Winemaking style & red wine phenolics

Perfecting Pinot Noir Workshop
Mornington, 17 June 2015

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UNIVERSITY of TASMANIA

tia
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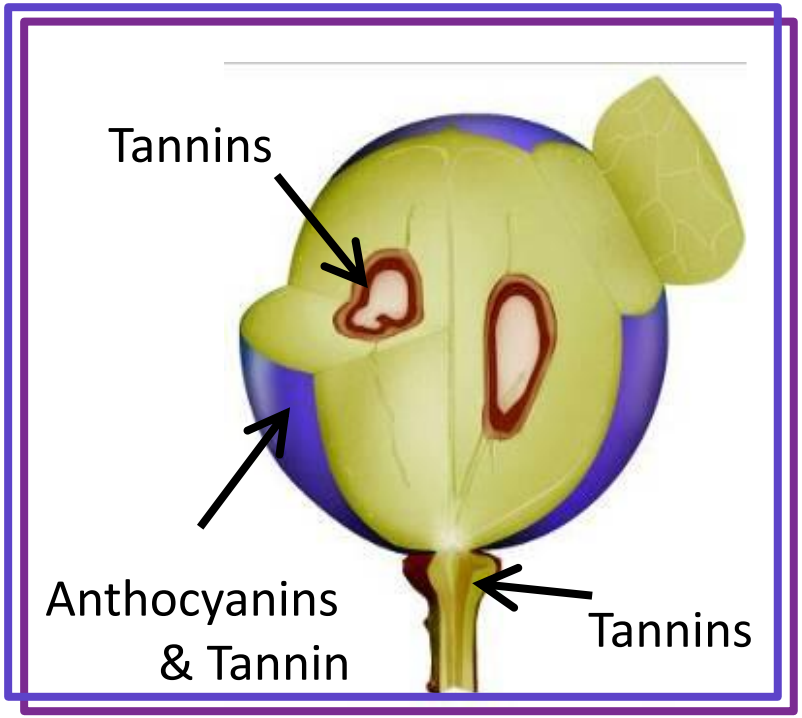
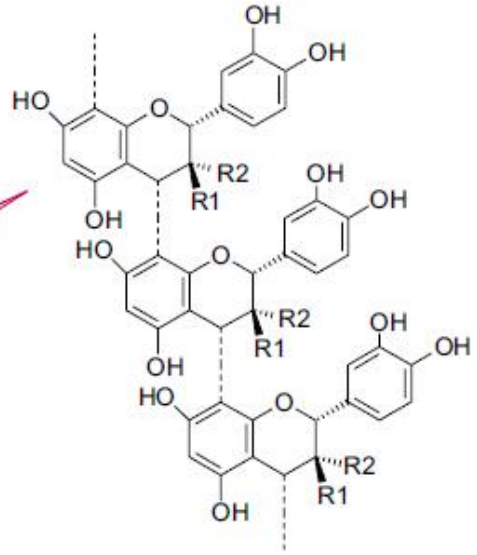
Australian Government
Australian Grape and Wine Authority

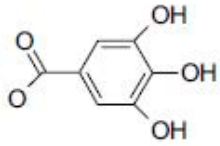
Background

- Anthocyanins and tannins for red wine colour and mouth feel
- Colour stabilisation from reaction between anthocyanins and tannins
- Tannin mouth feel and role in stabilisation of colour may vary by source (seed, skin)



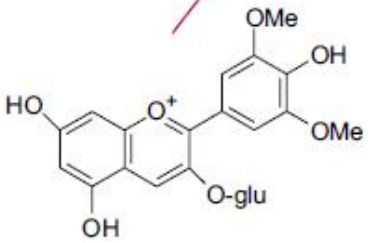


R1=H, R2=OH; R1=OH, R2=H; R1=H, R2=

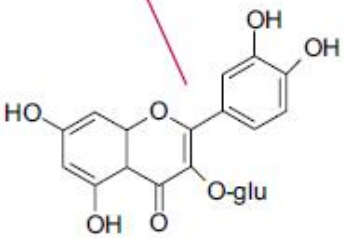


(Gal)

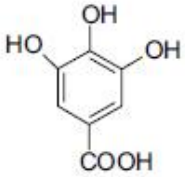
Proanthocyanidins
Polymers mainly consisting of of catechin, epicatechin and epicatechin gallate



Anthocyanins
e.g. Malvidin-3-glucoside



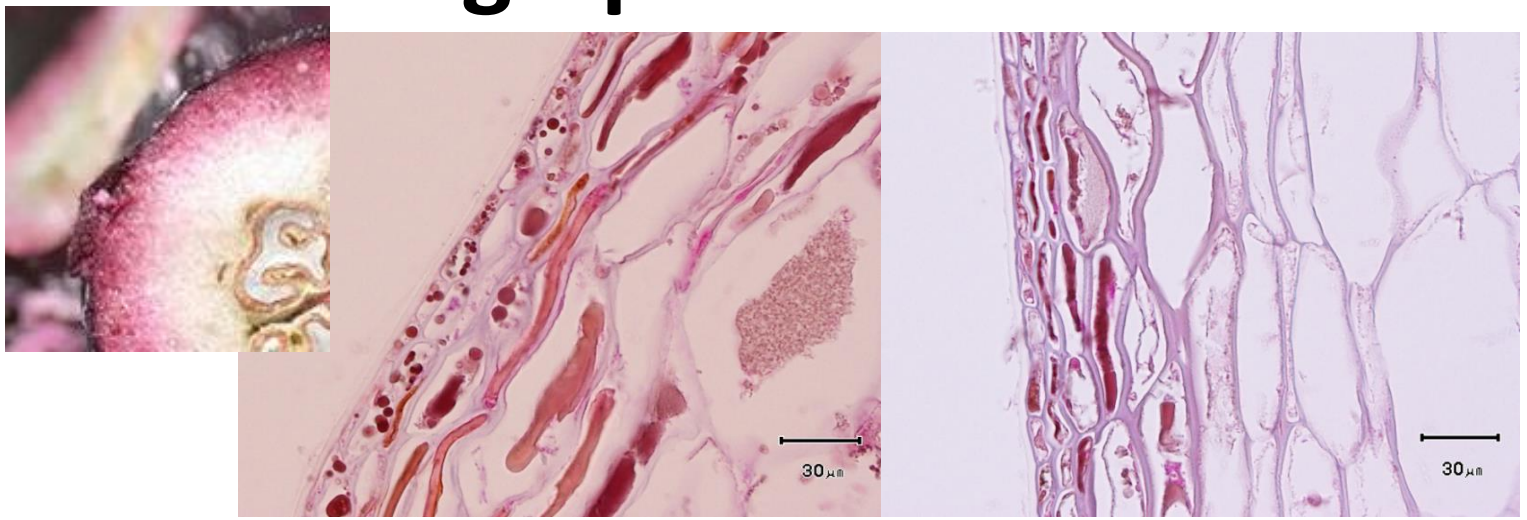
Flavonols
e.g. Quercetin glucoside



Hydroxy benzoates and Benzoic acids
e.g. Gallic acid

Fig. 1. Cross-sectional picture of a red grape berry. Skin, pulp and seeds can be distinguished.

