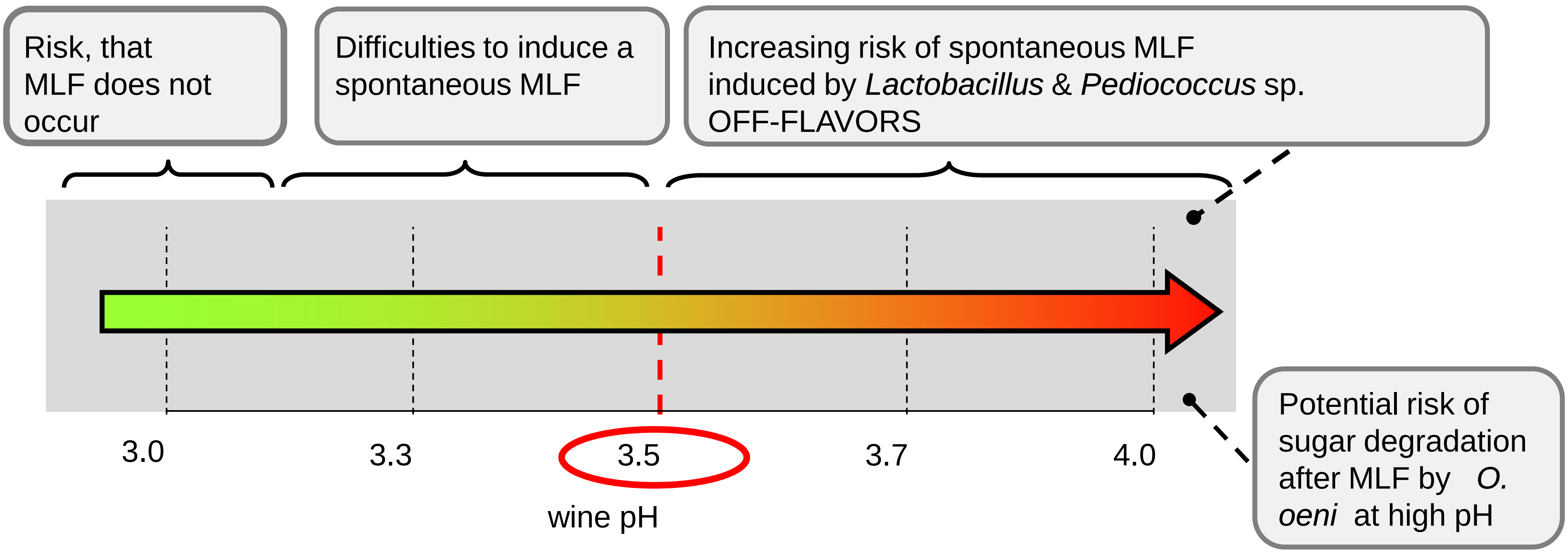




Co-inoculation concerns

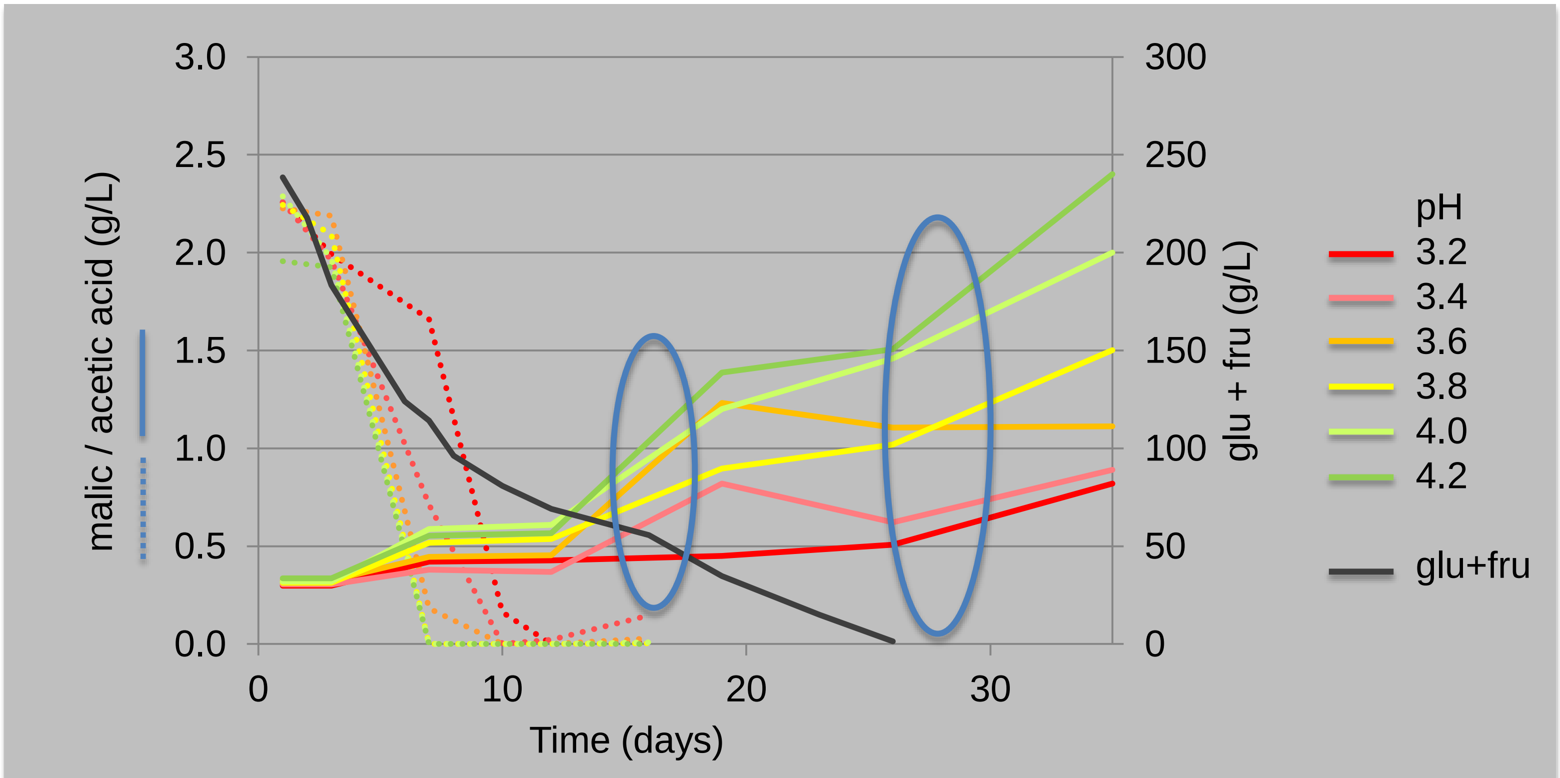
The Australian Wine Research Institute

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



Acetic acid & co-inoculation

The Australian Wine Research Institute



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

Co-inoculation

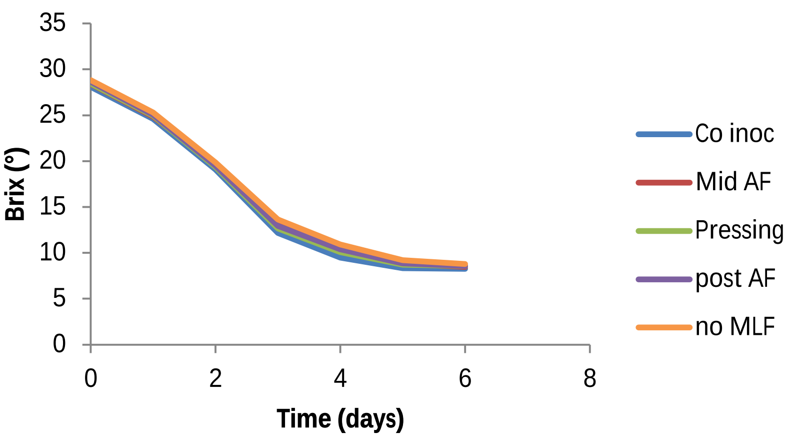
- Concerns
  - VA production during AF by the bacteria
  - The yeast will stop fermenting
  - Wine colour affected
- What are some sensory consequences

- *Three examples examining these questions*
  - Cabernet Sauvignon, Shiraz, and Chardonnay

