Capturing the pepper character in Shiraz

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THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

Gas chromatography-mass spectrometry

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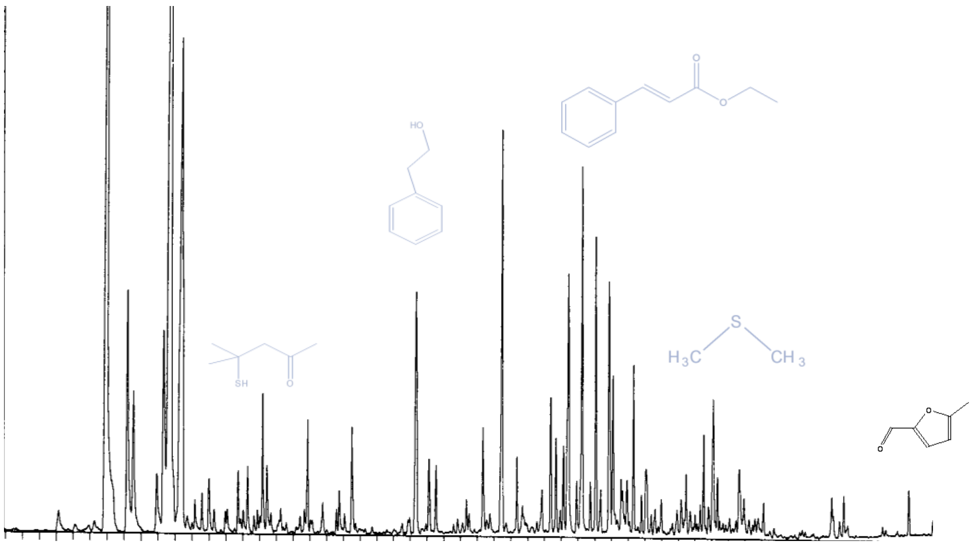

(-)-Rotundone

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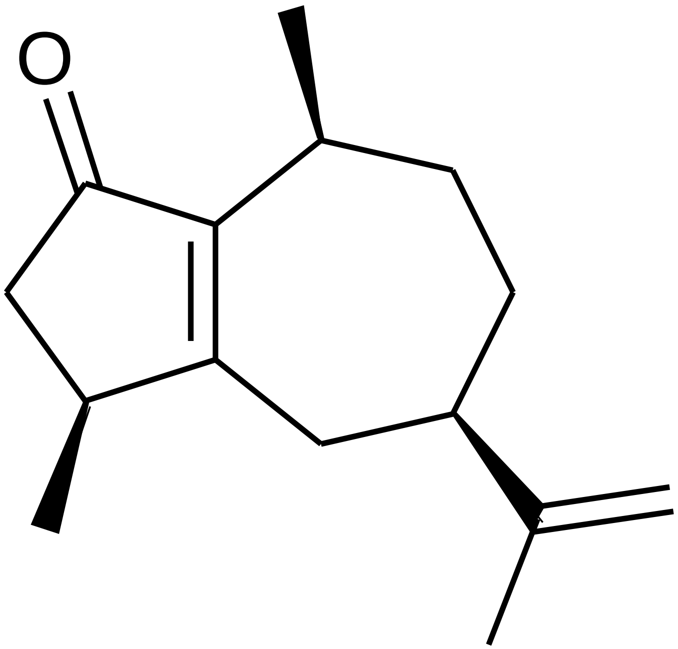

- Identity confirmed with reference compound (Symrise)

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?

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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

Aroma detection threshold of the black pepper compound Rotundone, in red wine, is 16 ng/L

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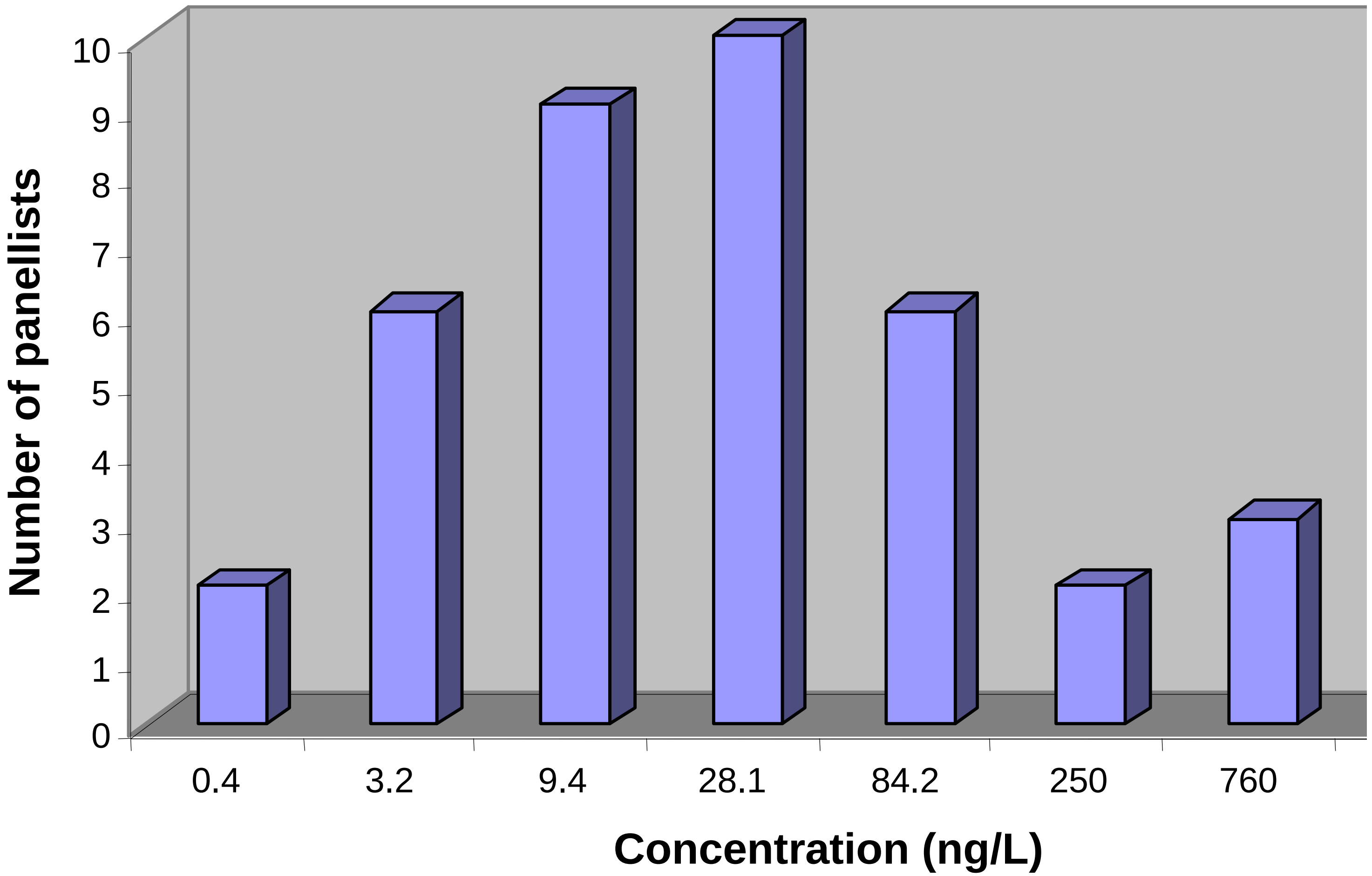