Pinot noir grape skin sections



A. Fresh grape skin

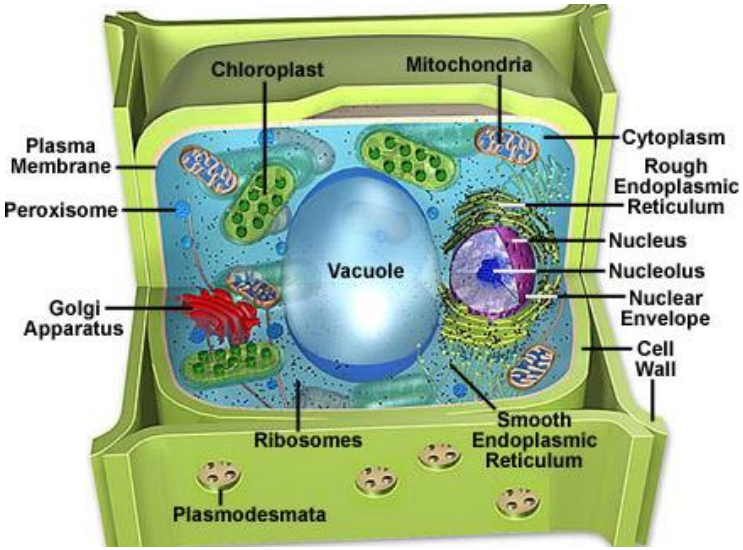
B. Post-fermentation (8 days)

Where are phenolics located in grape cell?:

- ‘free’ in cytoplasm
- held inside vacuole
- vacuole/cell membrane-associated

- NB: hydrophilic/hydrophobic & H-bonding

(good review by Pinelo et al, 2006)

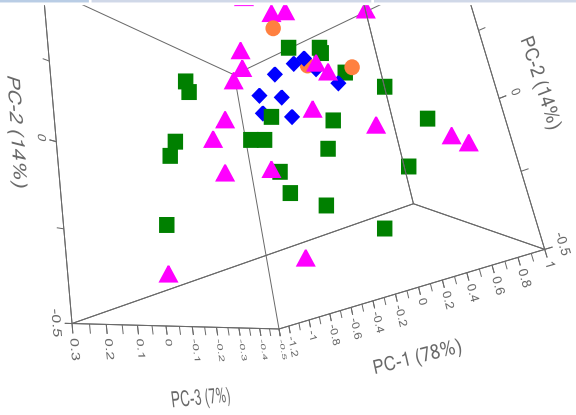


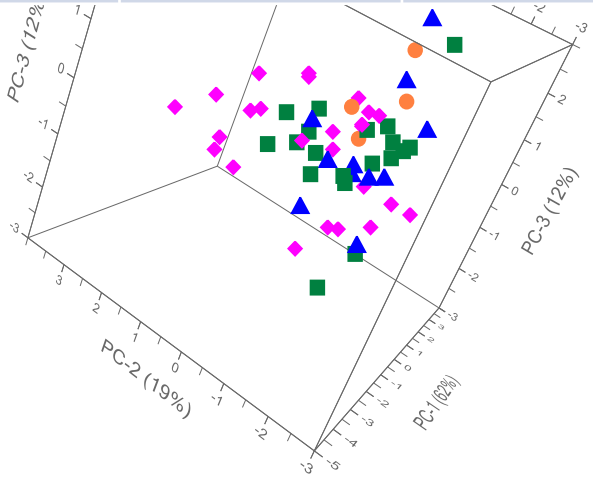
Similar histology images in: Carew AL, Gill W, Close DC, Dambergs RG. (2014) American Journal of Enology and Viticulture. Acknowledging Dane Hayes, DPIPWE.

Phenolics target? Medal-winning?

Quadratic discriminant analysis: 2014 Tas Wineshow

	ACTUAL	GOLD	SILVER	BRONZE	NO MEDAL
PREDICTED					
GOLD		**4**	0	0	0
SILVER		0	**9**	6	4
BRONZE		0	1	**9**	7
NO MEDAL		0	1	4	**14**