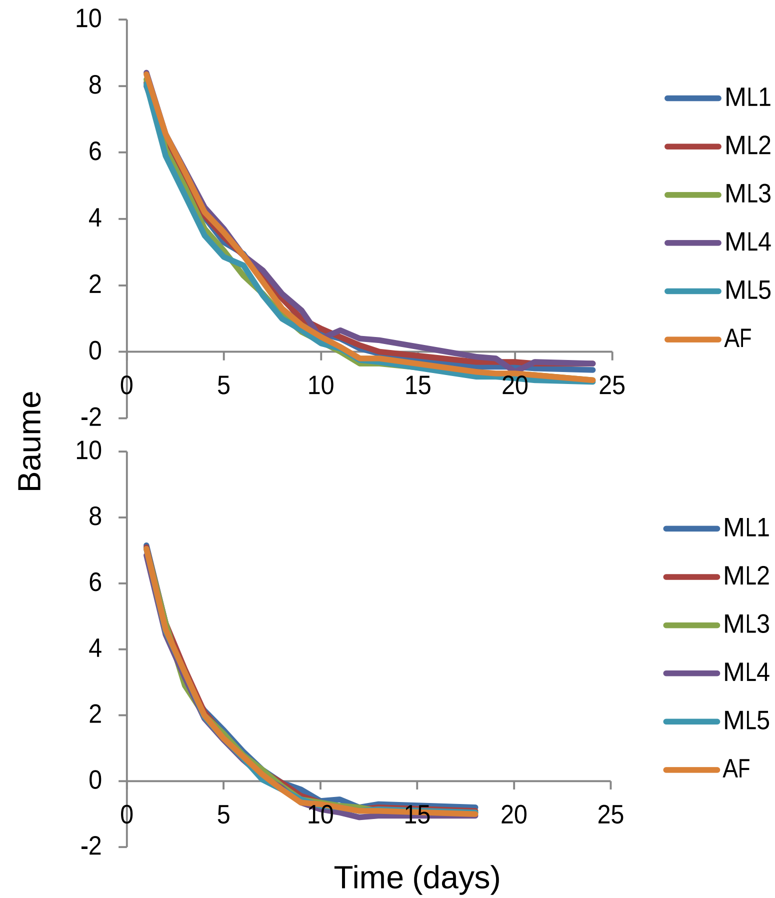
Co-inoculation

The Australian Wine Research Institute

- The yeast will stop fermenting



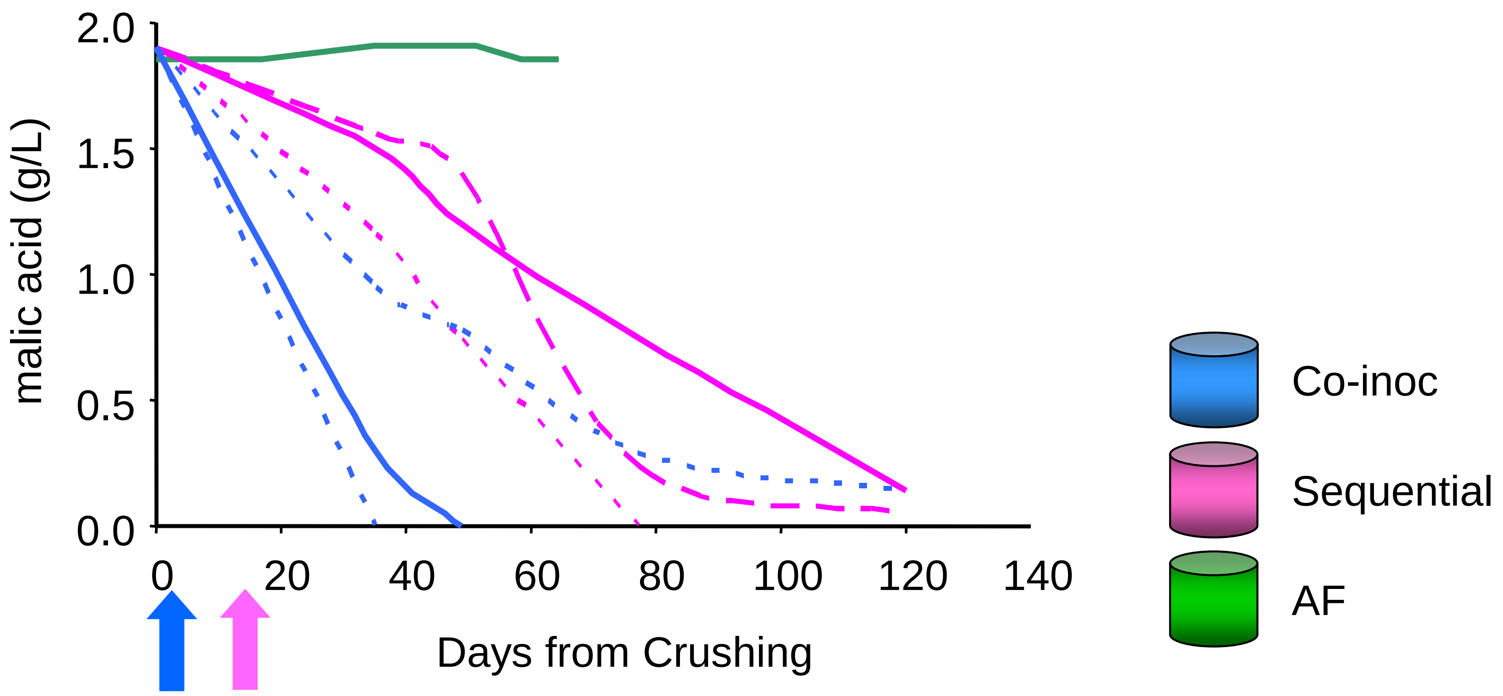
Shiraz (2008)
Clare Valley



Chardonnay (2011)
Barossa Valley

Example: Cabernet Sauvignon

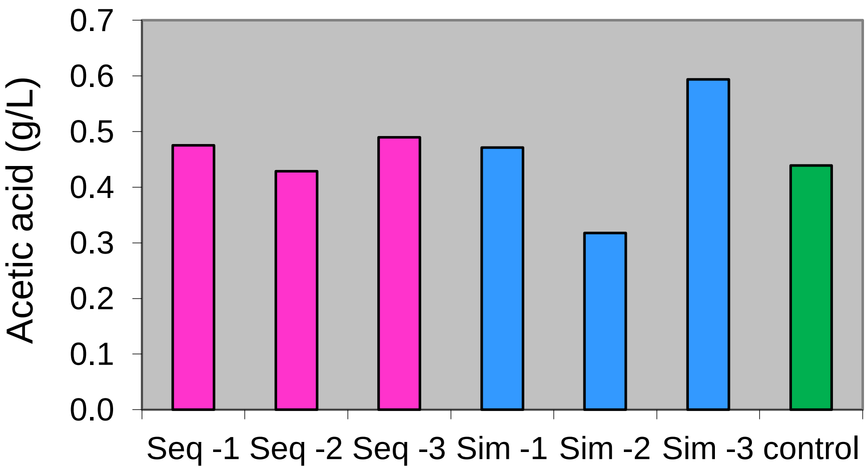
The Australian Wine Research Institute

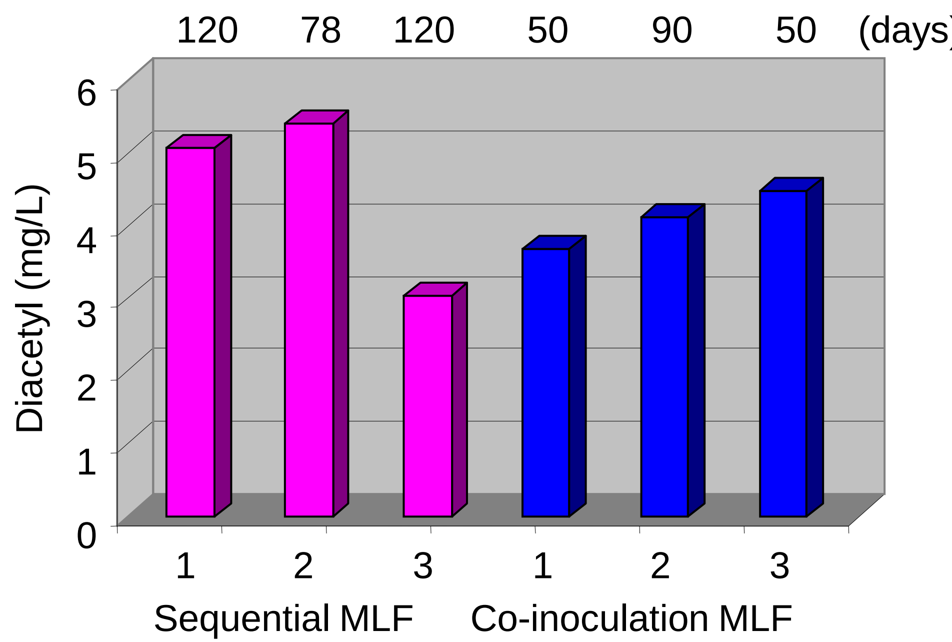


Cabernet Sauvignon
2006
Bordertown

Cab Sauv: Acetic acid & diacetyl

The Australian Wine Research Institute



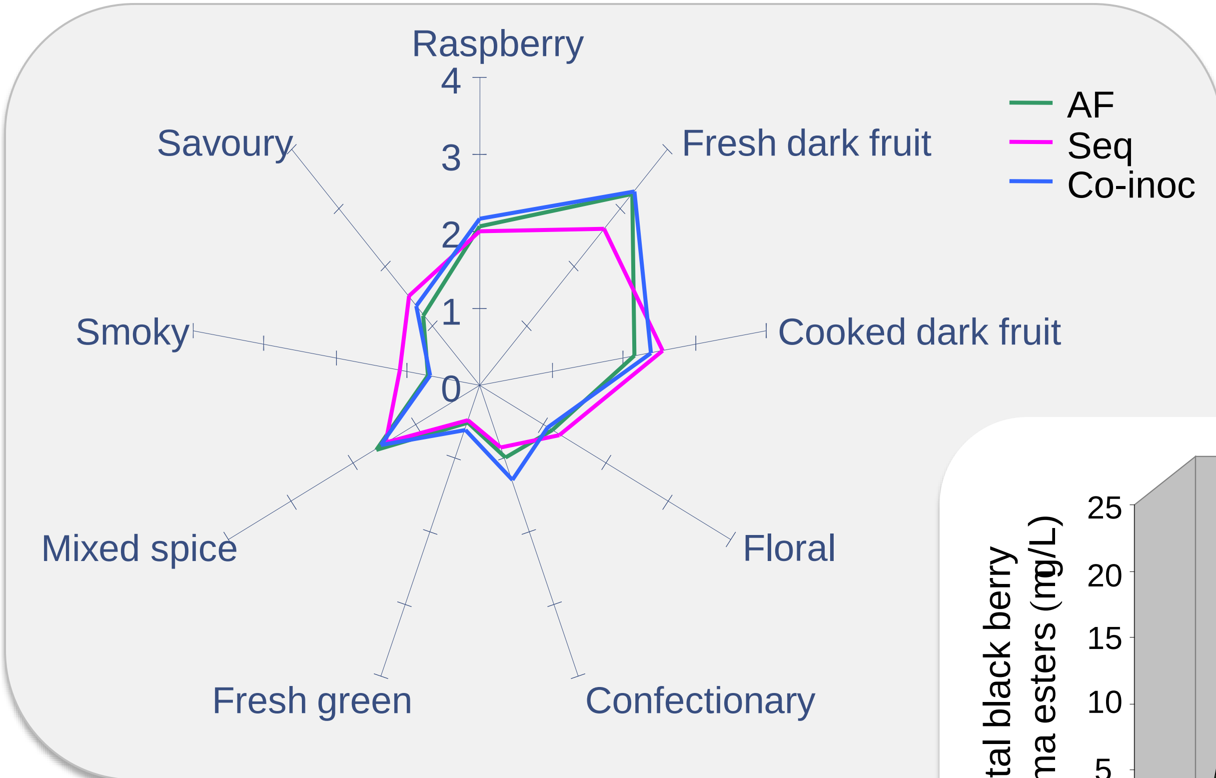


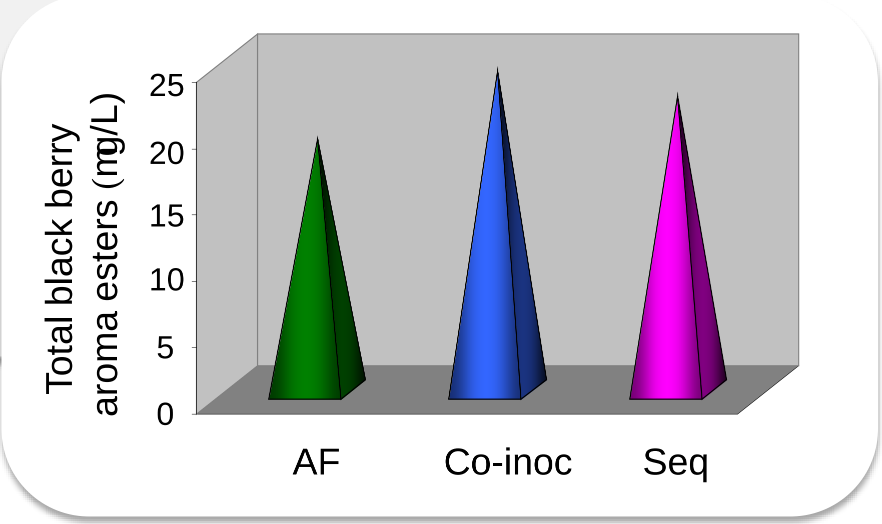
Cabernet Sauvignon
2006
Bordertown

Tend to have higher diacetyl concentrations with a slower MLF

Cab Sauv: Aroma profile

The Australian Wine Research Institute

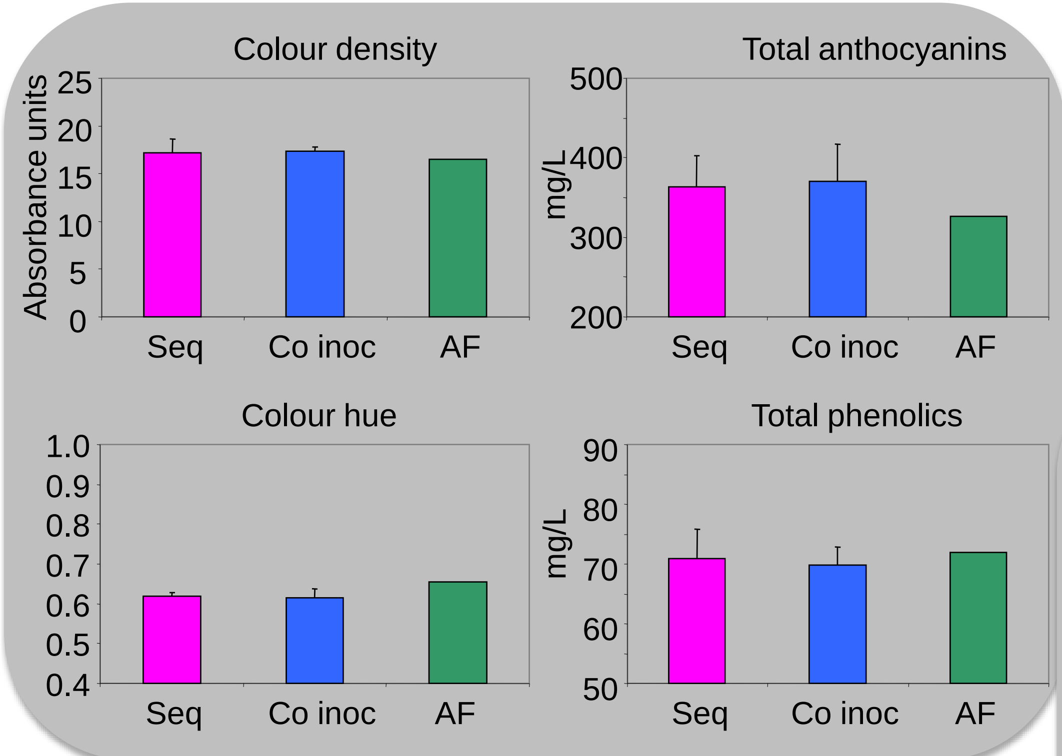


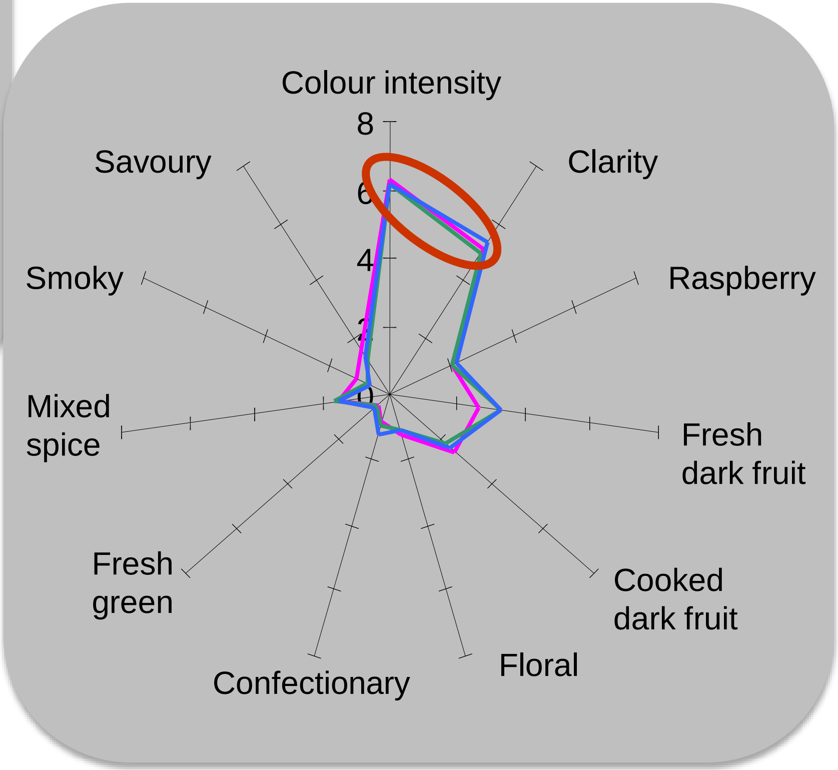


Cabernet Sauvignon
2006
Bordertown

Co-inoculation increased fruity characters

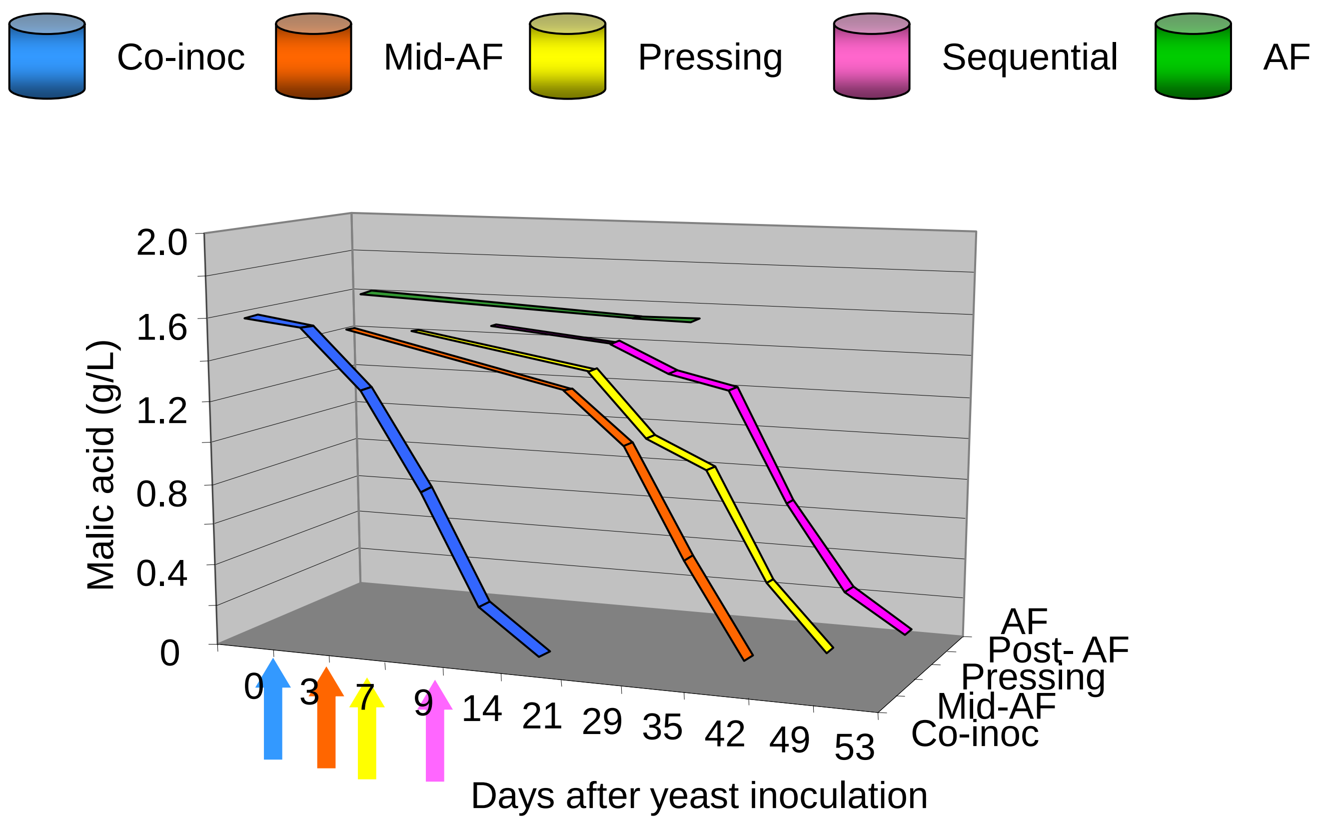
Cab Sauv: Wine colour





Example: Shiraz

The Australian Wine Research Institute



Shiraz
2008
Clare Valley

Reduced fermentation time with co-inoculation

Shiraz: Wine composition

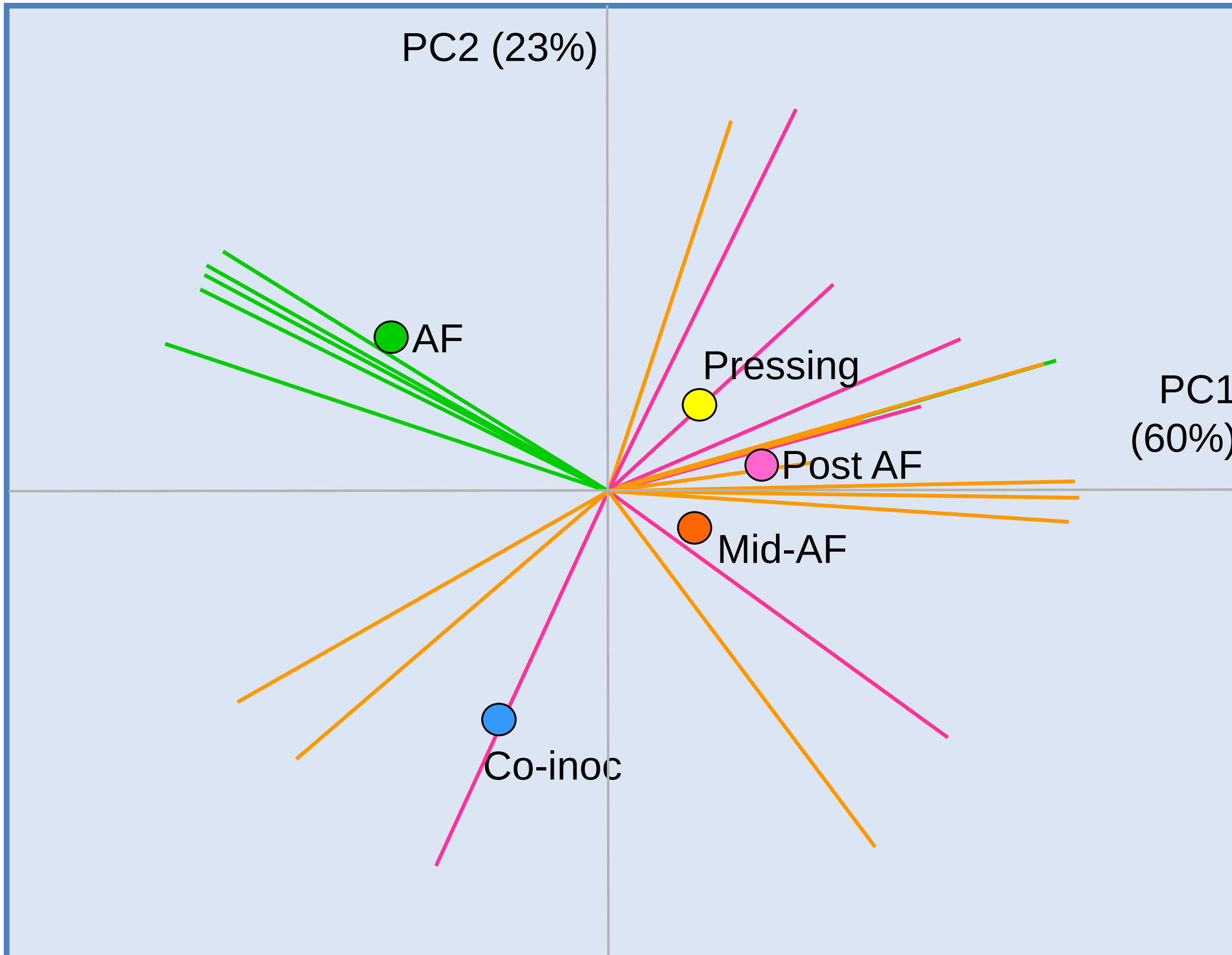
The Australian Wine Research Institute

	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 fermenta^{n} metabolites

The Australian Wine Research Institute

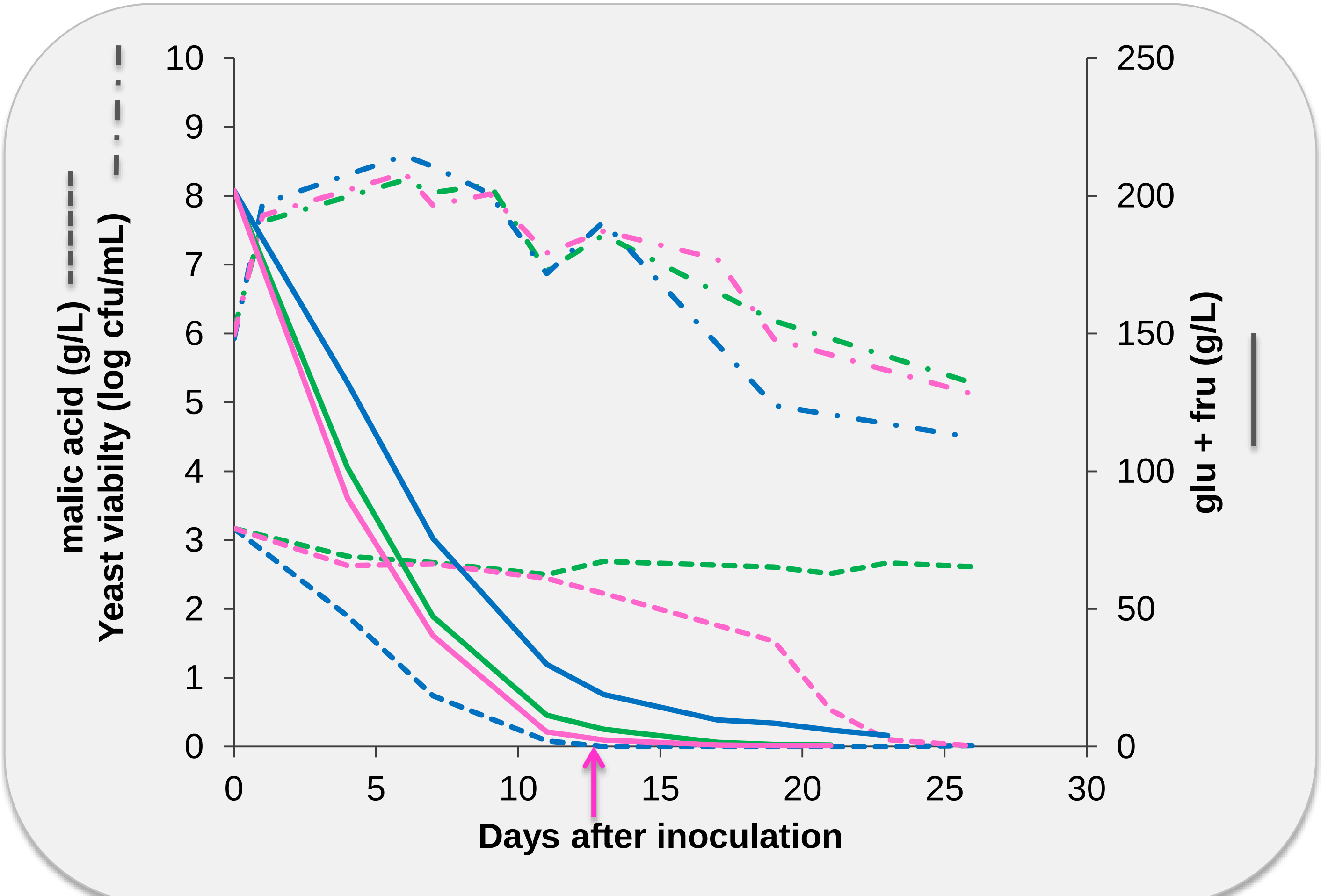