Rotundone in Australian wines

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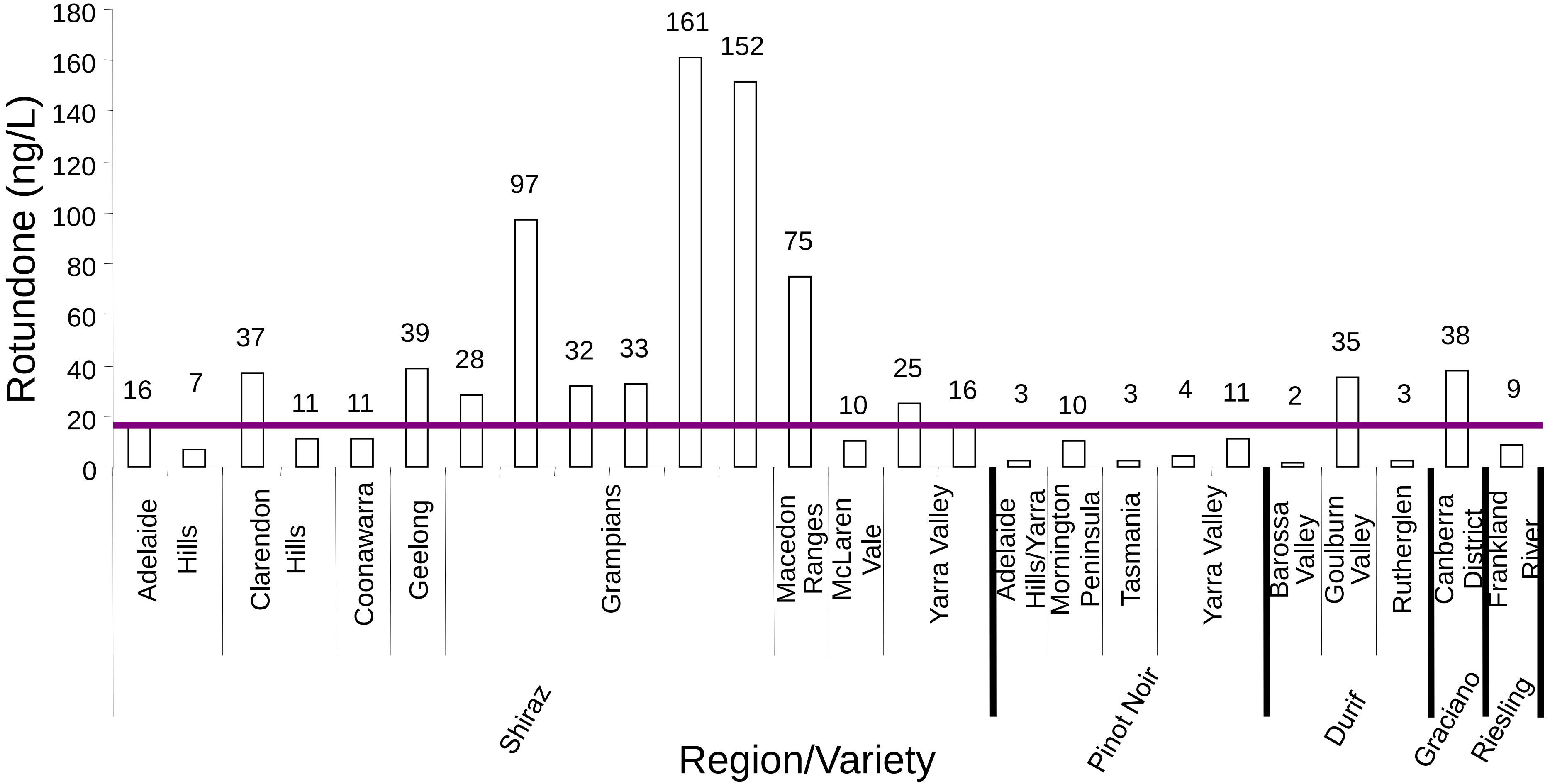

AWRI TR #180 (June 2009)