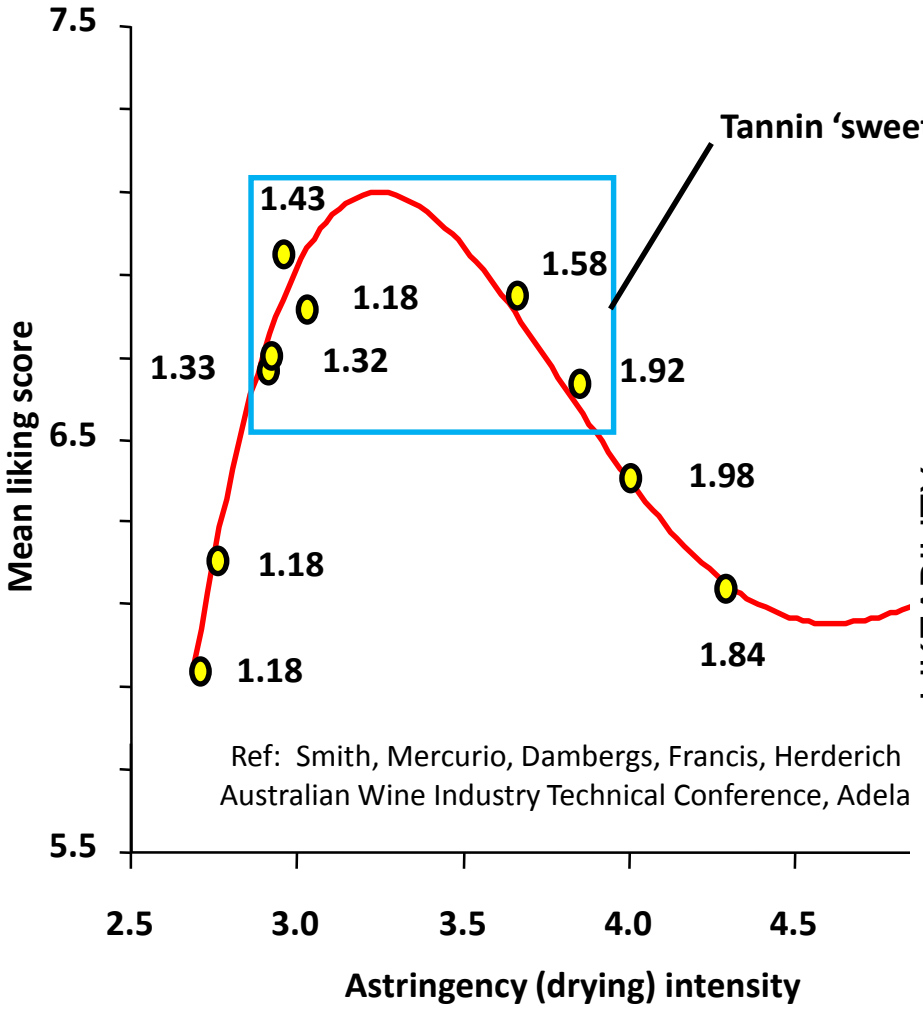
Bronze Gold No medal Silver

Bronze Gold Silver None

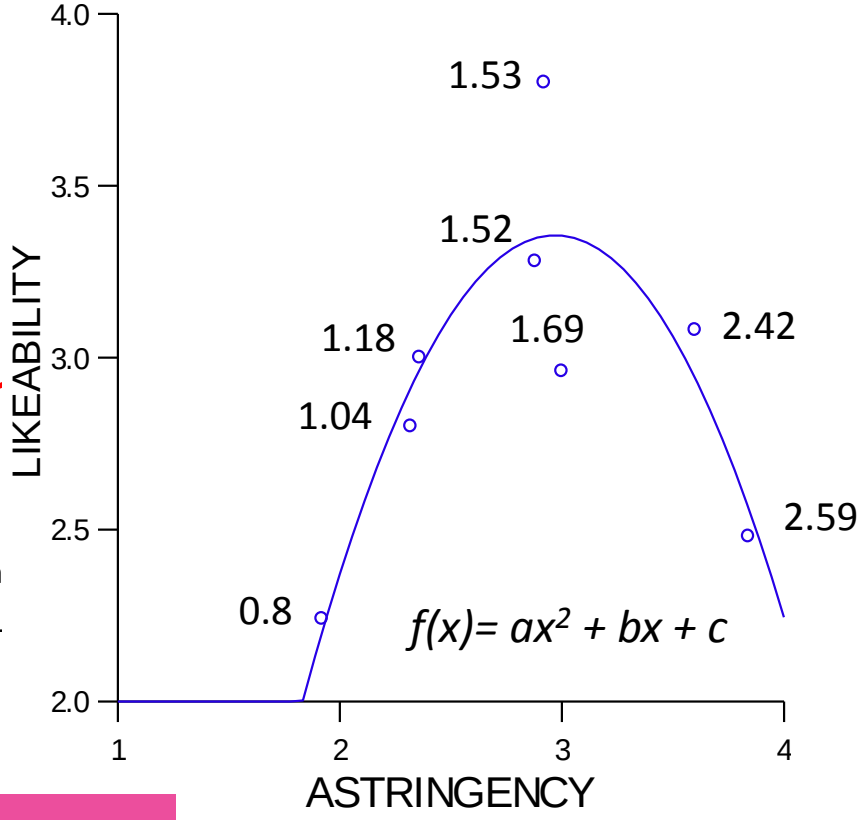
The Tasmanian Wine Show Society is gratefully acknowledged for allowing access to wines for sampling.

Carew A and Dambergs B (2014) A consistent relationship between Pinot noir phenolics concentration and wine show performance? CRUSH Symposium, Adelaide, 2014.

The tannin sweetspot



Ref: Smith, Mercurio, Dambergs, Francis, Herderich
Australian Wine Industry Technical Conference, Adela



2014 Gold Medal wines = high pigment, purple hue, moderate tannin

Acknowledgment: Dr B. Dambergs and D. Sanderson Wine Tasmania Conference/AWRI Node Wrap-up 2014

Improving phenolics in vineyard or winery…or both?

CRUSH Symposium Adelaide, 2014

Drs Fiona Kerslake, Bob Dambergs, Dugald Close and Anna Carew (TIA)

+ additional analyses from Drs Paul Smith and Keren Bindon (AWRI)

Acknowledgments: Brown Brothers, AWRI, TIA

In the vineyard

- 2 vineyards 2013
  - Leaves on
  - Leaves off

- Site differences for yield, phenolics and anthocyanins
  - Leaf removal
    - 18 % lower yield
    - 7 % increase total phenolics
    - 7 % increase total tannin

- Standard winemaking
  - Leaf removal
    - 8 % increase total phenolics
    - 13 % increase total tannin

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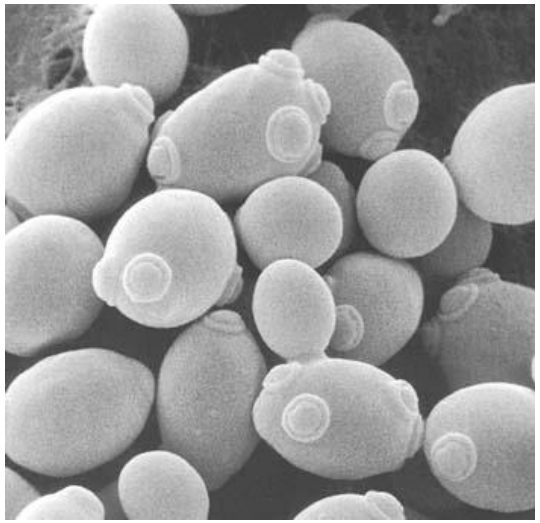
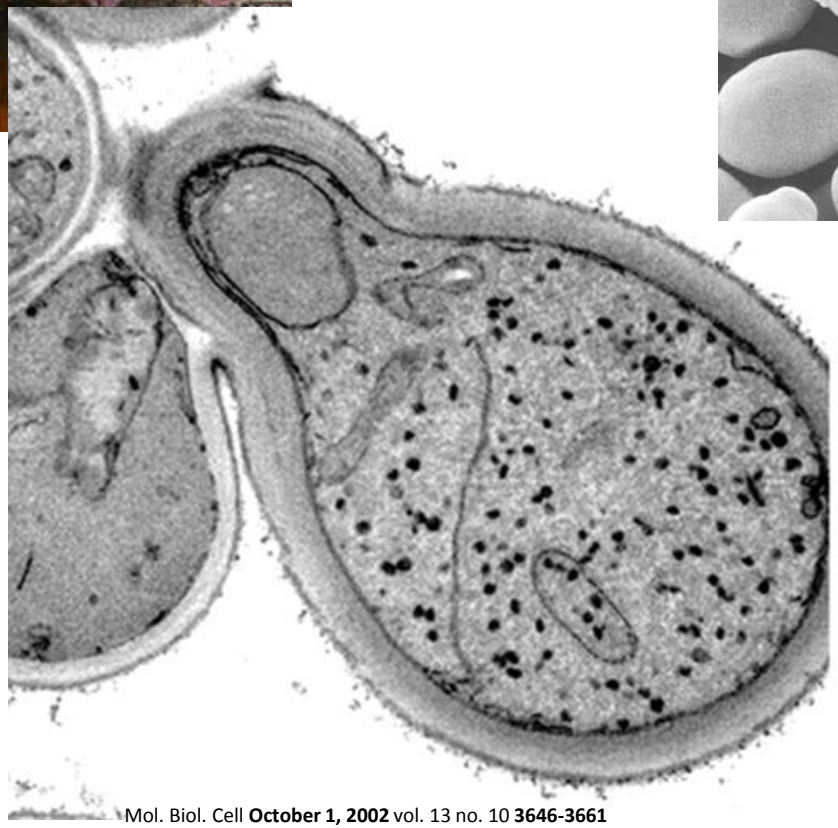
In the winery

- Wine
  - Microwave
    - 30 % increase total phenolics
    - 50 % increase total tannin
  - Additive effect
    - No leaves off + standard
      - 0.59 AU SO_2 resistant pigment
      - 4.57 AU colour density
    - Leaves off + microwave
      - 0.86 AU SO_2 resistant pigment
      - 6.69 AU colour density

- Costs vary between leaf removal or microwave
- Decision based on the desired outcome in the wines
- Ongoing work with AWRI suggests tannin composition also influenced differently by leaf removal and microwave (microwave extraction with early pressing and leaf removal enhance skin tannin extraction into wine)