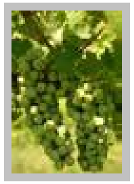
Ethyl fatty esters
Higher alcohols
Acetate esters

Shiraz
2008
Clare Valley

Example: Chardonnay

The Australian Wine Research Institute





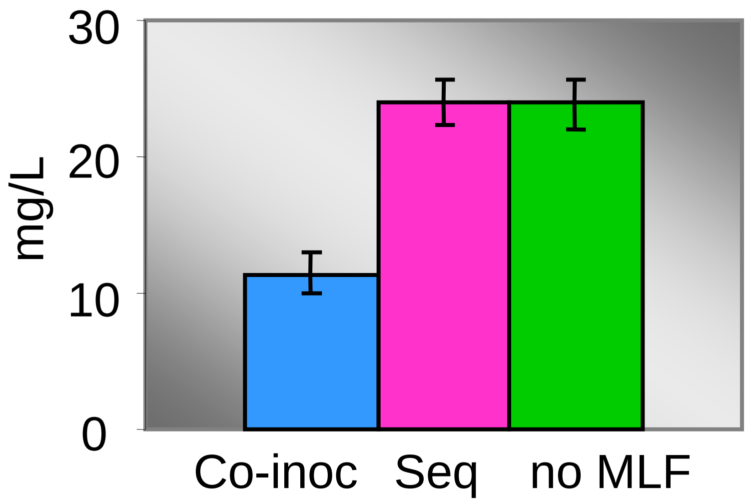
Chardonnay
2001
Langhorne Creek

Co-inoculation – Reduced overall fermentation time
– Yeast performance unaffected

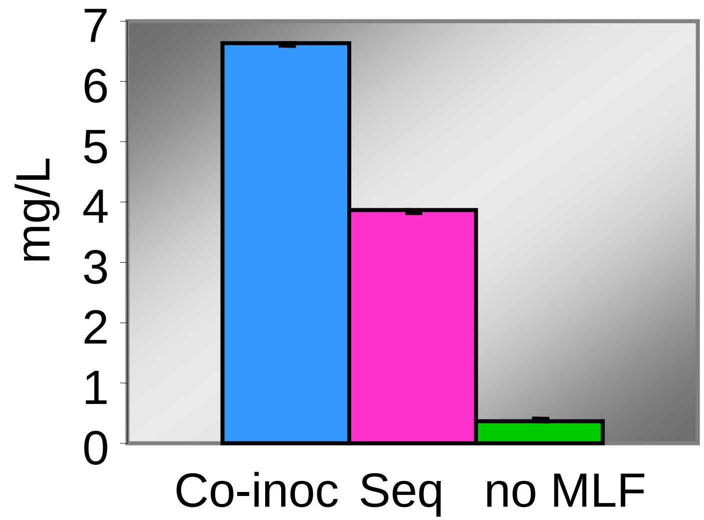
Chard: Volatile fermenta^{n} metabolites

The Australian Wine Research Institute

Total higher alcohols



Total ethyl fatty esters

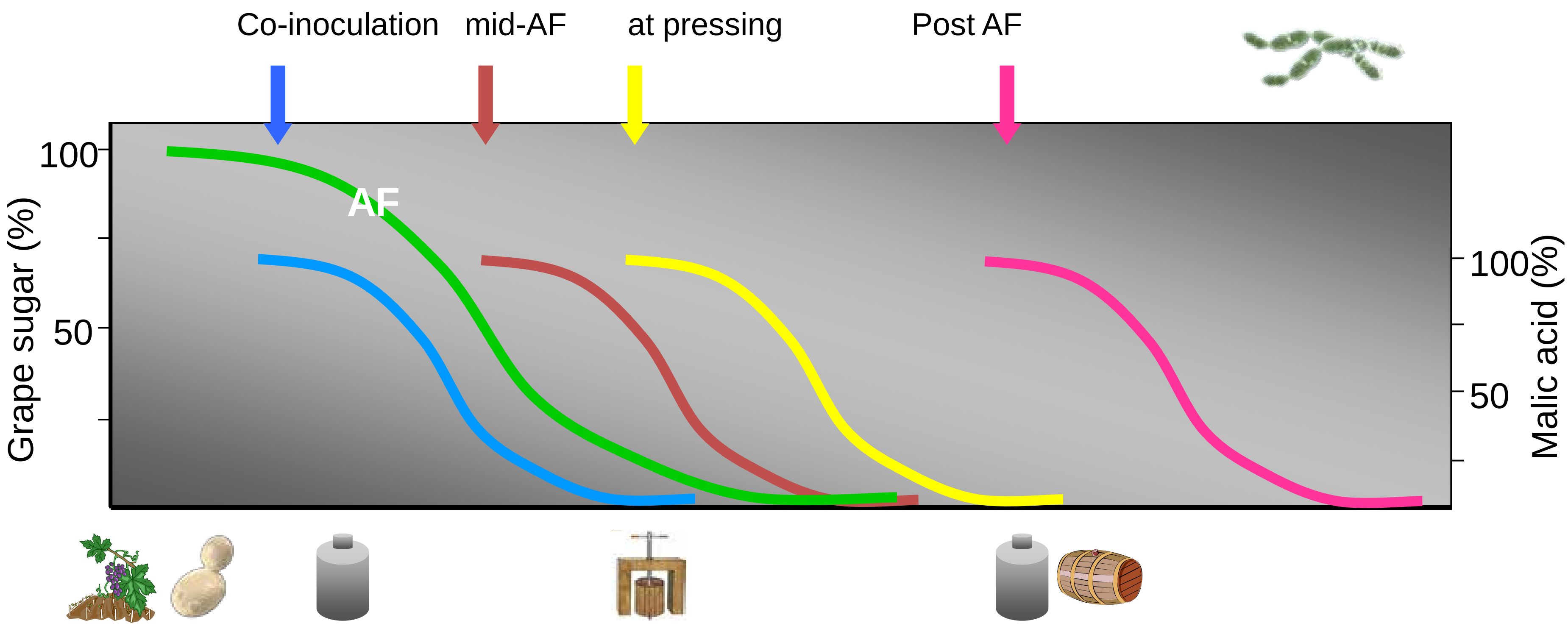


Chardonnay
2001
Langhorne Creek

Co-inoculation increased fruity characters

Options for MLF inoculation

The Australian Wine Research Institute

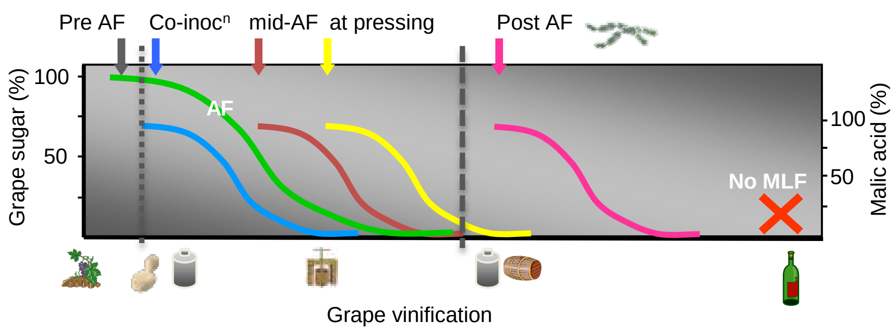


Choice of inoculation point affects the relative difficulty of MLF induction and competition by indigenous strains, which are often better adapted to the wine

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
  - Reduces overall fermentation time
  - No affect on wine colour
  - Does not affect 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

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

Acknowledgments

The Australian Wine Research Institute

- AWRI Wine Biosciences

  MLF Team
  - Caroline Abrahamse
  - Peter Costello
  - 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