Rotundone in other commercially available Shiraz wines

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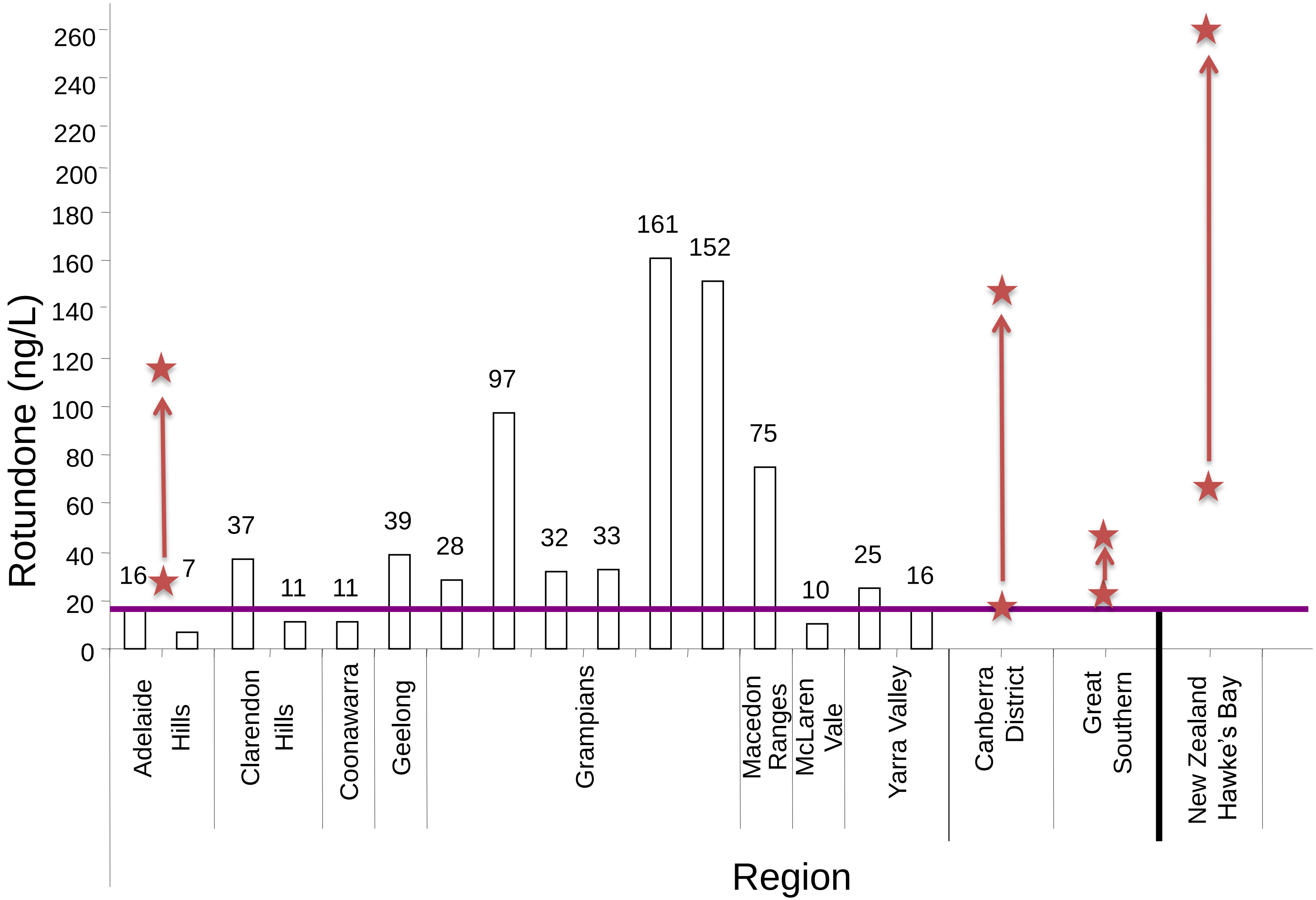
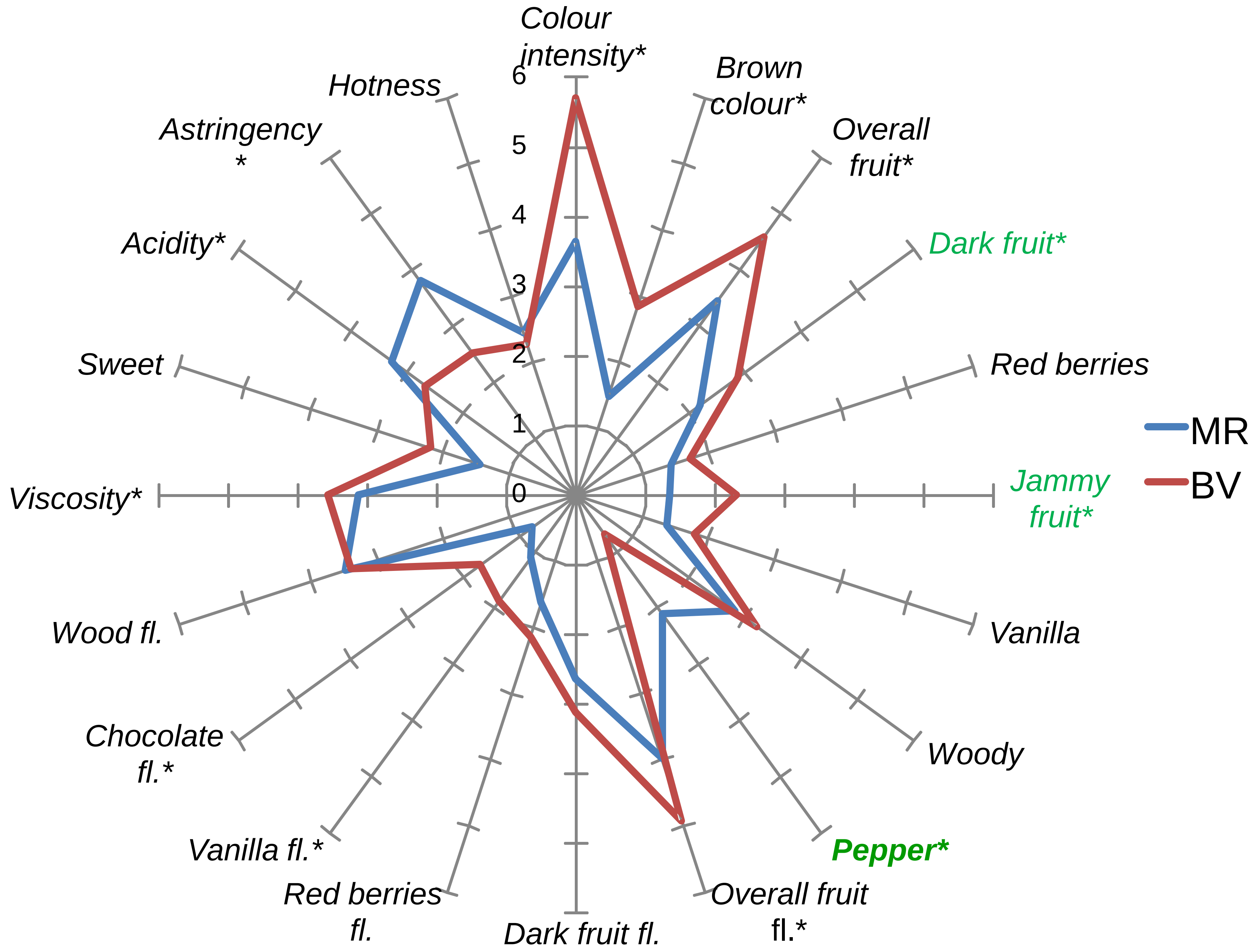