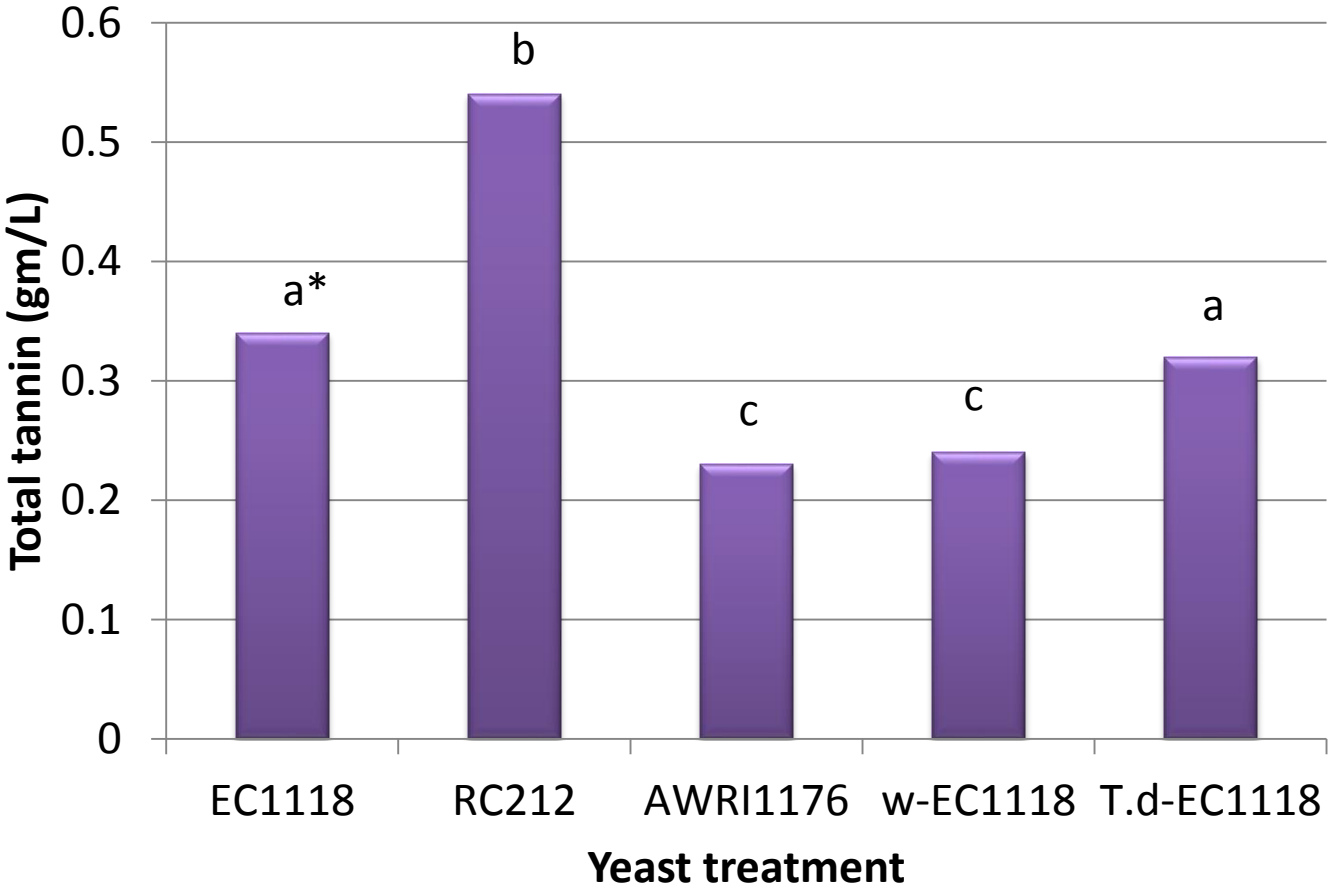
Yeast & Phenolics





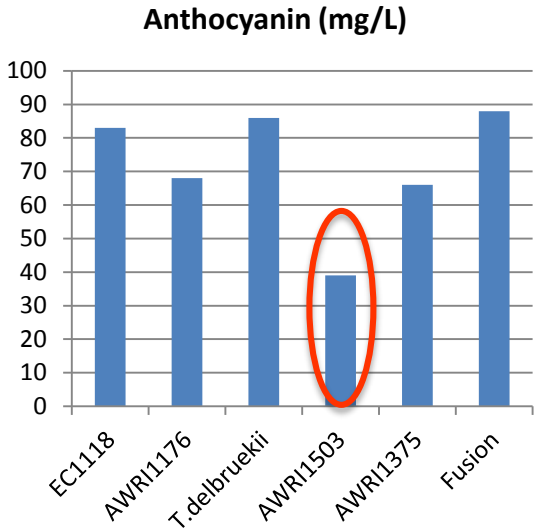
Mol. Biol. Cell **October 1, 2002** vol. 13 no. 10 **3646-3661**

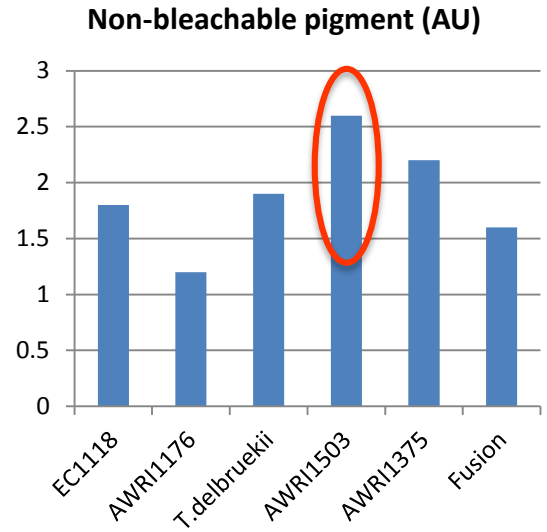
Yeast strain influences tannin

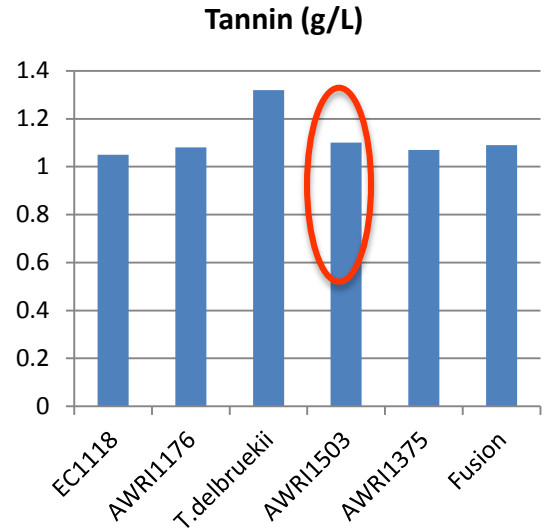


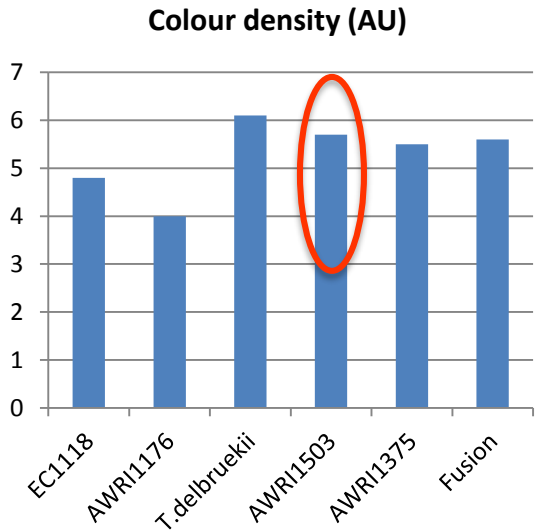
*Means with the same letter are not significantly different at the $p \leq 0.05$ level according to Tukey's Test.