Causes and Management of Slow and Stuck Fermentations

Paul Henschke

Peter Godden

and AWRI Industry Development & Support team

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

The problem of sub-optimal fermentation

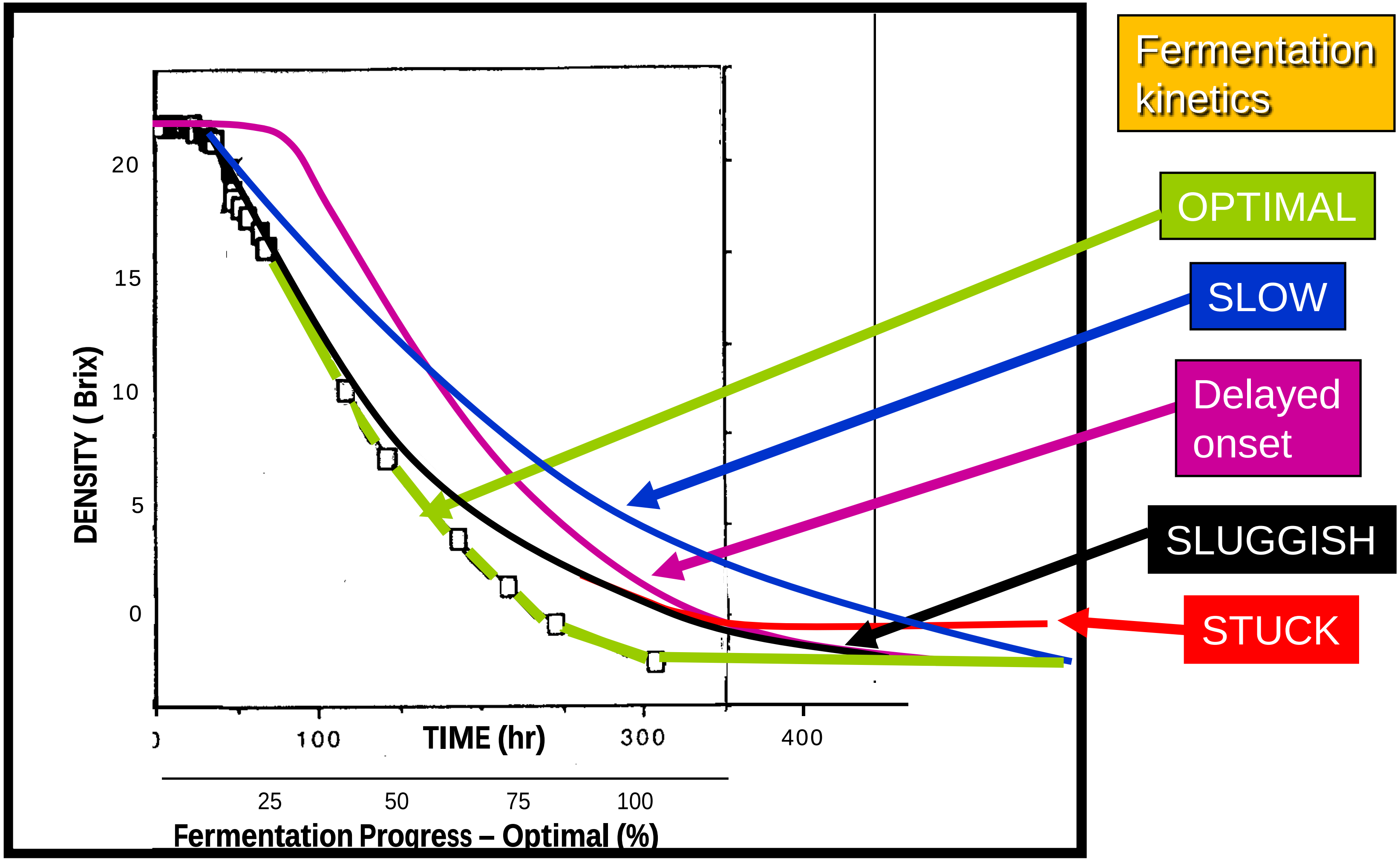
The Australian Wine Research Institute

- 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 loss of quality

>>> This talk contains practical information on how to reduce the risk

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

v 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

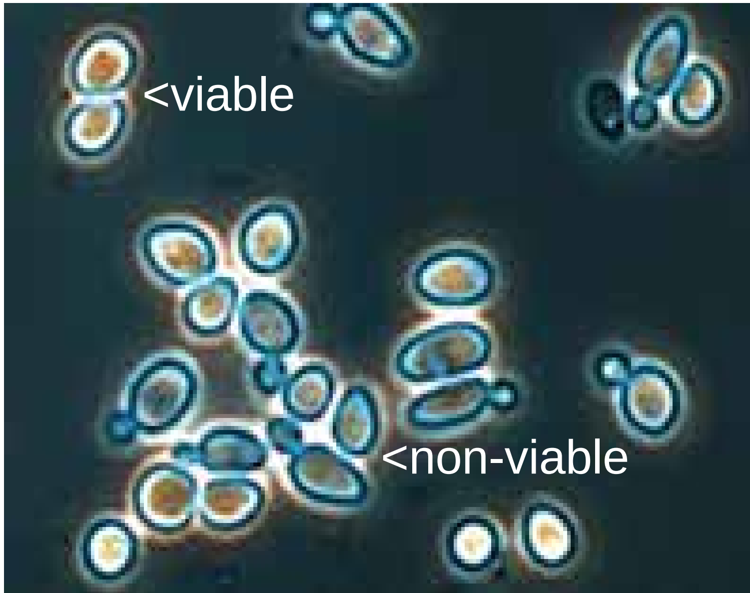
Diagnosis:

- 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

Methylene blue staining of yeast culture assessing culture 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

v 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

v 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

The Australian Wine Research Institute

Yeast-related factors

- incorrect choice (alcohol stress tolerance)
- poor quality starter culture
  - rehydration / reactivation
  - viability / vitality
- unsuccessful inoculation
- indigenous microflora
- degree of must clarification
- temperature stress
- vigour and sedimentation

Nutrient deficiency

- yeast assimilable nitrogen (YAN)
- oxygen / lipids
- vitamins
- minerals

Inhibitors

- high concentration of sugar (high °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

A list of Alcohol Tolerances of Fermentation Yeast*

choice guide only – data most relevant to 'cellar bright' juice ferments†

Sugar Conc (g/L)	Degree Baume	Degree Brix	Maximum alcohol produc'd (% v/v)	Strain – Commercial name
200	11	20	12	Uvaferm CEG, CM UCD 522-Montrachet CH158-Siha 4
218	12	21.5	13	Hefix 1000 VRB
235	12.7	23	14	Fermivin Simi white Lalvin Actiflore, Assmannhausen, B, ICV D-47, ICV K1, CSM, M1107, M2, QA23, T306 Maurivin AWRI 796 Zymaflore VL1, VL3a
>250	>13.5	>24.5	> 15	**Fermivin PDM**, Fermichamp Lalvin L-2056, **L-2226**, L-2323**, L-43**, V1116, BDX, BM45, CY3079, D254, DV10, **EC1118**, M1, RC212, S6U, Syrah, O 16, Agglo, Enoferm R2, **Uvaferm 43** **IOC 18-2007, Prise de Mousse**, **Maurivin PDM**, AWRI 350, AWRI R2 WET 136-Siha 3 Uvaferm PM
			unspecified	Siha 5

Source: Cunier, ITV Manual (1994) ; Bold, recommended for restarting fermentation

***Measured as the maximum [EtOH] produced by standardised fermentation test, with surplus sugar.**

†Presence of grape solids (phytolipids) or oxygen/YAN can increase yeast tolerance to alcohol

Yeast-related risk factors

The Australian Wine Research Institute

Active Dried Yeast - rehydration/reactivation (1)

- Follow manufacturers instructions precisely
- Choice of rehydration medium
  - Mineral water is preferable to rain water
  - If using tap water, remove Cl_2 by boiling/sparging when necessary
  - Water with grape sugar concentrate (10% sugar)
  - Diluted preservative-free (SO_2) grape juice (sterile)
- Temperature of medium should be 38-40 °C
  - measure temperature with a thermometer

  (optimum for reformation of yeast lipid membranes)
- For high risk juices: high sugar (>13 Be), bright (low solids), low YAN (<150 mg/L), to be fermented cold (<15C) consider proprietary 'inactivated yeast' nutrients rich in sterols

Yeast-related risk factors

The Australian Wine Research Institute

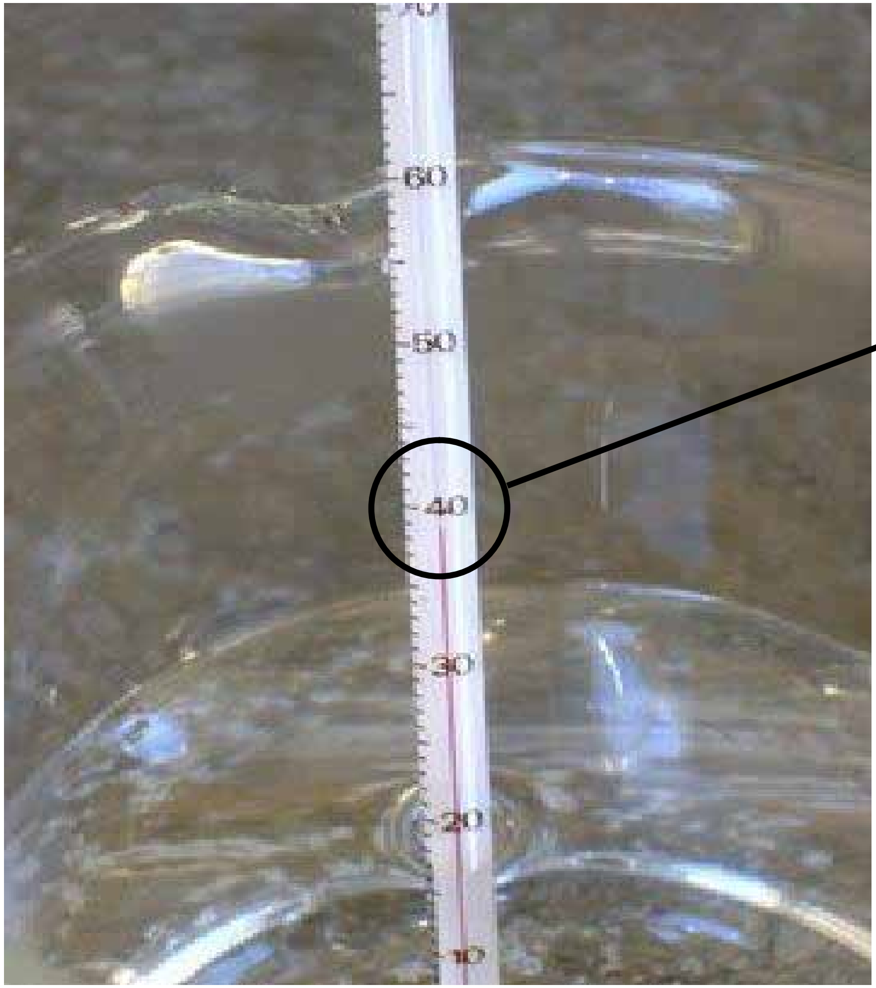
Active Dried Yeast - rehydration/reactivation (2)

- Add yeast slowly to container with large surface area. Avoid clumping - clumping produces non-wetted, and hence, non-rehydrated yeast
- Avoid vigorous (mechanical) stirring during re-hydration step, which reduces viability
- Leave yeast for 15 min before mixing/aerating
- Use yeast after 20-30 min from start of rehydration

  – do not use yeast after this time unless grape sugar or juice has been added, because reactivated yeast rapidly loses activity in water

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

Hydration final step – temperature amelioration

The Australian Wine Research Institute

Culture amelioration before inoculation of difficult to ferment juices/ musts

Step-wise cooling by adding juice to the culture can be beneficial for cold juices or musts (post cold maceration) and/or of high Be/Brix

Yeast-related risk factors

Active Dried Yeast - rehydration/reactivation (3)

The Australian Wine Research Institute

- Add rehydrated yeast to pre-warmed juice (ie after cold settling or cold soak, preferably >15°C
- For cold (<15 °C), highly clarified, high sugar juice ferments, step-wise cool reactivated yeast in 5-10 °C steps at 5 min intervals by adding appropriate volumes of the juice to be inoculated
- 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
- Do not use old yeast stocks for high risk juices

Yeast-related fermentation factors

Fermentation management

- 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

Yeast-related fermentation factors

The Australian Wine Research Institute

Factors affecting yeast implantation

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

v 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.

v Optimise yeast starter culture population

- Yeast propagator should exceed 10^8 cfu/ml, but be capable of producing maximum population of 3-4 x 10^8 /ml

- ADWY viable cell population should exceed $2x10^{10}$ cfu/g

v Recommended Inoculation rates

- whites: 5 x 10^6 cells/ml(typically 250 g ADWY per kL juice);

- reds: 4 x 10^6 cells/ml ; lower rates can compromise yeast implantation

Yeast-related factors

The Australian Wine Research Institute

Factors affecting yeast implantation

Control of indigenous yeasts and nutrient loss

- **Grape condition**
  - **Damaged grapes (rain/bird damage/mouldy/heat wave) have higher wild microbial load, including wild yeast, acetic and lactic acid bacteria**
- **Method of harvest and transport**
  - **Mechanical harvest gives higher microbial load due to poor harvester/transport bins hygiene – eg adjust sulfite: time, temperature**
- **Must processing**
  - **Time (minimise) / Temperature (as low as practical)**
  - **Chemical antimicrobials (effective levels of sulfite (measure pH)**
  - **Physical removal of microbes (ie enzyme / cold settling, filtration, centrifugation)**
  - **Hygiene (clean/sanitise harvester and transport bins regularly)**
  - **Minimise must dO_2 & contact with O_2 (stimulates oxidative microbes)**
- **Fermentation conditions**
  - **Temperature (18-27 °C favours *S. cerevisiae (Sc)* over non-*Sacch. sp*)**
  - **pH (<3.5 favours *S. cerevisiae*)**
  - **SO_2 (favours *S. cerevisiae,* generally tolerant to 10 ppm free)**
  - **O_2 at 30-40% Ferm Progress prolongs survival of *Sc* yeast**

Nutritional deficiency risk factors

The Australian Wine Research Institute

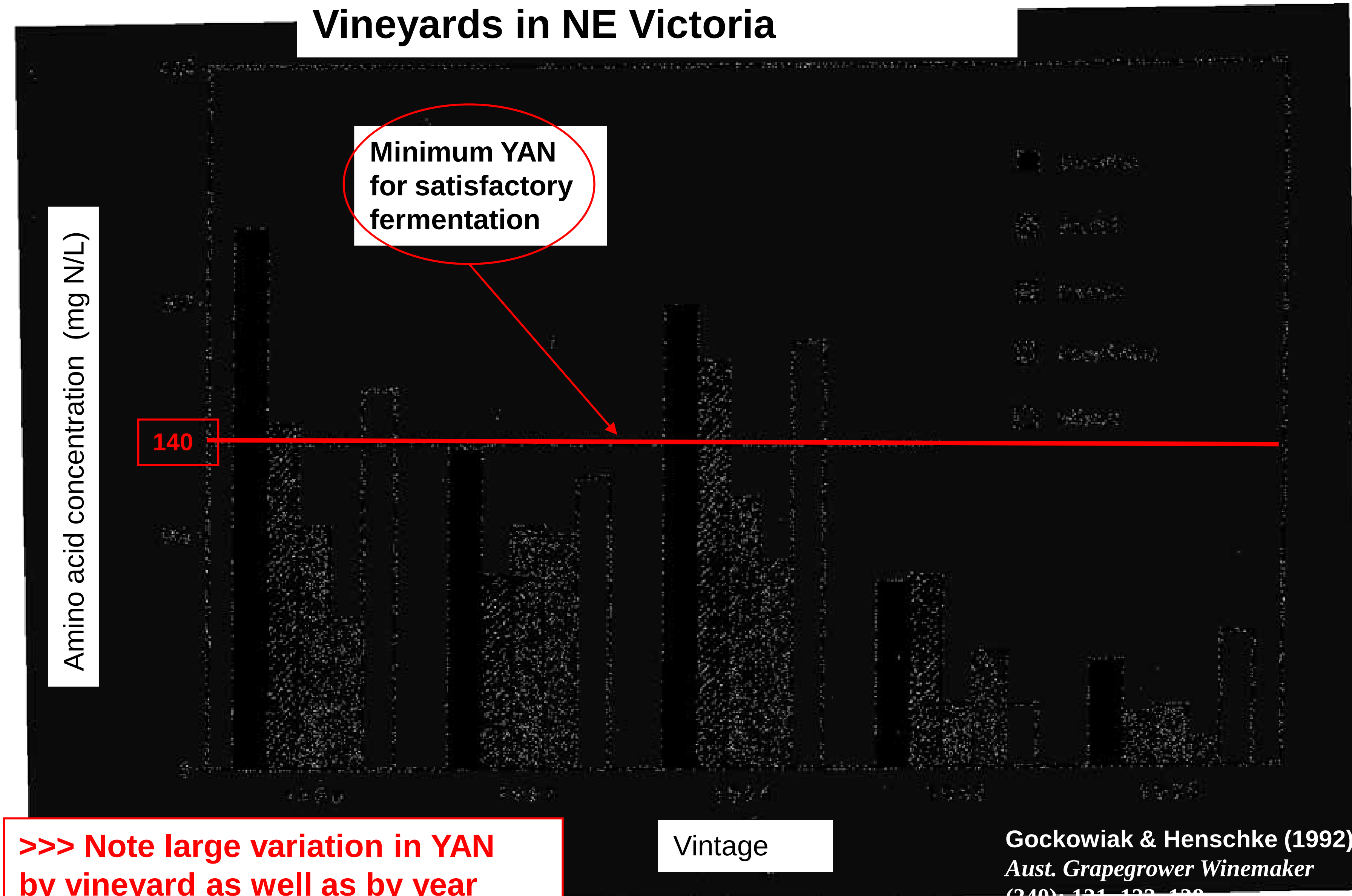
- Yeast Assimilable Nitrogen (YAN)
  - A variable proportion of Australian juices/musts have inadequate YAN
  - Measure YAN on a grape maturity sample or juice sample
  - Low YAN of <150 mg N/L for whites or < ~ 100 mg N/L for reds increases risk of slow/stuck fermentation
  - Maximum growth achieved at approx. 400 mg N/L (NB high heat productn)
- Lipid deficiency (phytosterols and unsaturated fatty acids (UFA))
  - Over clarification removes lipids necessary 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 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 (after 35-50% sugar has been fermented) is highly beneficial
  - Aerate to give ~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
    - losses caused by high SO_2 use and wild yeast growth
  - 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 is unknown
  - **Phosphate – normally considered adequate; can be added with DAP**
  - **Low K^+/Low pH** can lead to stuck ferms with some yeast strains (sparkling/tirage)
  - **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
- ## Low YAN juices/musts
  - Low YAN musts are typically also low in other nutrients
  - **Useful to add proprietary inactivated yeast nutrients to yeast starter cultures when deficiencies are suspected**