Sensory attribute intensities: Margaret River and Barossa Shiraz



Compound	Barossa Valley Shiraz concentration (µg/L)[b]	OAV[c]	Margaret River Shiraz concentration (µg/L)[+]	OAV
acetic acid	680000	3.4	510000	2.6
ethyl lactate	366500	2.4	247250	1.6
ethyl acetate	164400	13.4	103100	8.4
3-methyl butanol	161250	5.4	208400	6.9
2-methyl butanol	40150	<1	76000	1.2
2-methyl propanol	26750	<1	56200	1.4
2-phenyl ethanol	26350	1.9	56450	4.0
methionol	2018	2.0	3061	3.1
hexanoic acid	1840	4.4	1900	4.5
ocatanoic acid	1480	3.0	1680	3.4
3-methylbutyl acetate	508	17.0	465	15.5
3-methylbutanoic acid	438	13.0	946	28.3
butyric acid	433	2.5	174	1.0
ethyl octanoate	378	76.0	439	87.8
ethyl hexanoate	369	26.0	391	27.9
2-methylbutanoic acid	335	10.0	907	27.5
cis-oak lactone	313	13.0	243	10.0
ethyl butanoate	305	15.0	234	11.7
vanillin	301	1.5	149	<1
ethyl-2-methyl propanoate	207	14.0	353	23.5
dimethyl sulfide	130	13.0	37	3.7
ethyl 3-methyl butanoate	54	18.0	100	33.3
4-ethylphenol	45	3.5	11	<1
eugenol	41	6.8	28	4.7
ethyl 2-methyl butanoate	36	36.0	76	76.0
guaiacol	35	1.5	28	1.2
linalool	15	1.0	13	<1
sotolon	9	1.8	3	<1
methanethiol	2.5	1.4	1.7	<1
β-damascenone	2.2	44.0	1.2	24.0
hydrogen sulfide	0.6	<1	1.8	1.6
rotundone	0.001	<1	0.038	4.0

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JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
Article
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Characterization of the Key Aroma Compounds in Shiraz Wine by Quantitation, Aroma Reconstitution, and Omission Studies

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ABSTRACT: The key aroma compounds of premium Australian Shiraz wines from the warm Barossa Valley and cooler Margaret River regions were characterized. GC–Olfactometry was conducted to determine the most important volatile compounds, which were then quantitated. The wine from the Barossa Valley had higher concentrations of ethyl propanoate, dimethyl sulfide (DMS), and oak-derived compounds, whereas the Margaret River wine contained above threshold concentrations of the 'cheesy' compounds 2- and 3-methylbutanoic acid, as well as rotundone, the 'pepper'-smelling compound.

Mayr, C.M., Geue, J.P., Holt, H.E., Pearson, W.P., Jeffery, D.W., Francis, I.L. 2014. *Journal of Agricultural and Food Chemistry 62 (20): 4528-4536.*

Rotundone variability across vintages: Canberra District

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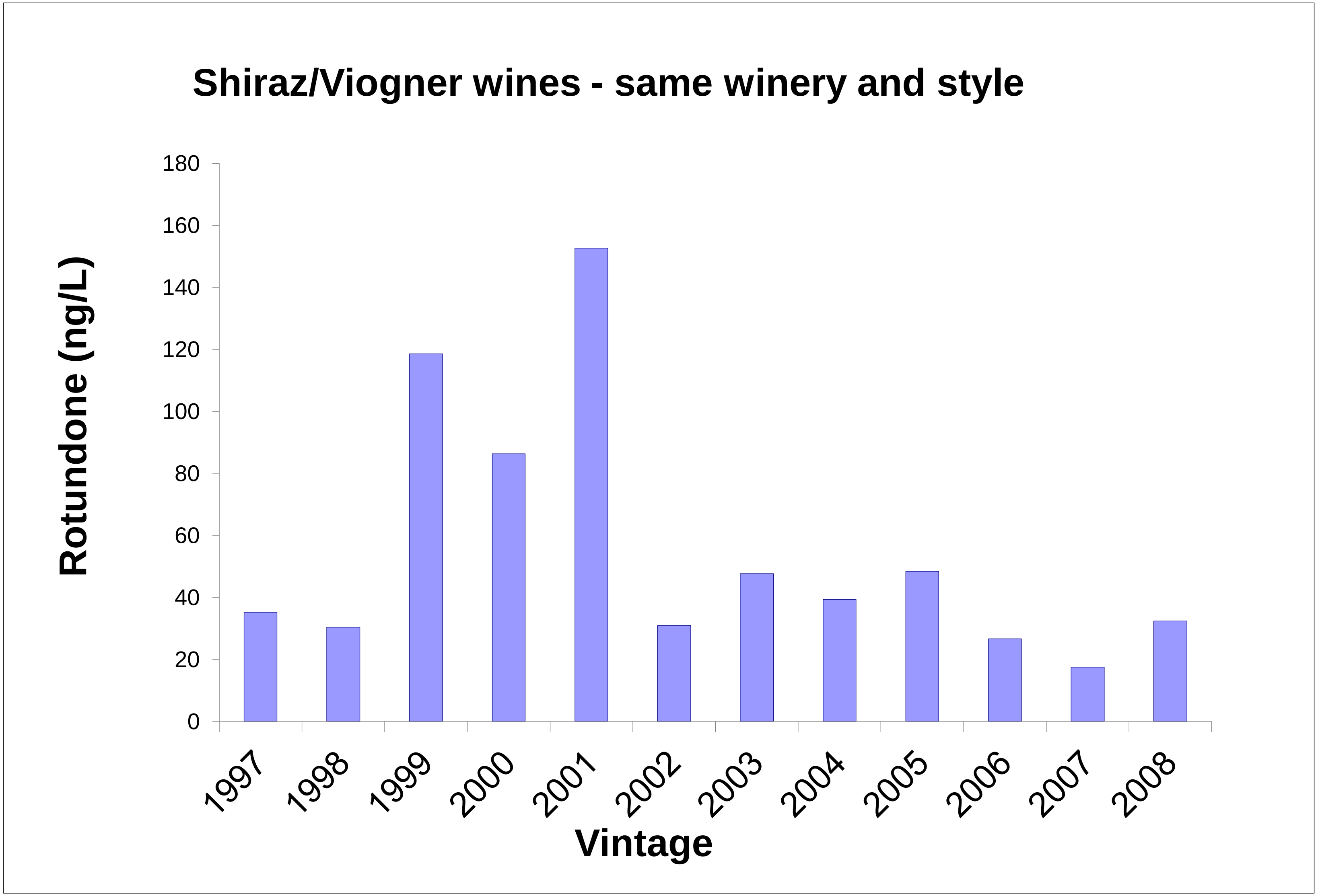