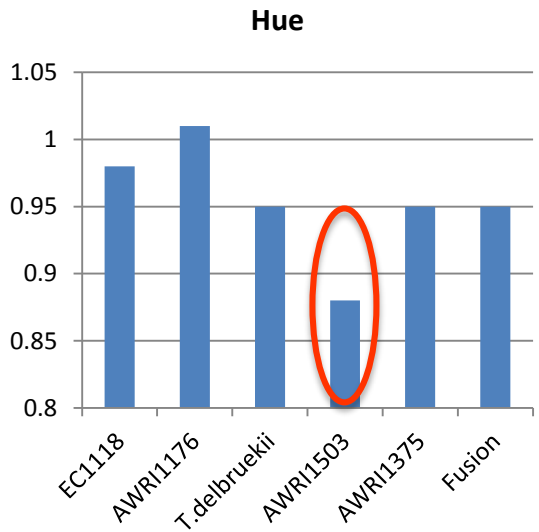
Industry strains trial – 3yo Pinot noir





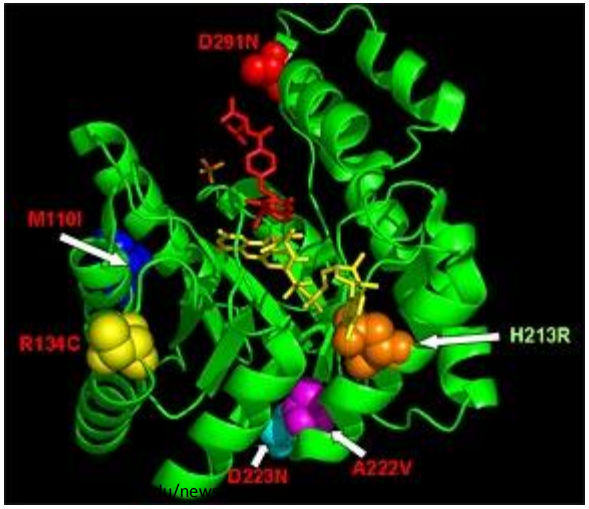


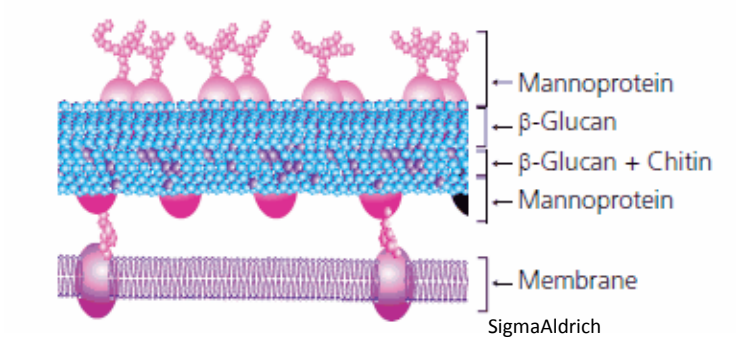




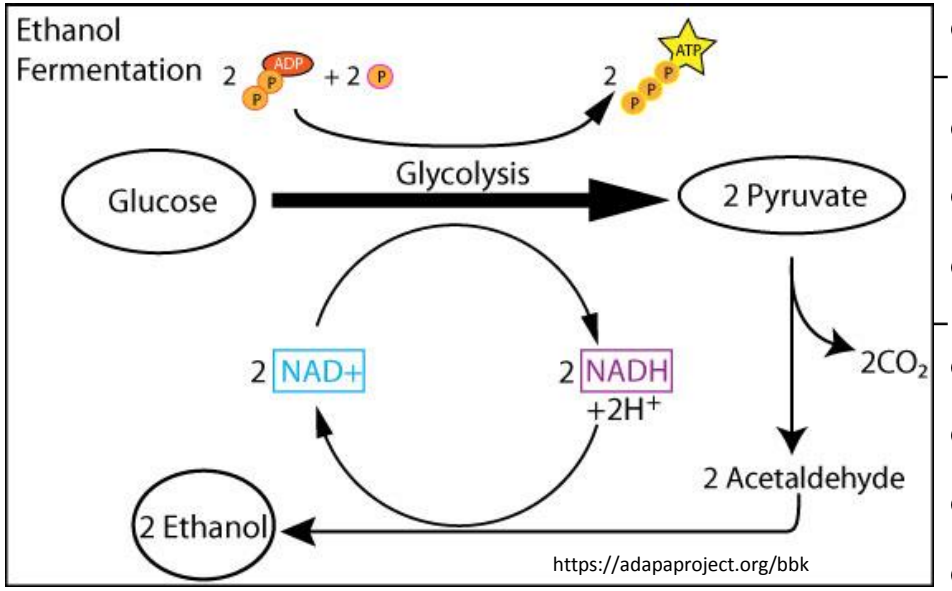
NB: non-replicated trial – results indicative only. Acknowledgements and thanks to winery partners in this research.

Yeast Enzyme, Adsorption, Polymerisation effects?