Vineyard & Year effect on juice YAN

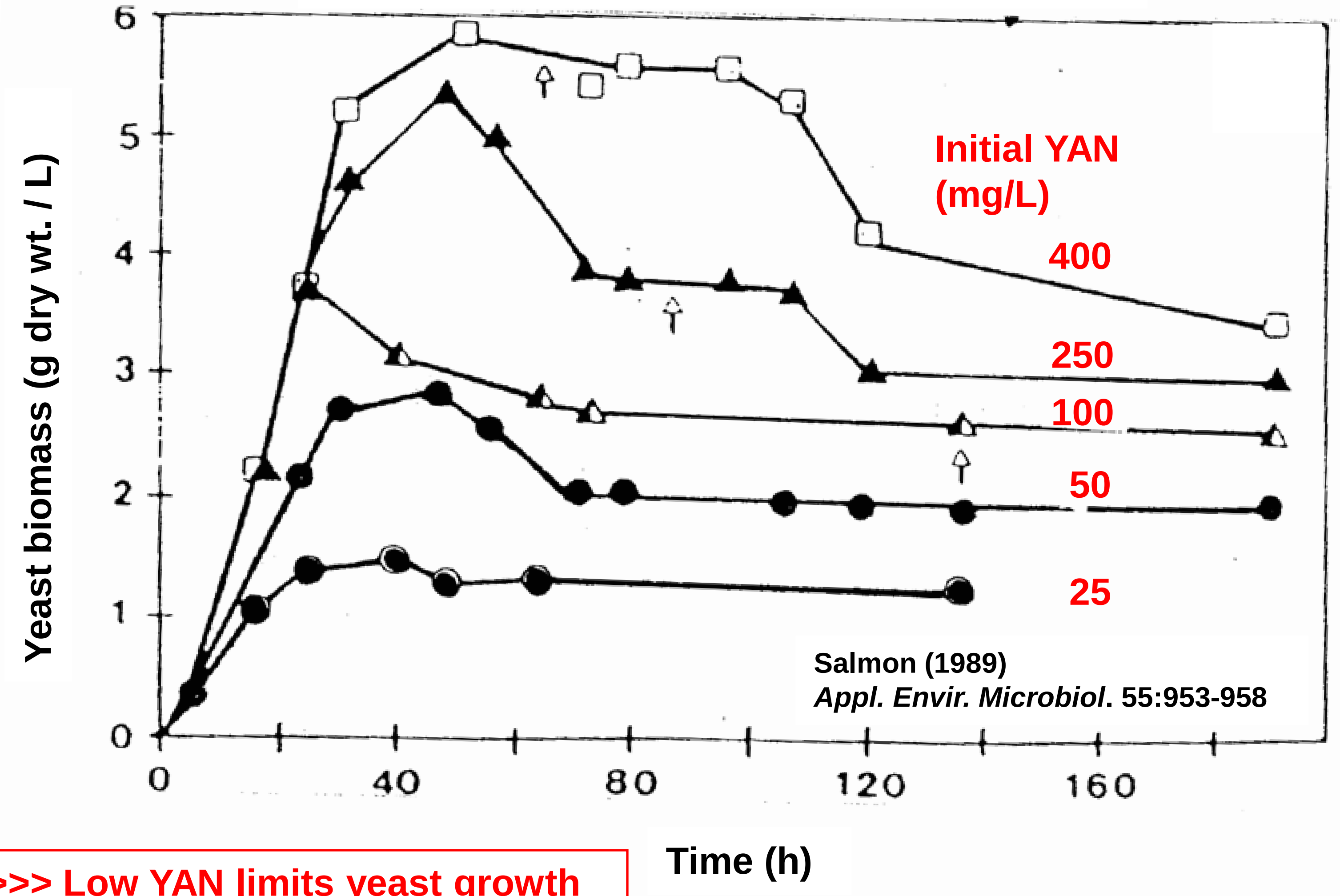


>>> Note large variation in YAN by vineyard as well as by year

Gockowiak & Henschke (1992)
Aust. Grapegrower Winemaker

Yeast growth response to YAN

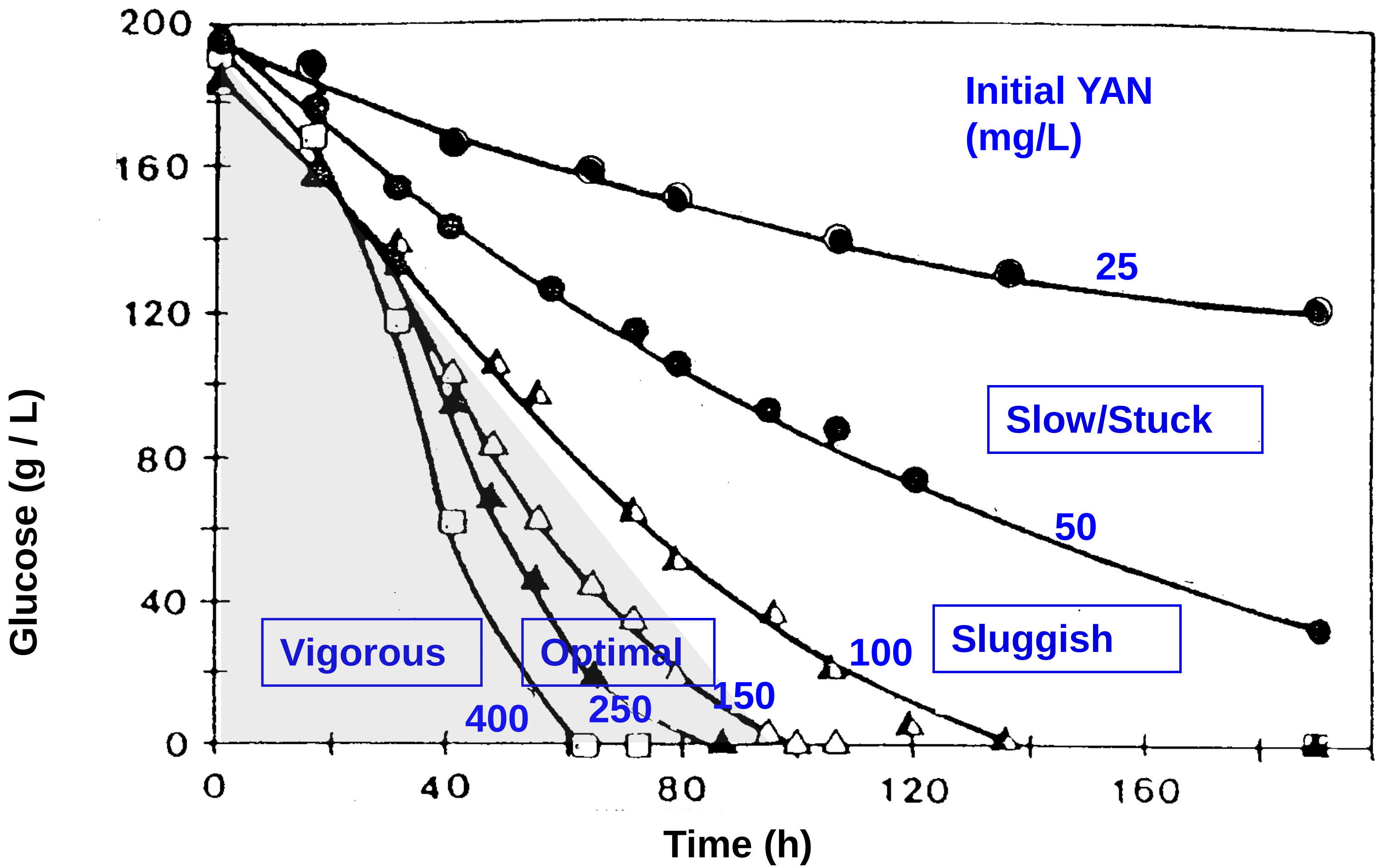
Synthetic juice ≡ 'cellar bright' juice
(all other nutrients are adequate)



>>> Low YAN limits yeast growth
Excessive YAN has no benefit

Fermentation response to YAN

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



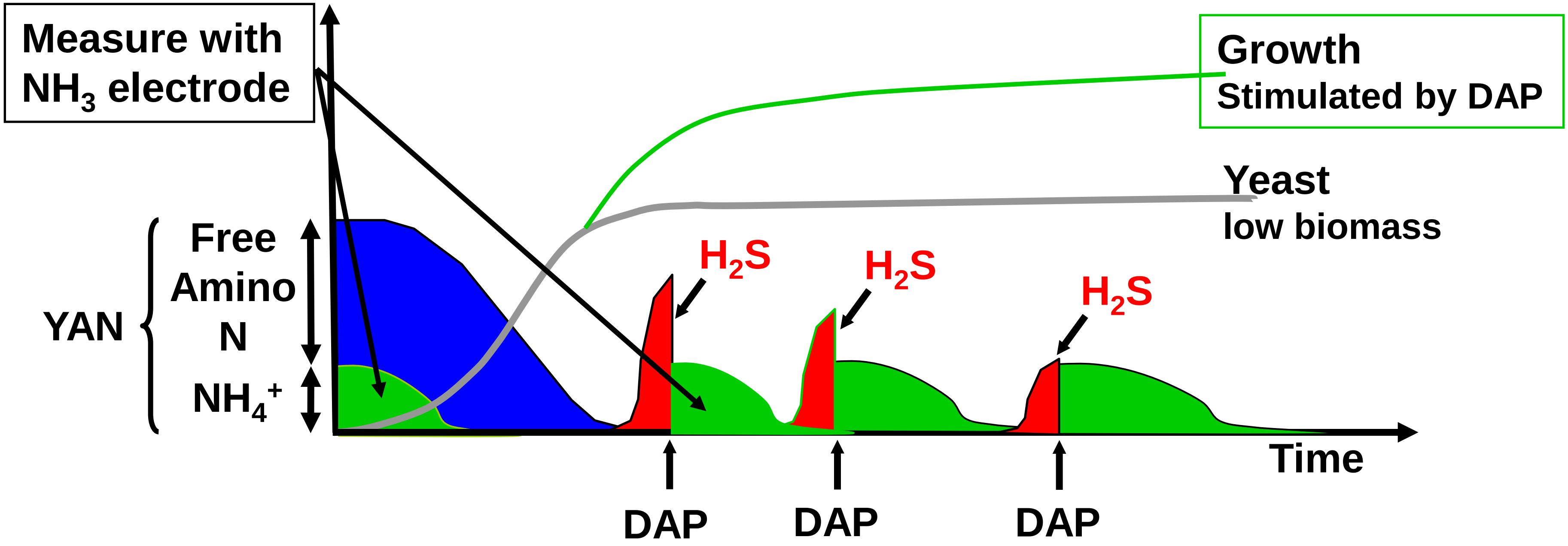
>>> Low YAN - slow/stuck fermentation
Excessive YAN – too vigorous

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

Nitrogen utilisation during 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

(white juice, low solids fermentation conditions)

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 – approx. 150 mg/L
   Reds – approx. 100 mg/L
3. **Minimum YAN to prevent H_2S**
   approx. 250 – 350 mg/L (yeast x must dependent)
4. **Optimum flavour formation**
   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

N-demand of fermentation yeast

examples from Lallemand range

The Australian Wine Research Institute

N demand	Yeast	Type
Low	71B/Actiflore	R/(W) Estery
(1-1.5 mg N/g CO2)	DV10	W/R/S Neutral
	QA-23	W/S EVC
	D47	W EVC
	M1107 / Uvaferm CM	R EVC
	Lalvin EC1118	W/S Neutral
Medium	V1116	W Neutral
	D254	R/W EVC
	L2056	W/R Estery
	Uvaferm CEG/Epernay 2	W/S (barrel)
	R2	W Estery
(1.5-2 mg N/g CO2)	RC212	R EVC
	S6U	W EVC
	BDX	R EVC
	CSM	R EVC
	CY-3079	W (barrel) EVC
	L2226	R Neutral
	L2323	R EVC
High	BM 45	R (barrel) EVC
	K1M	
(>2 mg N/g CO2)	VL1 / VL3	W EVC
	Sb 1176 / 1375	R/W EVC