Rotundone is only present in the skin

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Skin: *rotundone*

Seeds: *not detected*

Pulp: *not detected*

Photograph by Eric Wilkes

Rotundone increases during late stage ripening

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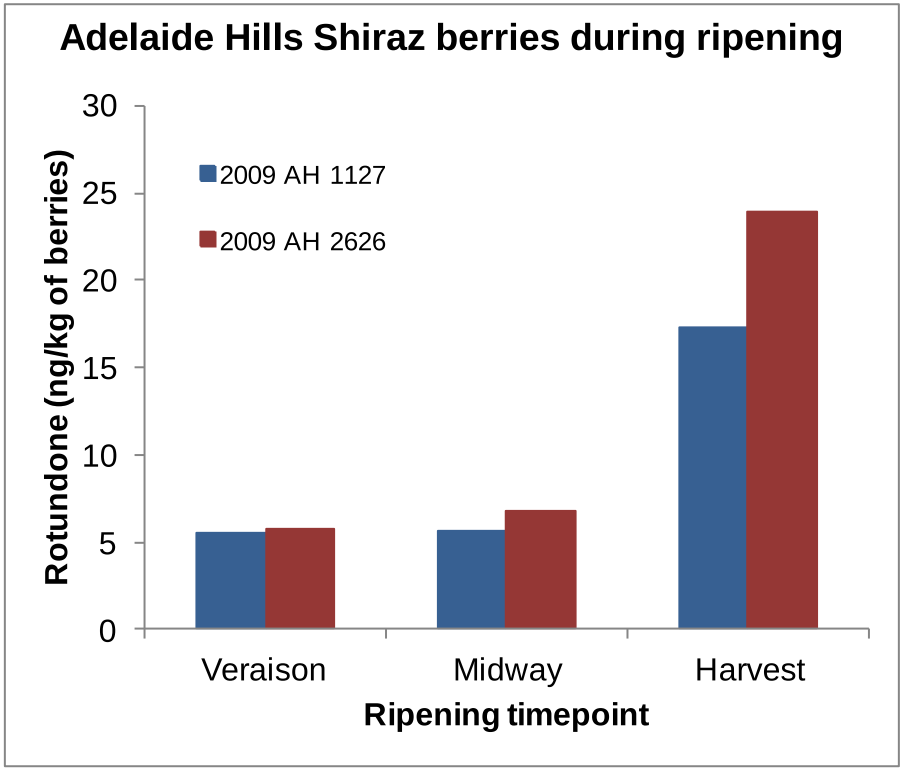

Rotundone increases during late stage ripening

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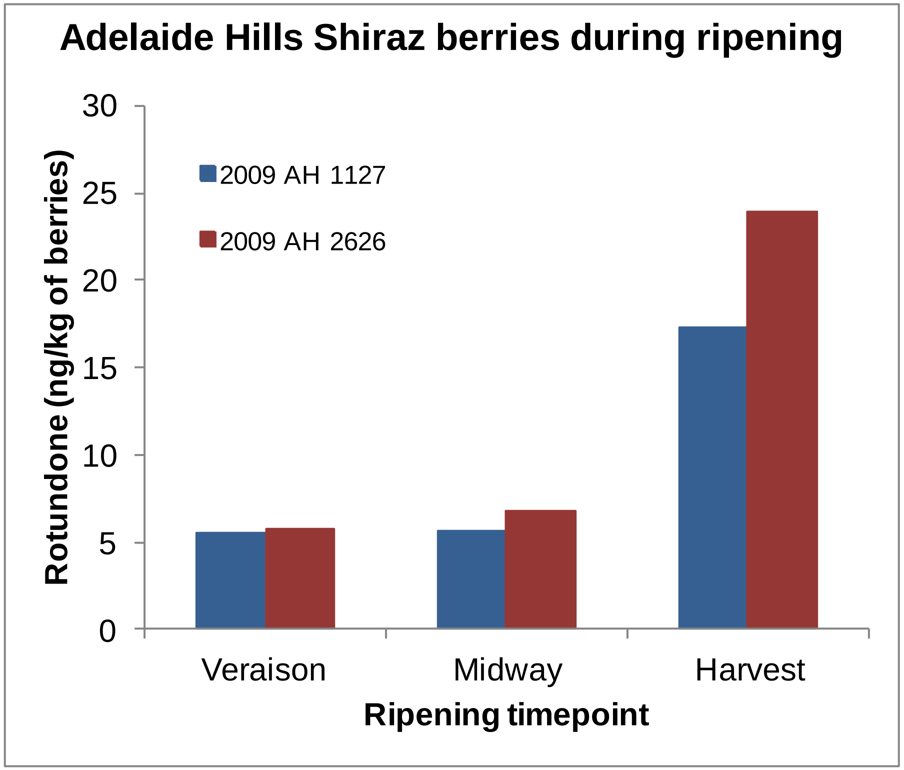