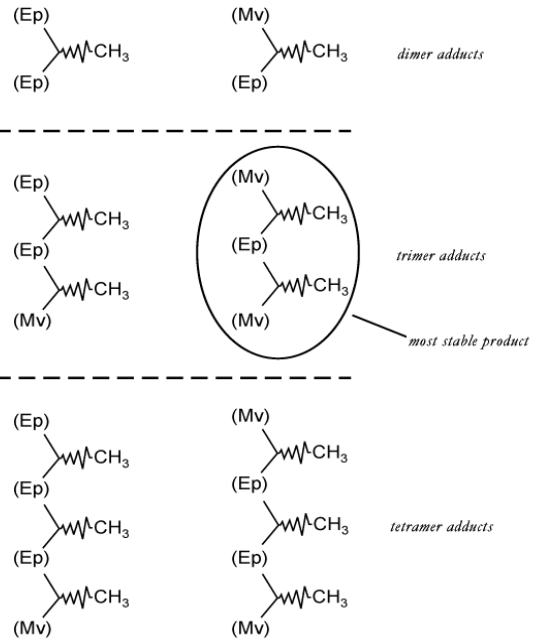




SigmaAldrich

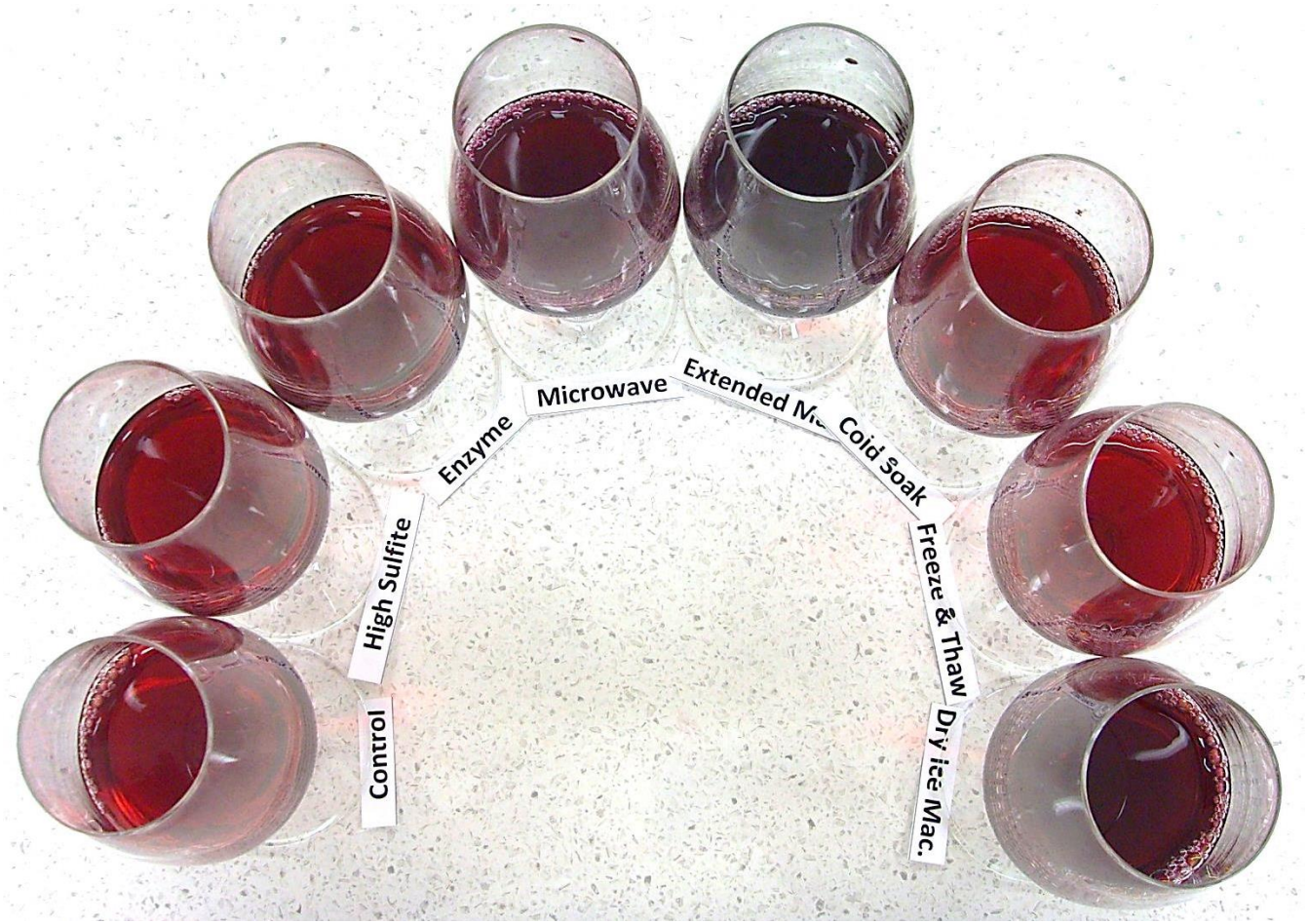


https://adapaproject.org/bbk



(Montounet et al., J. Agric. Fd. Chem., Vol. 47, pp. 2096-2102, 1999)

Maceration



Acknowledgment: Carew, Sparrow, Dambergs, Close (TIA, AWRI). Poster at International Cool Climate Symposium, Hobart, 2012.

Maceration

6 months

	Anthocyanin (mg/L)	Non-bleachable pigment (AU)	Tannin (g/L)
control	133 a	0.60 a	0.38 a
microwave	**252 b**	0.79 a	**0.88 c**
cold soak	138 a	0.57 a	0.47 ab
freeze and thaw	169 a	0.59 a	**0.94 c**
extended maceration	**52 c**	**1.80 b**	**0.61 b**

30 months

	Anthocyanin (mg/L)	Non-bleachable pigment (AU)	Tannin (g/L)
control	1.2	0.85 a	0.15 a
microwave	ND	**1.46 b**	**0.43 bc**
cold soak	ND	**1.28 b**	0.33 ab
freeze and thaw	ND	1.19 ab	**0.56 c**
extended maceration	ND	**1.29 b**	**0.41 bc**

Acknowledgment: Maceration trial 2011 – Carew, Sparrow, Dambergs, Close (TIA, AWRI)

Reference: Carew, 2014 'A Novel Process for Pinot noir Winemaking' UTAS Doctoral dissertation. PDF available online.

Plant cell wall

Image from 2014 TIA presentation by Prof L. Melton (University of Auckland)

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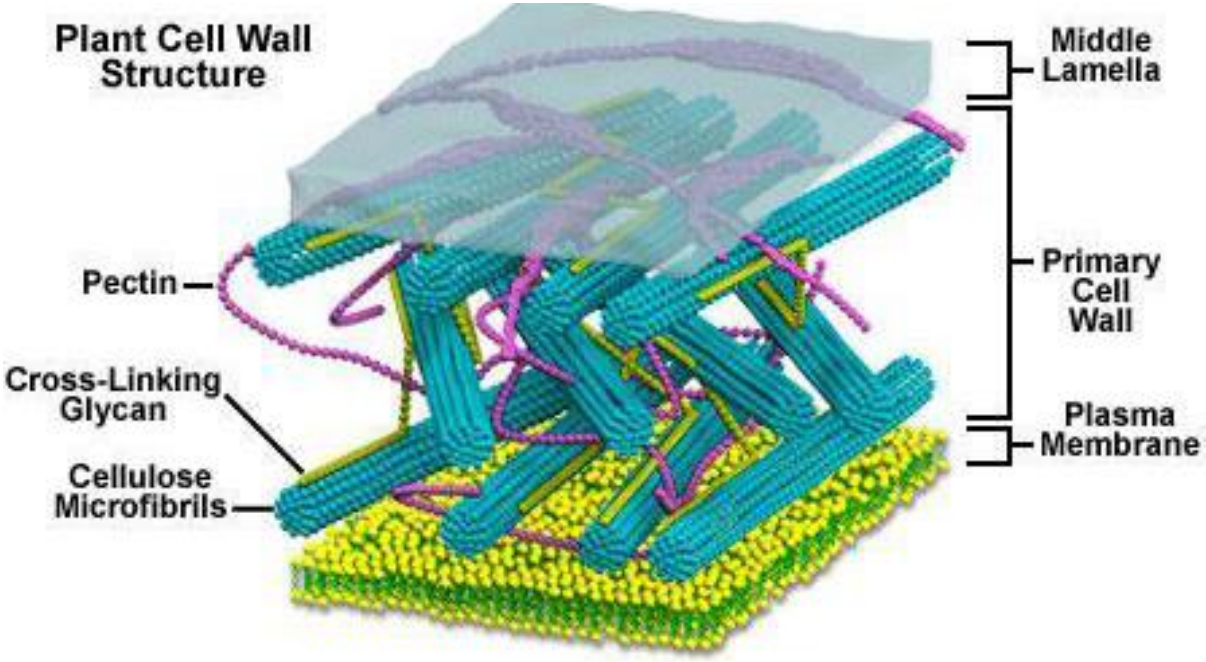
Pectin is like cement/glue between cell wall components like cellulose fibrils.

Post-harvest change in grape cell walls due to continuing grape enzyme activity.

Main pectin degrading enzymes in grape: Pectin Methyl Esterases (PMEs) & Polygalacturonases (PGs).