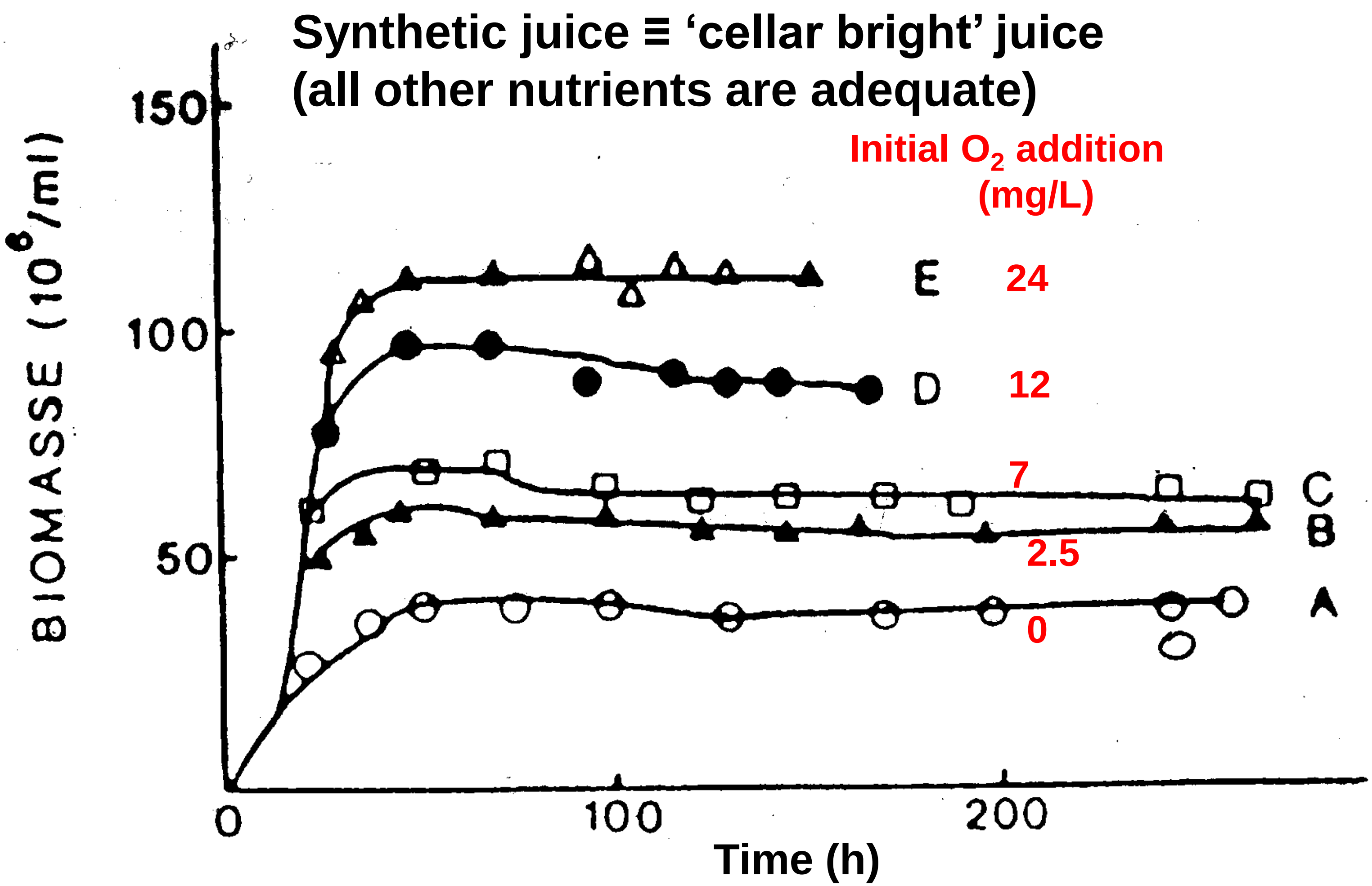
R, red; W, white; S, sparkling; EVC, enhances varietal character

Defined as Nitrogen needed to maintain constant fermentation rate in synthetic medium with initial YAN = 100 mg/L; sugar = 200 g/L

Adapted from Lallemand Product Catalogue (2000) & Julien, Roustan, Dulau & Sablayrolles (2000) AJEV

Yeast growth response to O_2 added at start of fermentation

The Australian Wine Research Institute



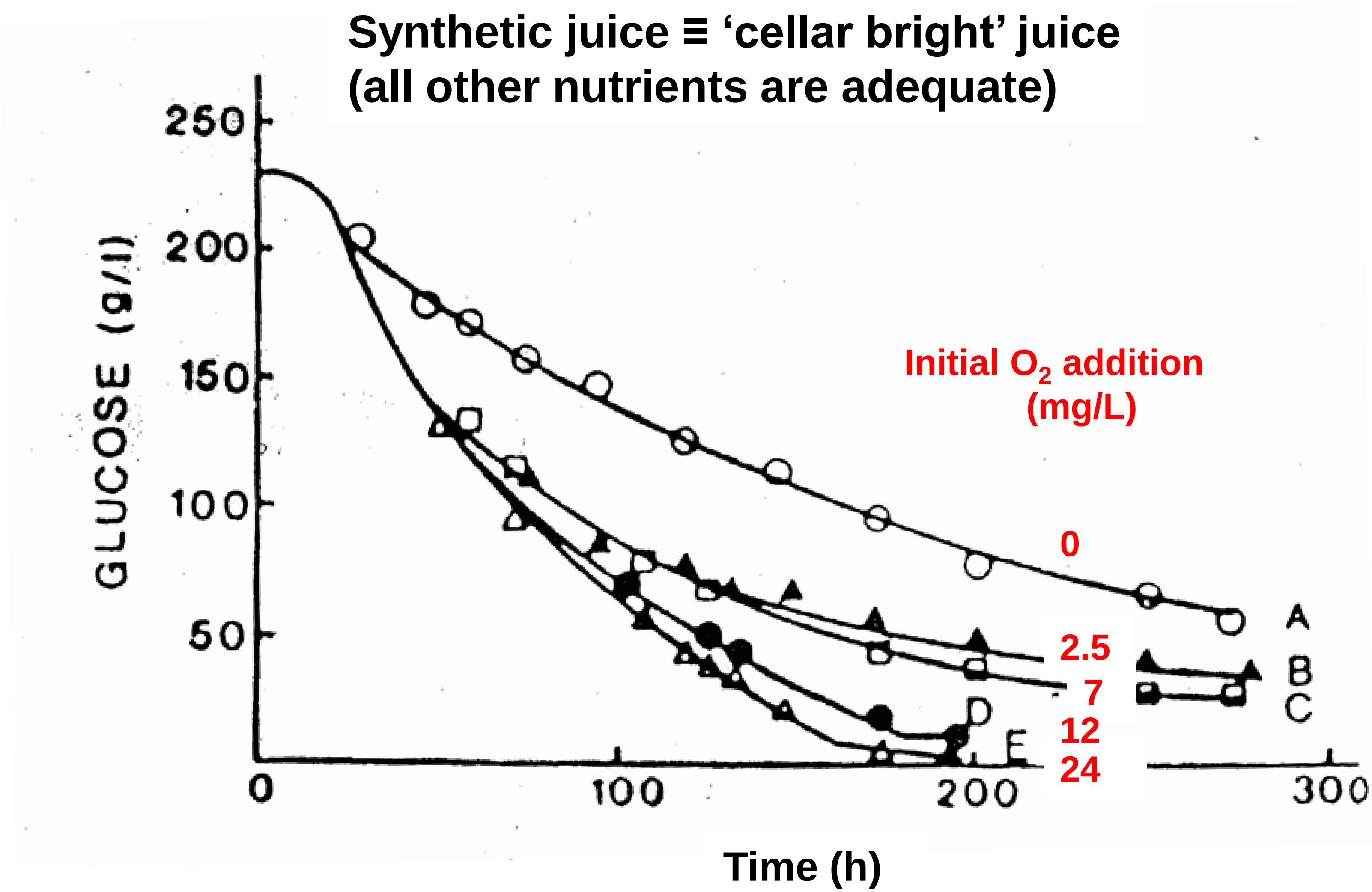
>>> Oxygen stimulates yeast growth

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

Fermentation response to O_2

The Australian Wine Research Institute

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



>>> Oxygen stimulates fermentation rate

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

Effect of O_2 on fermentation rate

The Australian Wine Research Institute

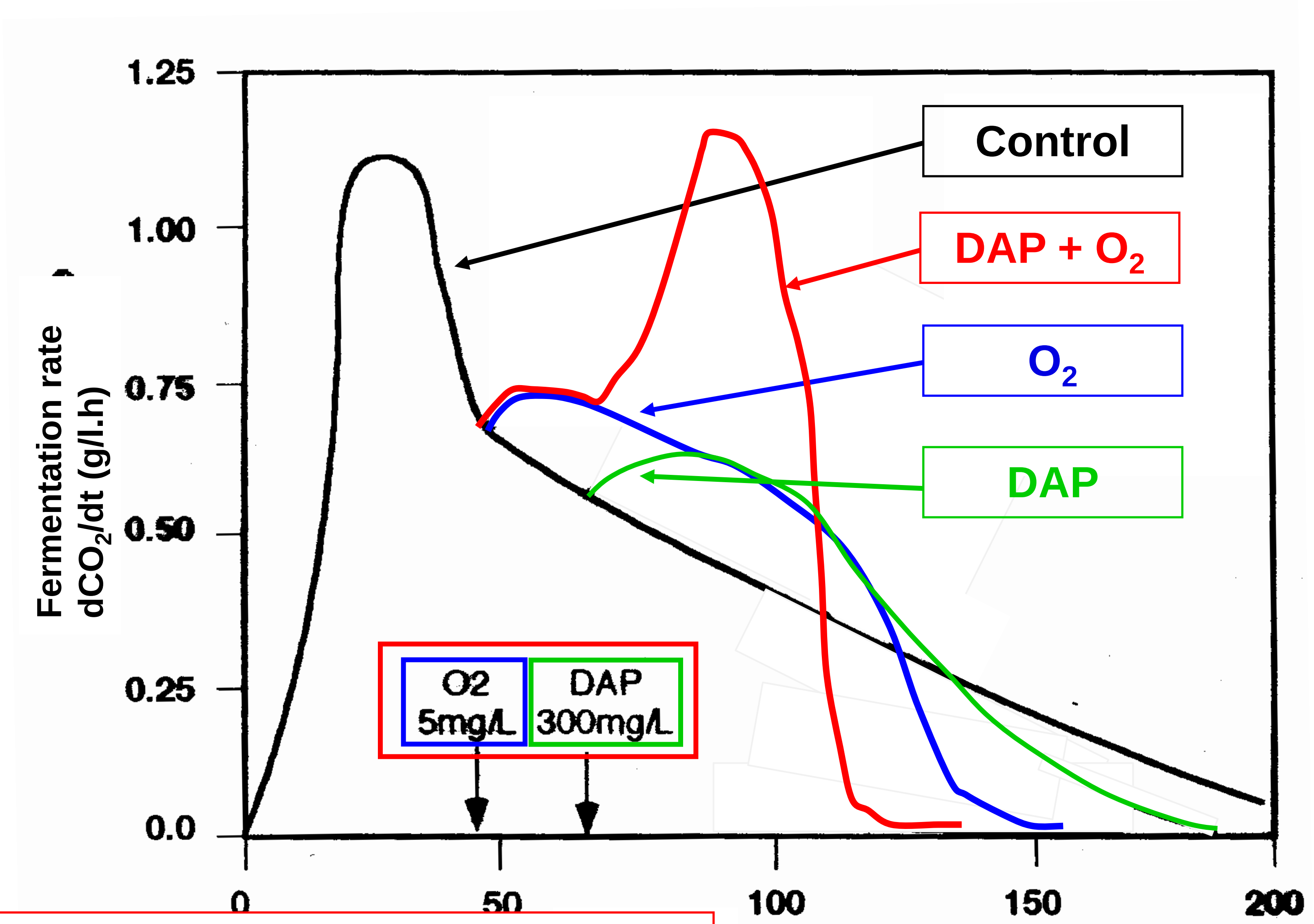
Rate Anaerobic (Max rate of CO_2 production)	**Yeast**	**%Rate gain** with O_2 added at 1/3 fermentation progress	**Yeast**
Low	S6U	**Low**	CSM
<0.5	CEG	(16%)	K1M
	EC1118		V1116
	DV10		CY3079
	QA23		R2
Medium	K1M		71B/Actiflore
0.6-0.7	VL3		S6U
	L2323		VL1
	L2226	**Medium**	D47
	VL1	(30%)	DV10
	71B		QA23
	R2		
High	D47	**High**	EC1118
>0.7	CSM	(45%)	IOC182007
	V1116		
	CY3079		

Adapted from Lallemand Product Catalogue (2000) & Julien, Roustan, Dulau & Sablayrolles (2000) AJEV 51:215-222

Combined effect of DAP + O_2 on fermentation

Nutrient strategy for stimulating fermentation

The Australian Wine Institute



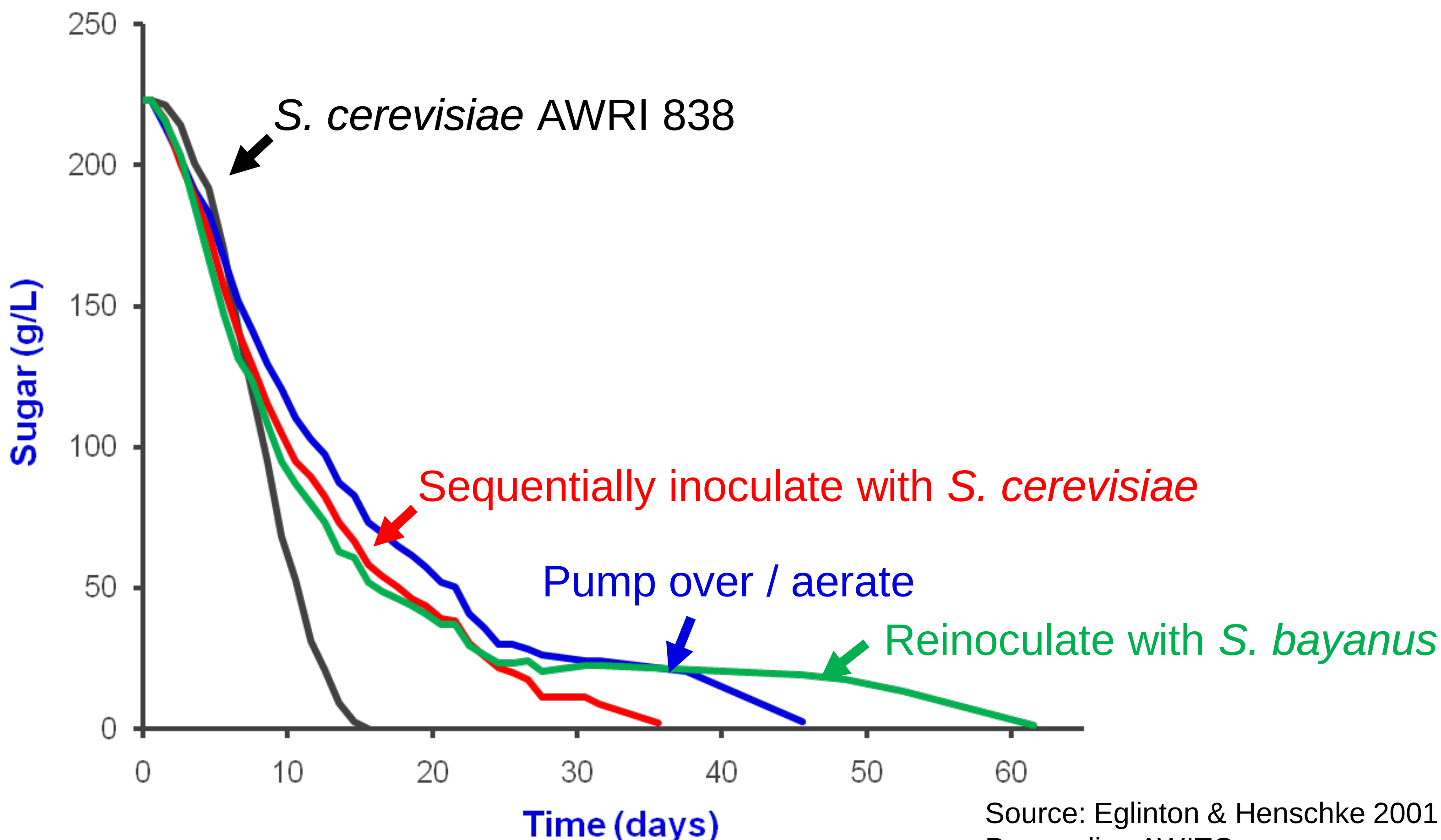
>>> Combined O2 and DAP gives greatest stimulation of fermentation rate