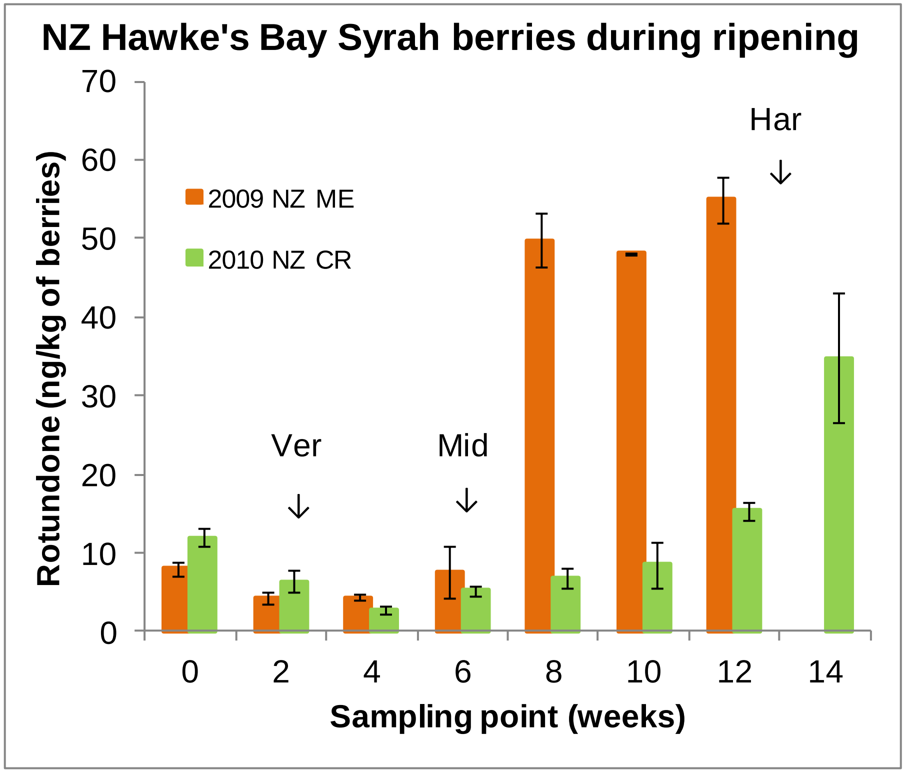

Clone and crop load

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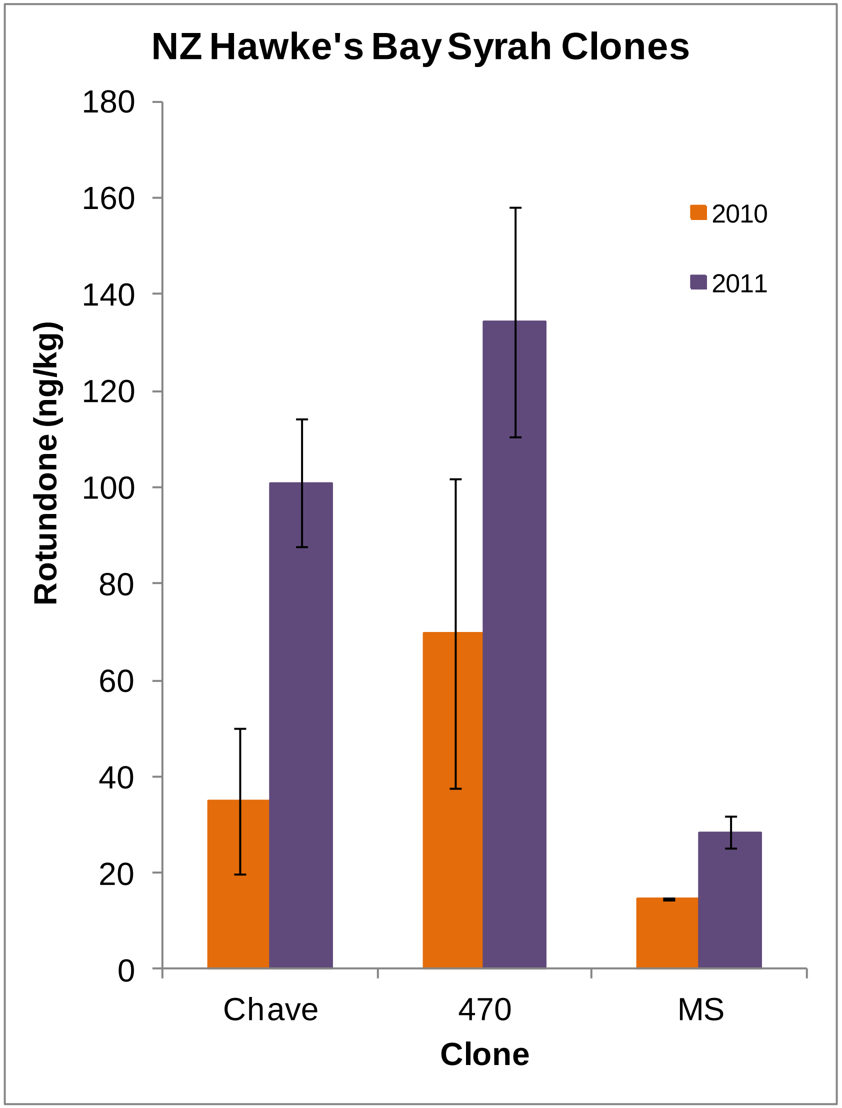