Proposed pectin structure

(NB: little khaki ovals = methyl groups; yellow triangles = galacturonic acid)
Image from 2014 TIA presentation by Prof L. Melton (University of Auckland)

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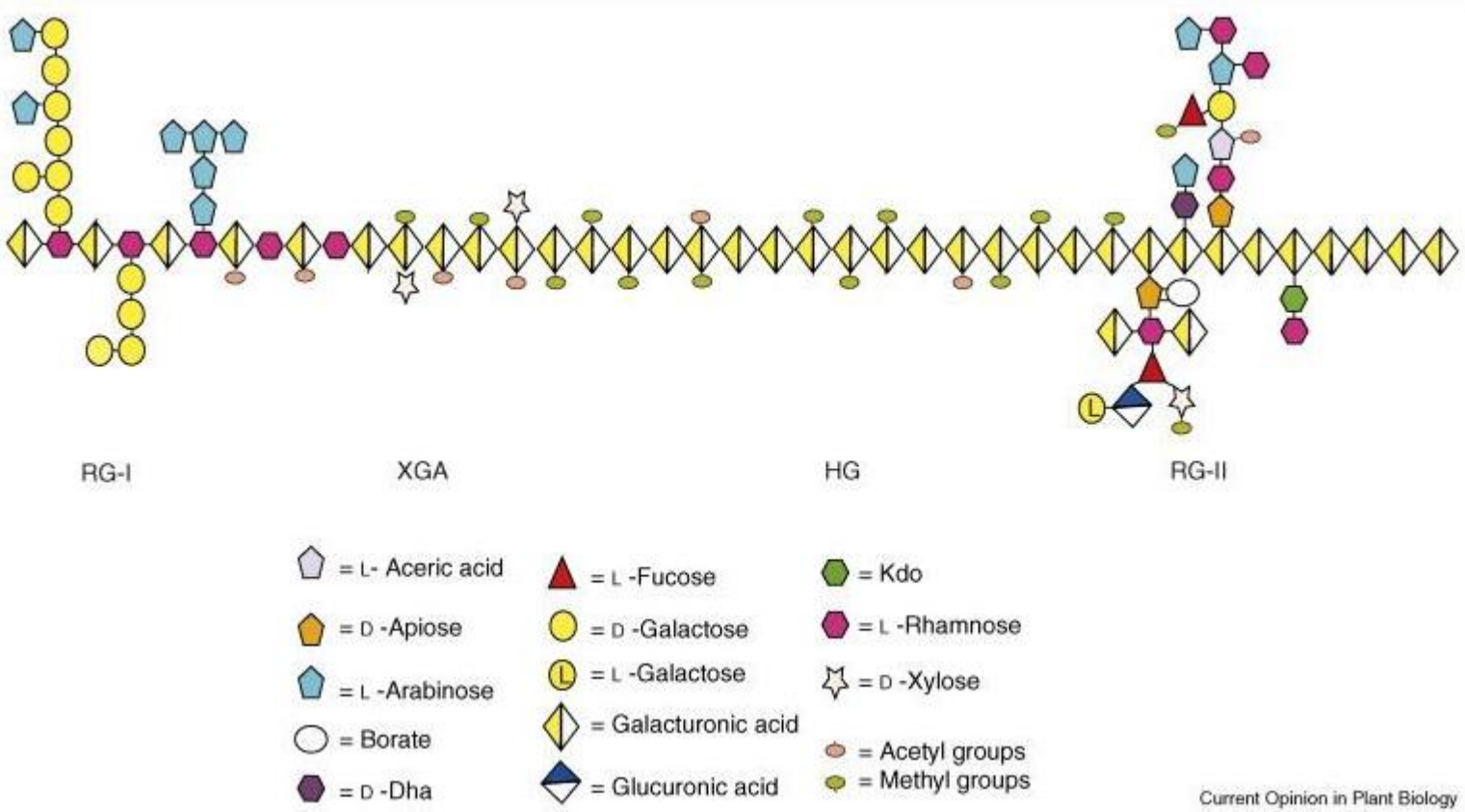

Cold soak questions:

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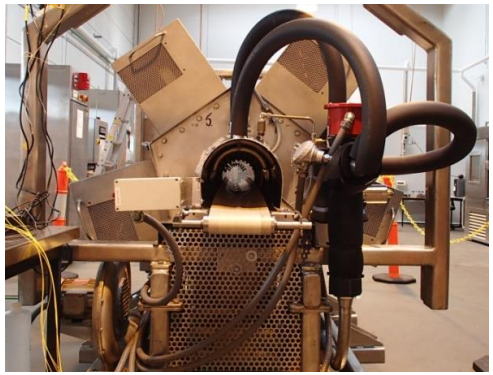
Black box questions:
Role of endogenous enzymes?
Impact of ripeness and viticultural practices on level of enzyme activity? Or is it related to cell wall permeability? Or are the 2 linked?
Do exogenous enzymes provide same effects?

Mechanism questions:
Can we measure enzyme activity?
What portion of extraction is enzyme-mediated versus physical (squashing, leakage, diffusion)?
Specific phenolics, specific parts of grape cell undermined?

‘Controlled Phenolic Release’ (CPR)

AGWA-funded research 2014-2017



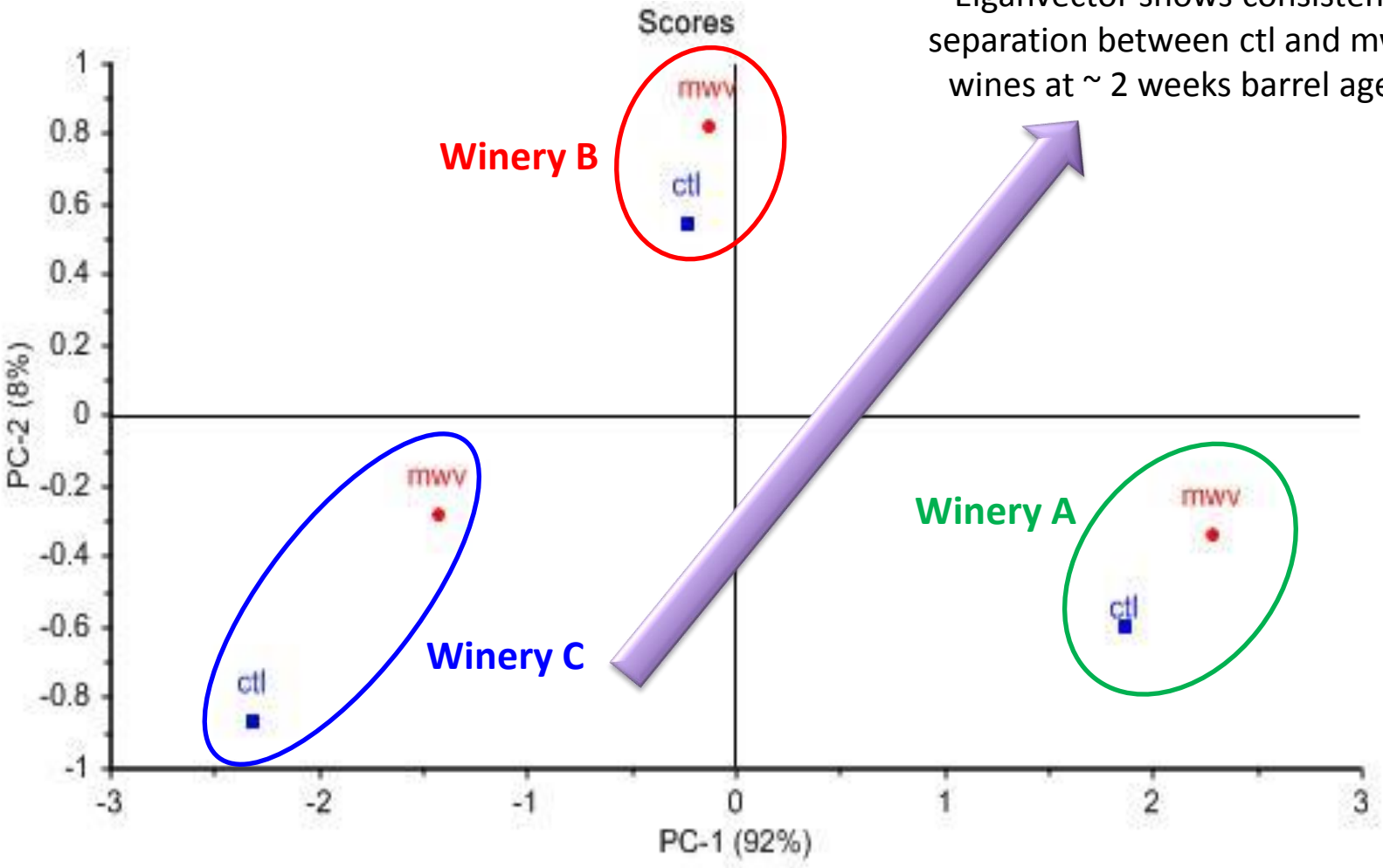
2014 - 400kg must, solids through 15 kW pentagonal microwave unit, ~100kg/hr, into juice chilled in Cleveland kettle (4°C)