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

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	turbidity	Clarification treatment
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 increases fermentation risk but enhances varietal character
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
  - strain dependent: growth at 8-12%, fermentation >12 %
  - **determined by grape maturity at harvest**
- SO_2
  - strain dependent, typ. >10 mg/L free SO_2 at pH 3.5
  - cell death at 45 mg SO_2/L, pH 3.5 (0.8 mg/L mol. SO_2)
- Fatty acids (good hygiene / aerate ferments)
  - acetic acid: yeast growth at >1.5 g/L at 8% EtOH
    fermentation inhibited at 3-4 g/L
  - aliphatics (C6, C8, C10): 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
  - some wine yeast are tolerant
  - some Lactobacillus toxins can inhibit ferm. (high/low solids)
- Agrochemical residues (very uncommon)
  - copper oxychloride 10-15 mg/L
  - captan, fenarimol (eg Rubigan) / triadimenol (Bayfidan)
- 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

Role of acetic acid in stuck fermentation

The Australian Wine Research Institute

Origin of acetic acid

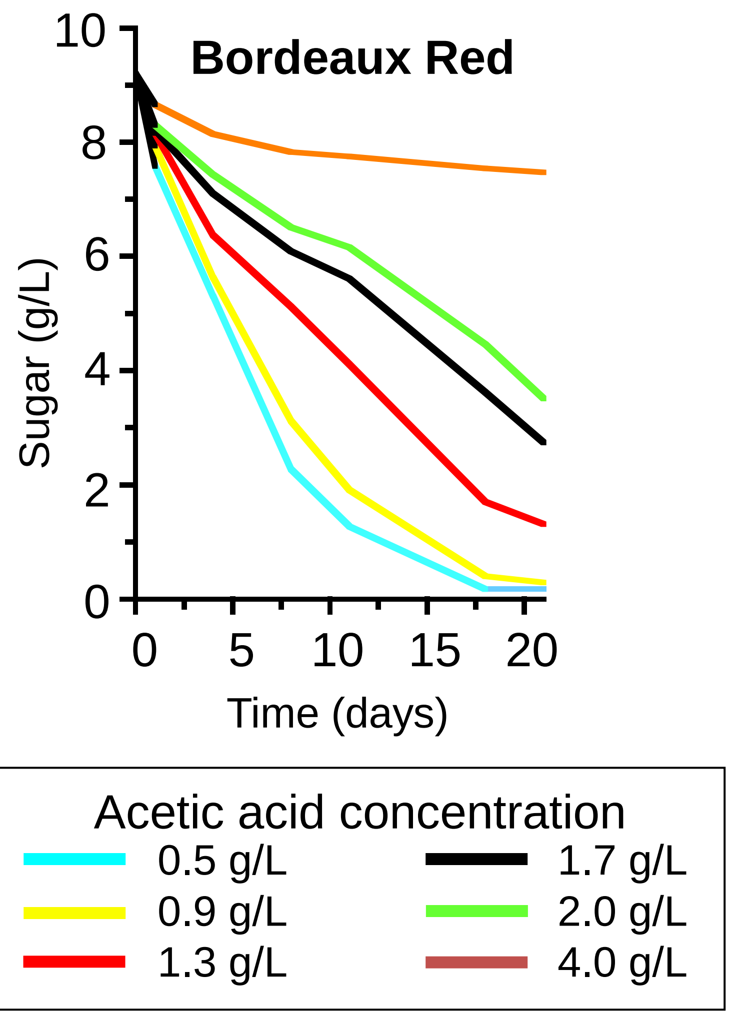
- inoculated yeast
  - Ø (excessive) nicotinic acid can stimulate production
- wild yeast
  - Ø apiculate yeasts (*Kloeckera/Hanseniaspora*)
- lactic acid bacteria – most important
  - Ø principally from citric acid
- acetic acid bacteria
  - Ø requires significant O_2

Effect of acetic acid on refermentation

Fermentation rate

The Australian Wine Research Institute

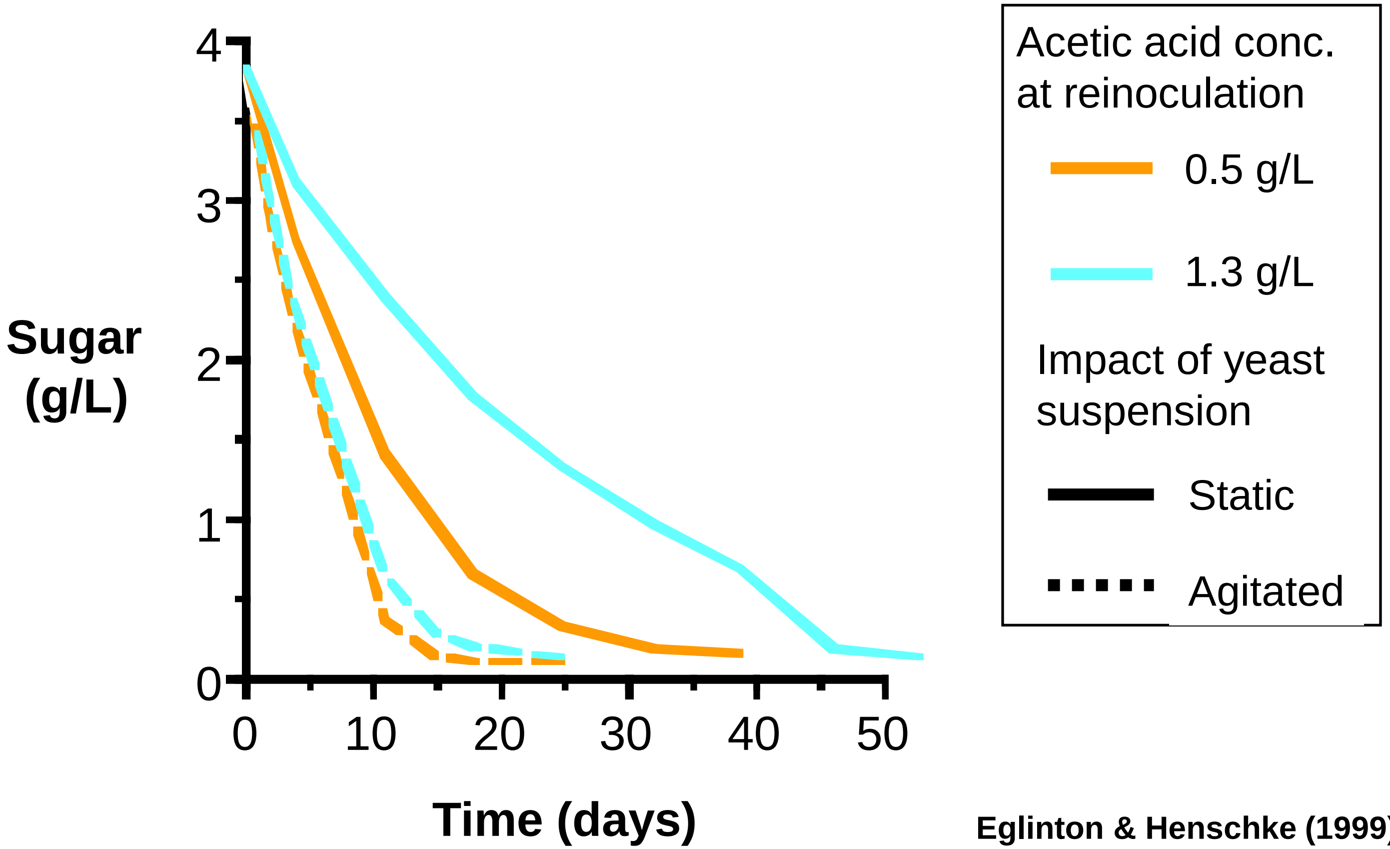
Stuck ferments containing different conc. acetic acid were inoculated with rescue yeast previously acclimatised to the stuck wine



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

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

The Australian Wine Research Institute

Conclusions

- Yeast starter cultures are more effective rescue cultures when prepared by step-wise acclimatisation to the stuck ferment wine.
- Acclimatised rescue cultures can effectively restart incomplete ferments which contain up to 2 g/L acetic acid.
- Yeast strains however vary in their ability to act as a rescue culture
- Use of an acclimatised rescue culture largely negates the need to remove acetic acid by RO before rescue unless a very high concentration of acetic acid is present.
- Since additional acetic acid can be formed during the rescue procedure it is best to remove the acetic acid following refermentation of the wine.

Fermentation management – Risk factors

- Temperature stress

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

- 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

  Beneficial to wine style but deprives yeast of key nutrients
  Lipids increase yeast tolerance to ethanol stress

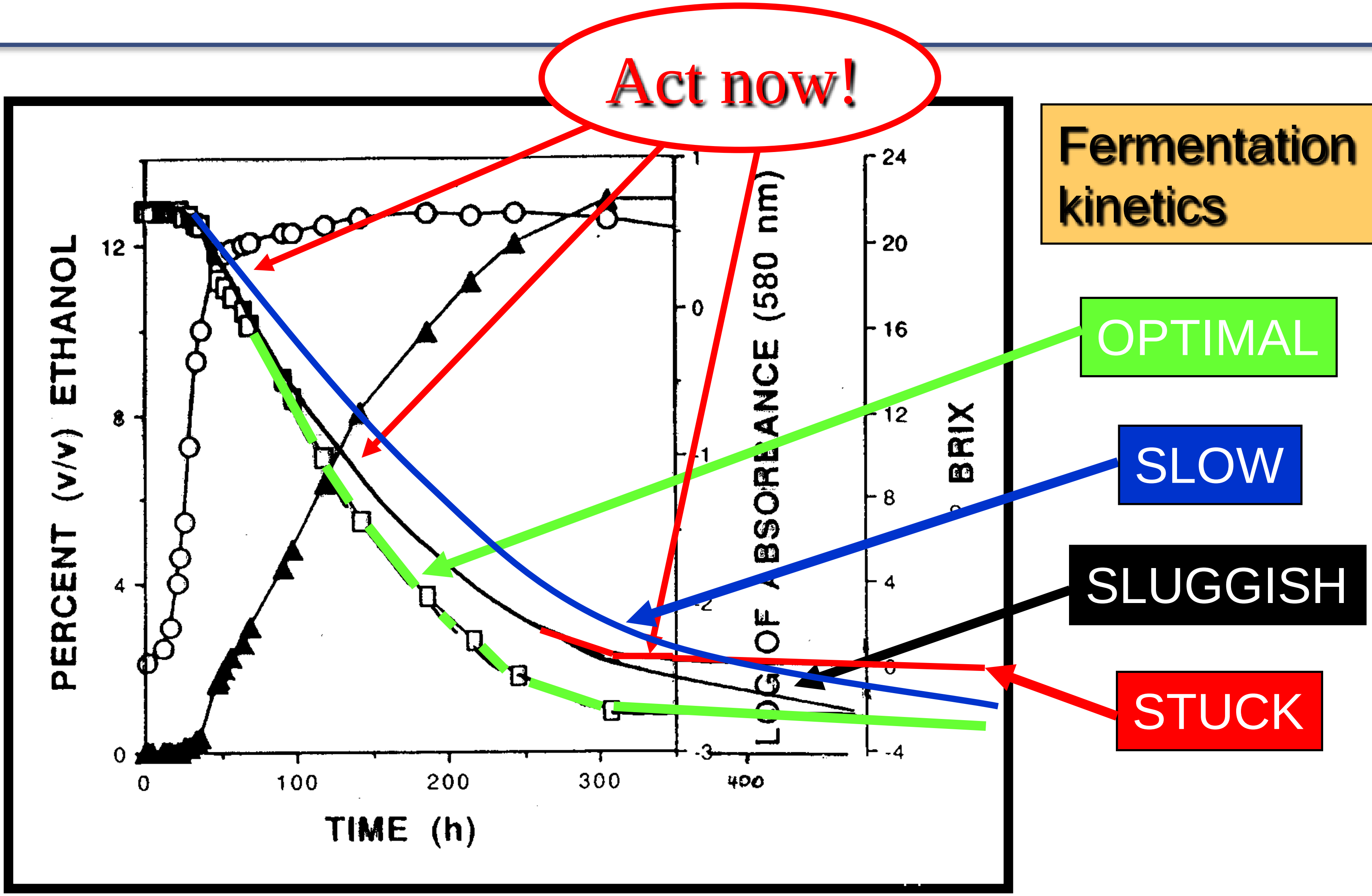
- Nutrients

  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

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

Problem fermentations

The Australian Wine Research Institute



Take corrective action early

Re-yeasting: AWRI Rescue procedure

The Australian Wine Research Institute

- Add 500 mg/L EC1118, PDM, Uvaferm 43, etc
- Rehydrate with sterol-rich reactivation nutrient
- don't let culture run dry – go onto next stage when 50% of sugar has gone
- Avoid temperature shock
- Add wine to culture, rather than culture to wine
- Add SO_2 if bacteria present in stuck wine
- Rack or centrifuge stuck wine (remove dead yeast)
- Add DAP and aerate once active
- Yeast hulls often beneficial
- Keep yeast in suspension
- Keep good records

Choice of rescue procedure

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

- **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

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

- 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
- Continuous aeration
- Agitation prevents nutrient starvation stress

For more information

The Australian Wine Research Institute

- **AWRI website – wealth of practical information**
- **ASVO seminar 1996**

  papers by: Henschke, Monk & Four industry practitioners
- **Industry Services Group ; AWRI Technical Note 05**
- **Contact 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, Paul Chambers (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

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
Grape and wine composition
Grape and wine production
Smart technologies
Wine microorganism culture collection
AWRI-Microbial Metabolomics
Research and Development
Science and technology working
for grape and wine producers
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

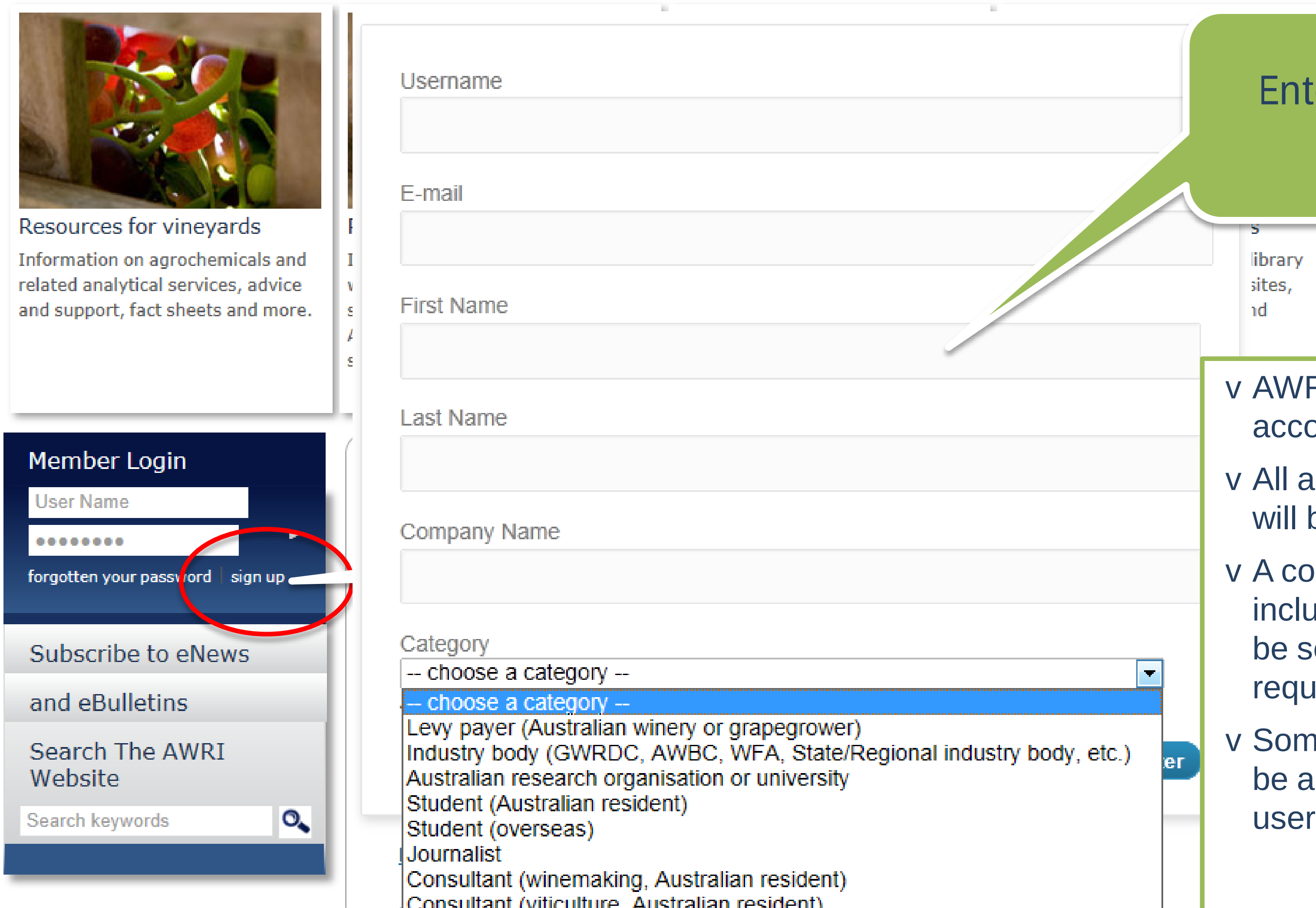
Information for exporters such as factsheets and publications, analytical services and more.