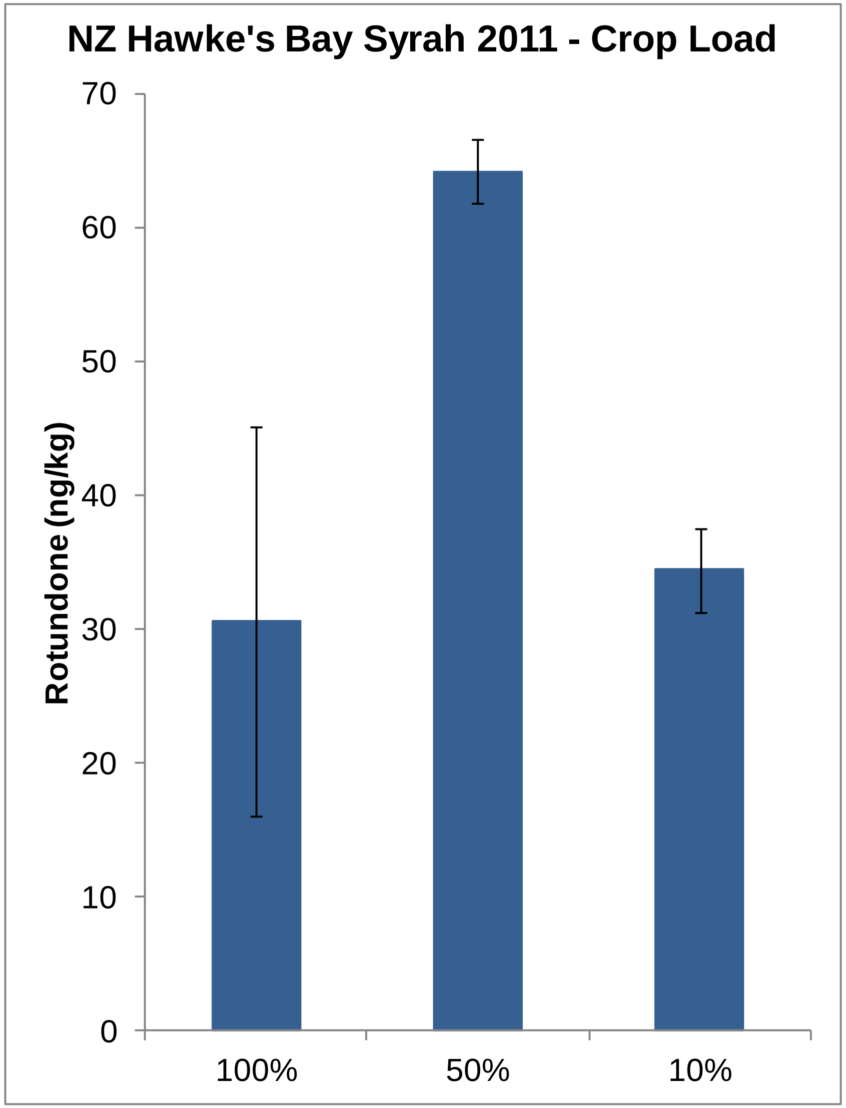

Leaf removal

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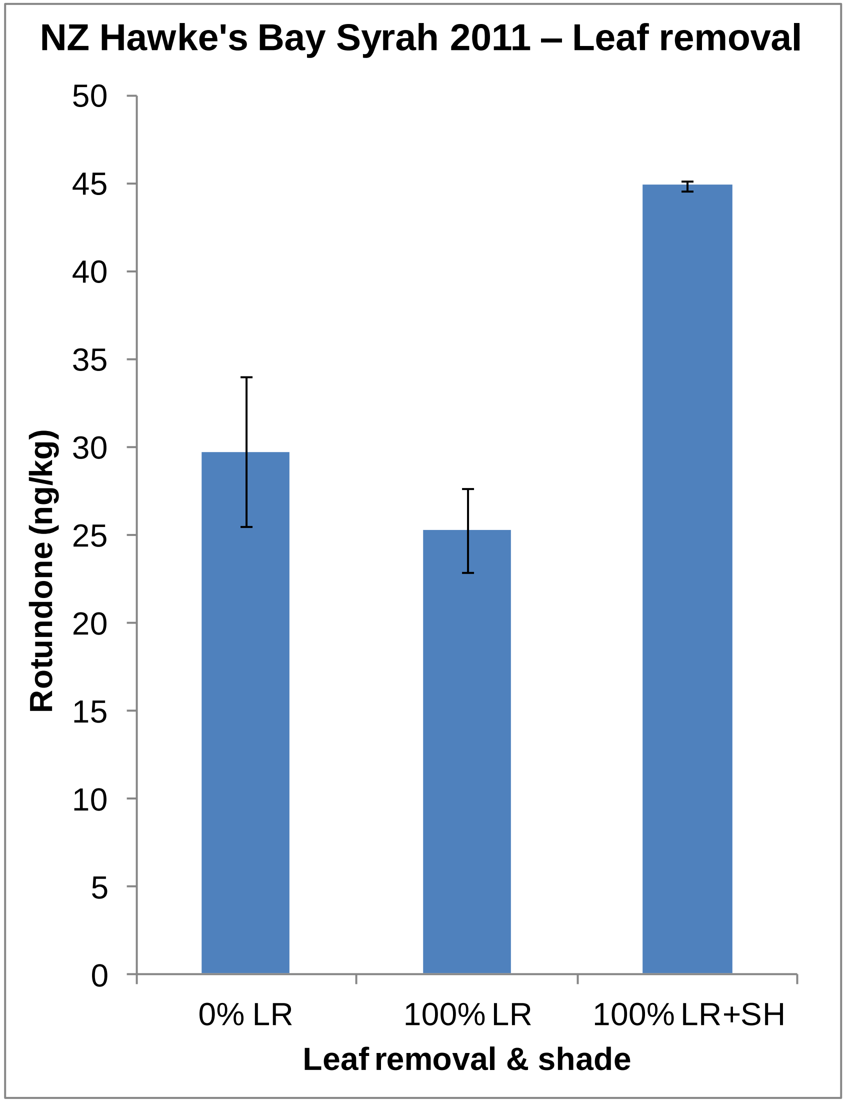