(with Dr Kai Knoerzer, CSIRO Animal, Food and Health Sciences, VIC)

CPR INDUSTRY TRIAL (Yarra, 2014)

- Winemakers volunteered & protocol negotiated
- Six 400kg lots of Pinot noir must
  - CPR x three lots (CSIRO Werribee)
  - Control x three lots
- Fermentation on skins ~8 days
- Press to barrel, inoculate for malo
- Analysis & (industry) tastings

Eiganvector shows consistent separation between ctl and mwv wines at ~ 2 weeks barrel age.



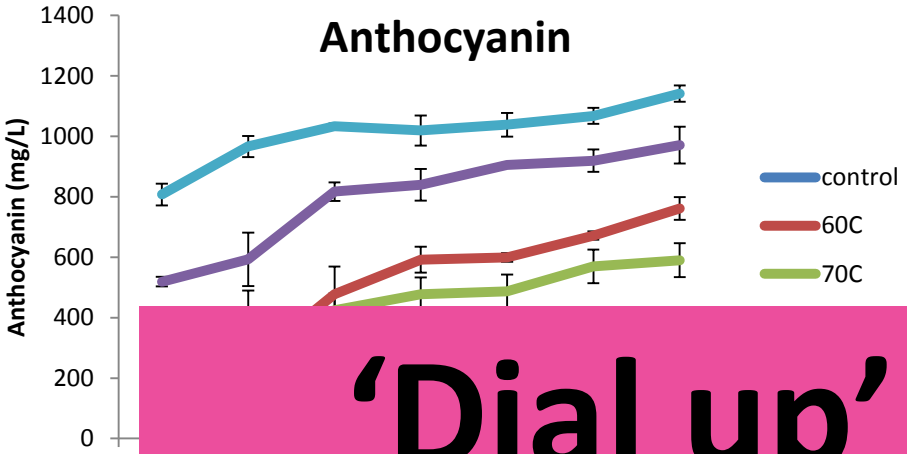
But, how does it taste?

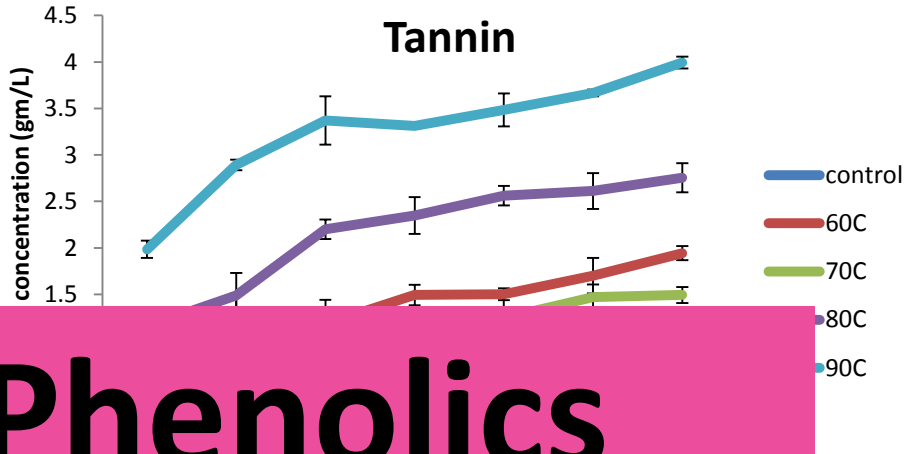
'…tasted the microwave batch in barrel. Looks good, more plump than the control but still structured. Fruit spectrum is darker with a firmer palate…'

Winemaker X

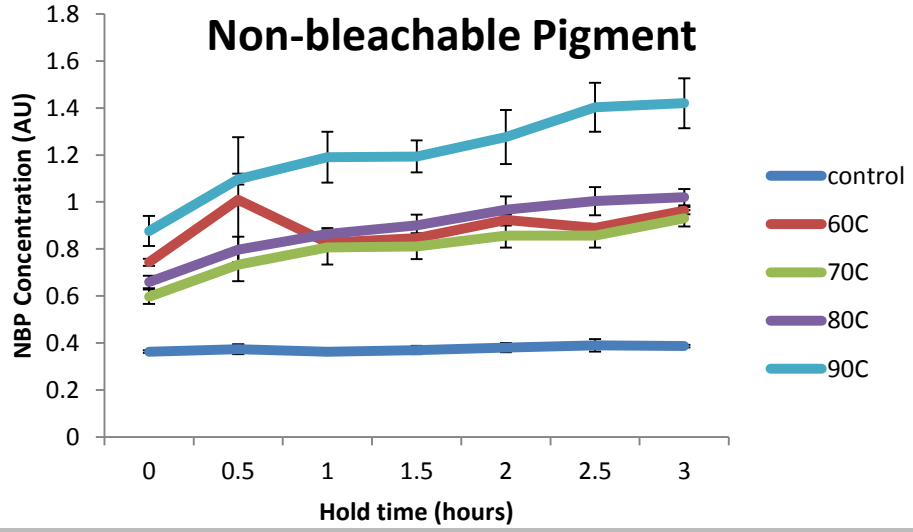
Process Control

peak temperature & hold time





‘Dial up’ Phenolics



Summary – focus on phenolics

- Tannin ‘sweetspot’ around 1.5 gm/L
- Yeast choice (impact on long term stable colour)
- Maceration (cold soak and extended maceration for greater long term stable colour)
- CPR thermal maceration for rapid extraction & early press off

Thank you! Questions?

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