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



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

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

- Courses, seminars & workshops
- Environment
- Online videos
- Regulatory assistance
  - Analytical requirements for the export of Australian wine
  - Additives & processing aids
  - Wine standards
- Viticulture
- Wine and health
- Winemaking advice and problem solving
- Winemaking resources
- WIC Winemaking Services

Member Login
Welcome, Linda Bevin
log out

Subscribe to eNews

Industry Support and Education > Regulatory assistance

Regulatory assistance

- Analytical requirements for the export of Australian wine
- Wine standards
- Additives & processing aids

The AWRI provides regulatory and technical advice to the Australian grape and wine the Managing Director, the Health and Regulatory Information Manager and membe Industry Development and Support team. The AWRI handles approximately 150 ind information requests annually, on technical, scientific and regulatory issues from go producers and the general public. The AWRI also prepares numerous position papers submissions in relation to viticulture and oenological practices.

The AWRI is represented on the following committees of relevance to regulatory mat

- South Australian Wine Industry Council;
- The Winemaker's Federation of Australia Wine Industry Technical and Advisory Co
- The Winemaker's Federation of Australia Wine Industry National Environment Com
- Wine Committee of the Royal Agricultural and Horticultural Society of South Austr
- Organisation Internationale de la Vigne et du Vin (OIV)

The AWRI's Library (the John Fornachon Memorial Library) maintains the largest coll related literature in the southern hemisphere. It also houses an extensive print colle European Union wine and grape legislation (updated weekly) which is linked electron

View requirements by country

China

display

View requirements by certificate

--please choose--

display

View requirements by analytical parameter

--please choose--

display

Industry Support and Education > Regulatory assistance > Analytical requirements for the export of Australian wine

Analytical requirements for the export of Australian wine

China

Quick Guide to Export Requirements

Export Region	Wine Standards	Minimum Specification	Maximum Specification	Continuing Approval Application	Certificate of Origin	Other Requirements
China	Y	Y	Y	Y	Y	Certificate of Free Sale

Standards

ANALYTICAL PARAMETER	SPECIFICATION MINIMUM	SPECIFICATION MAXIMUM
Alcohol strength at 20°C		
wines^	7.0 % v/v	–
Total sugar (glucose)*		
Still	–	–
Dry wines*	–	4.0 g/L
Semi-dry*	4.1 g/L	12.0 g/L
Semi-sweet	12.1 g/L	45.0 g/L
Sweet	45.1 g/L	–
Sparkling	–	–
Brut*	–	12.0 g/L
Extra-dry*	12.1 g/L	17.0 g/L
Dry	17.1 g/L	32.0 g/L
Semi-dry	32.1 g/L	50.0 g/L
Sweet	50.1 g/L	–
Dry extract		
White	16 g/L	–
Rosé	17 g/L	–

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

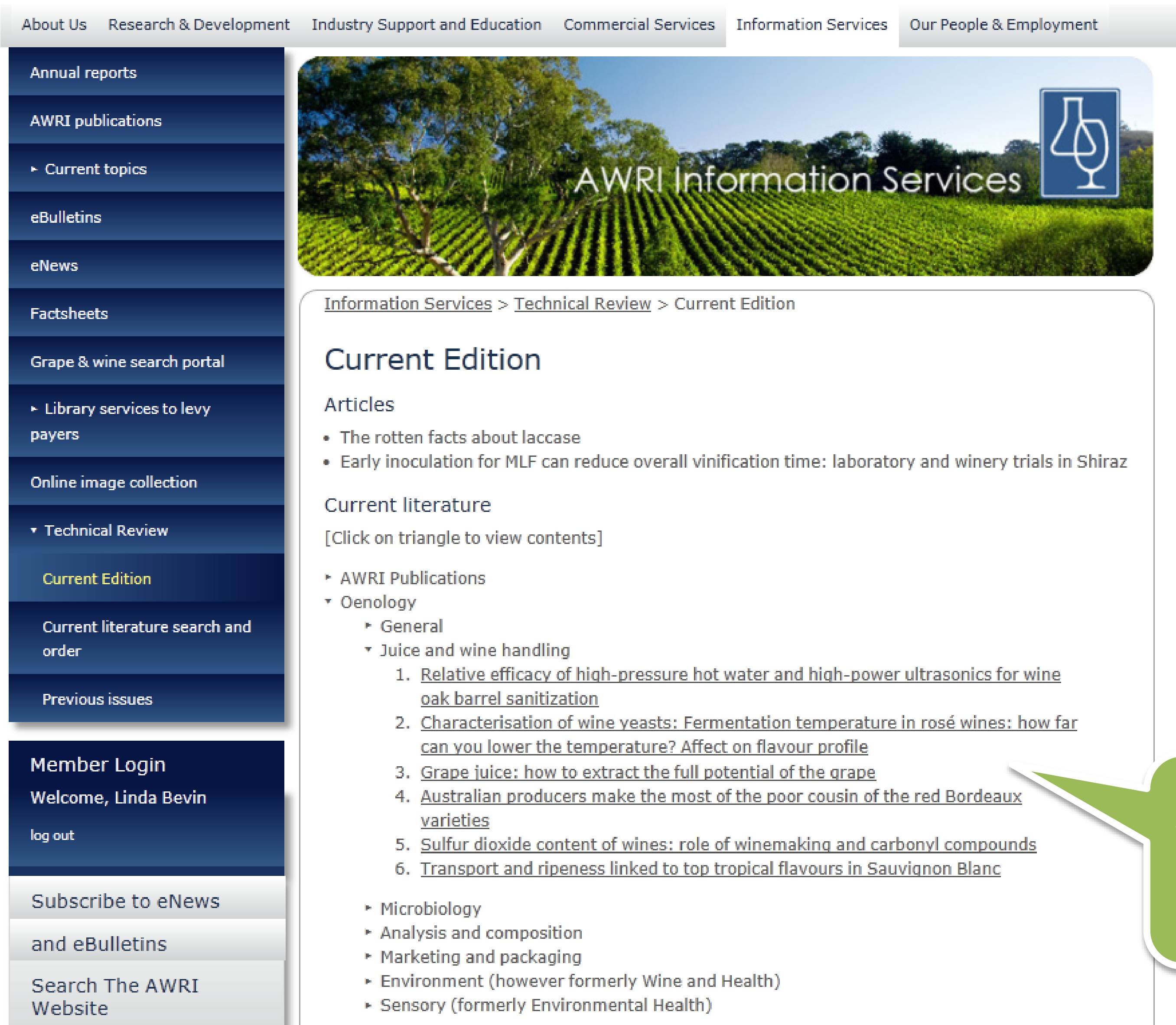
Approximate standard drinks

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

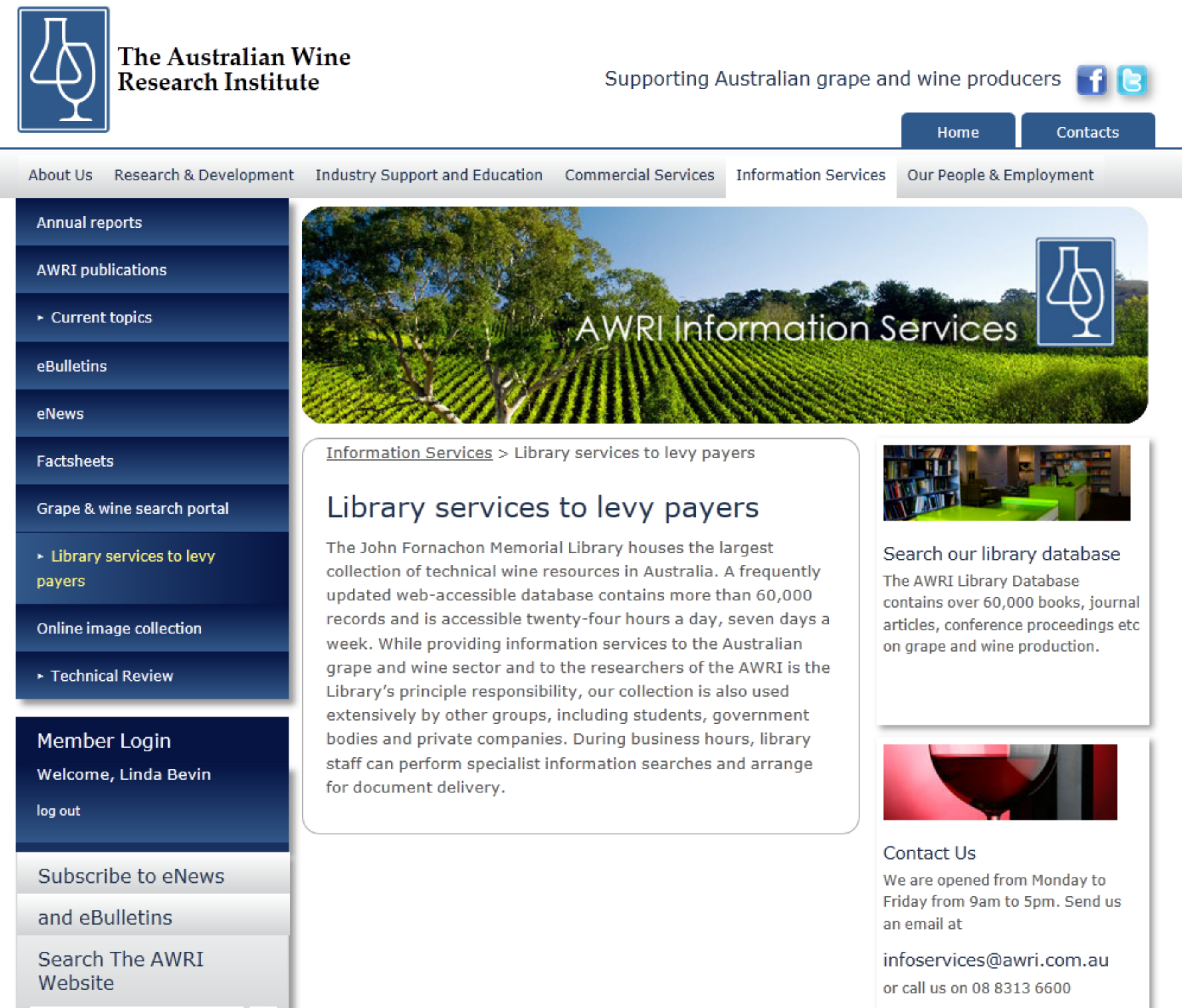


- eBulletins
- eNews
- Online image collection
- Grape and wine search portal
- Factsheets
- AWRI publications
- *Technical Review*

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

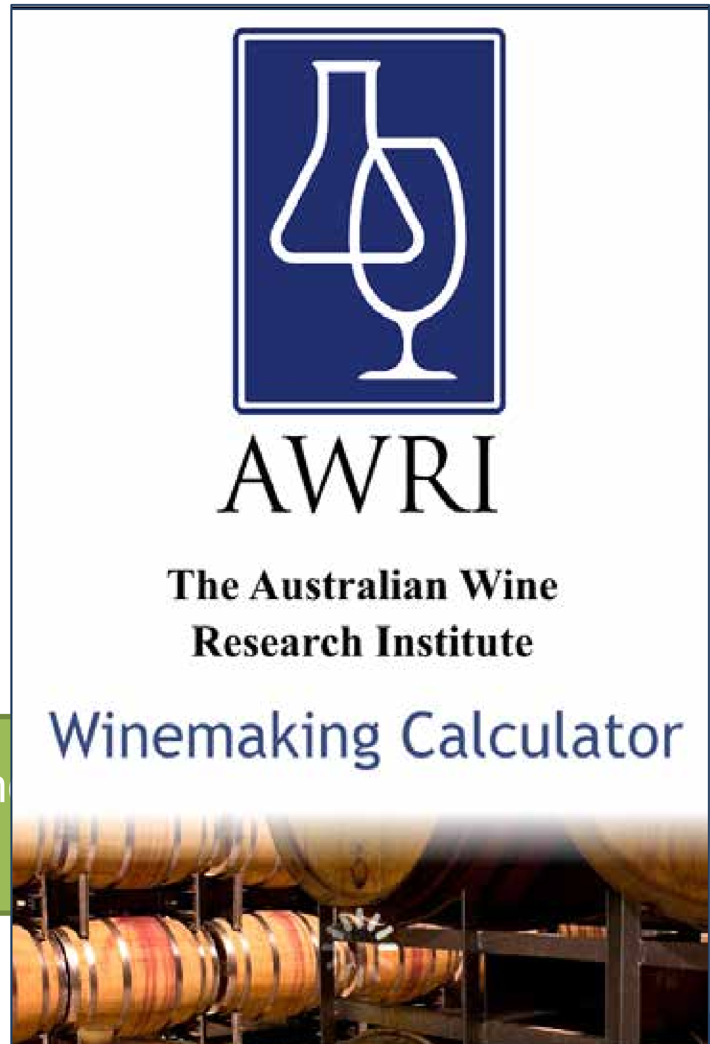
The Australian Wine Research Institute

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*

Download today's presentations via the AWRI website

The Australian Wine Research Institute

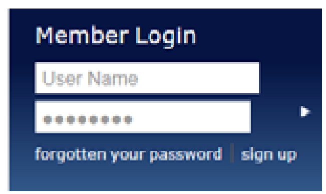
AWRI Website

Scan the QR code:

OR

Paste Link:
http://www.awri.com.au/industry_support/courses-seminars-workshops/seminars-workshops/presentations/

Login



Username: gwsbendigo
Password: awriBendig01

Save to USB

Instructions inside your seminar pack

The Australian Wine Research Institute

Your feedback is important to us . . .

Please assist by completing the evaluation forms inside your seminar packs and hand them back to any AWRI staff member.

Thank you for your participation today!