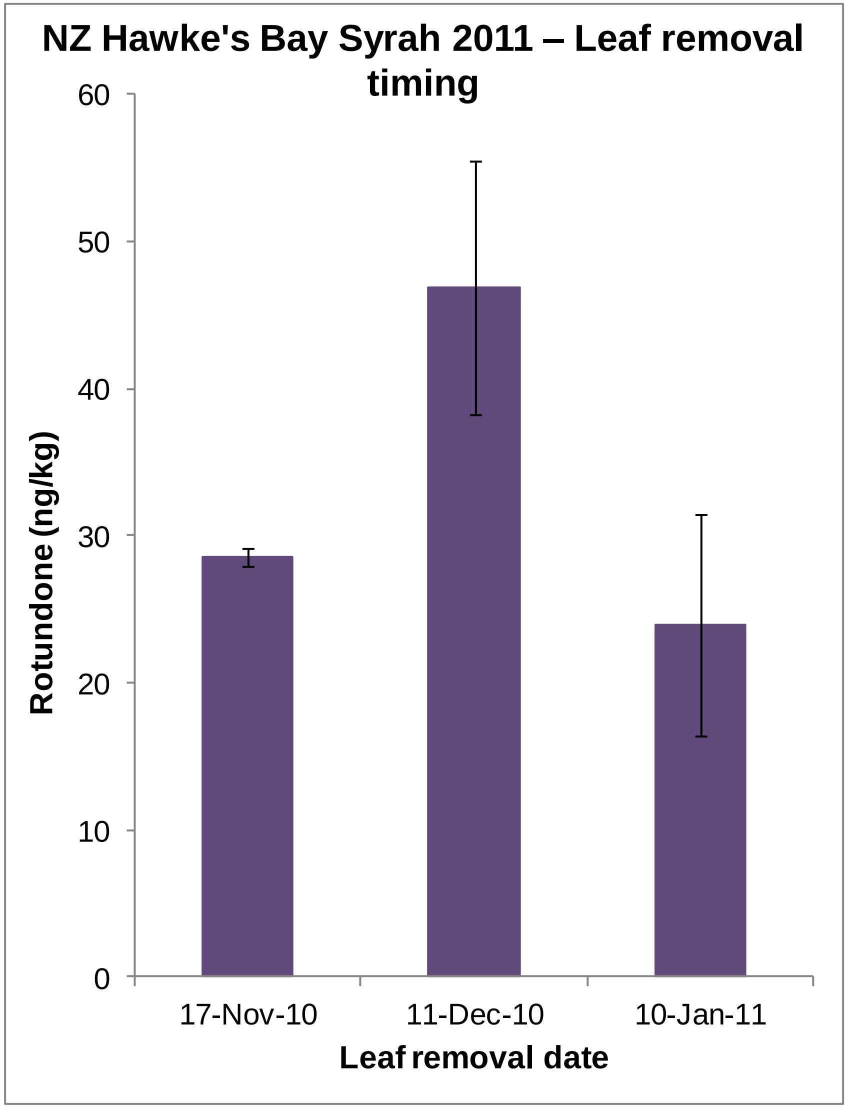


Trunk Circumference: 163mm
LLN: 2.73
Gaps: 1.5%


Trunk Circumference: 129mm
LLN: 0.795
Gaps: 29%

Vigour

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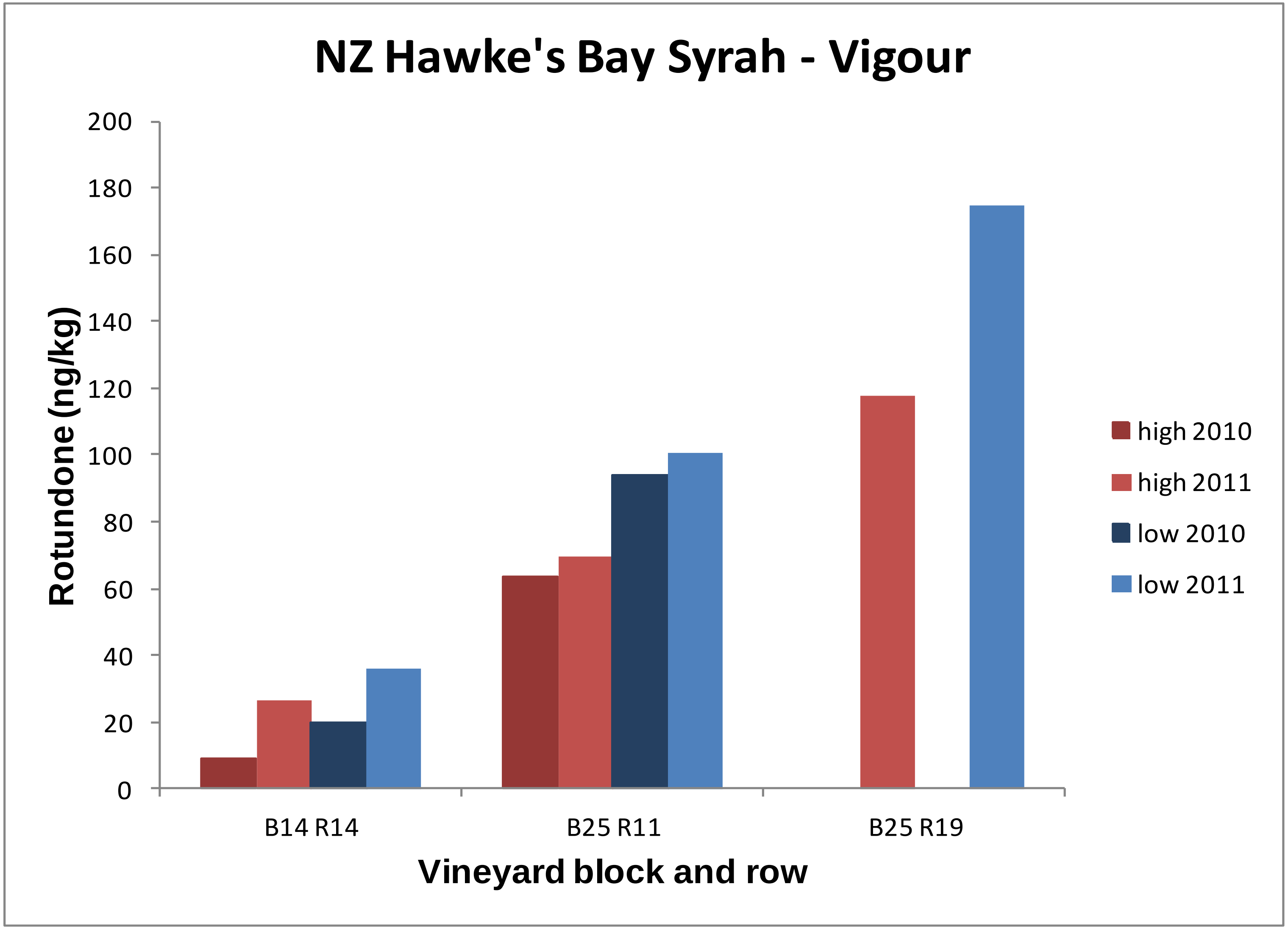

Rotundone extraction during winemaking

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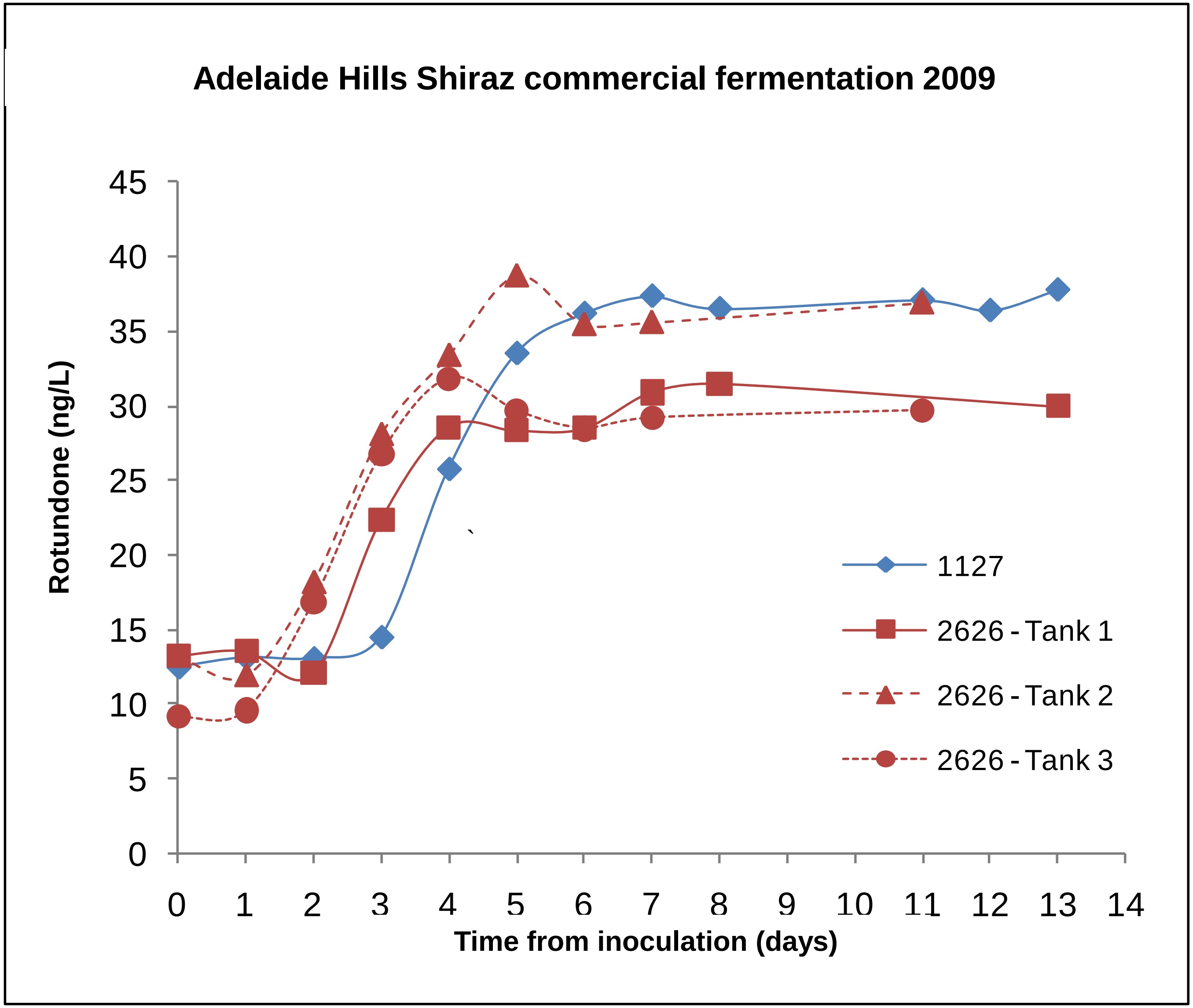

Rotundone extraction from berries during winemaking

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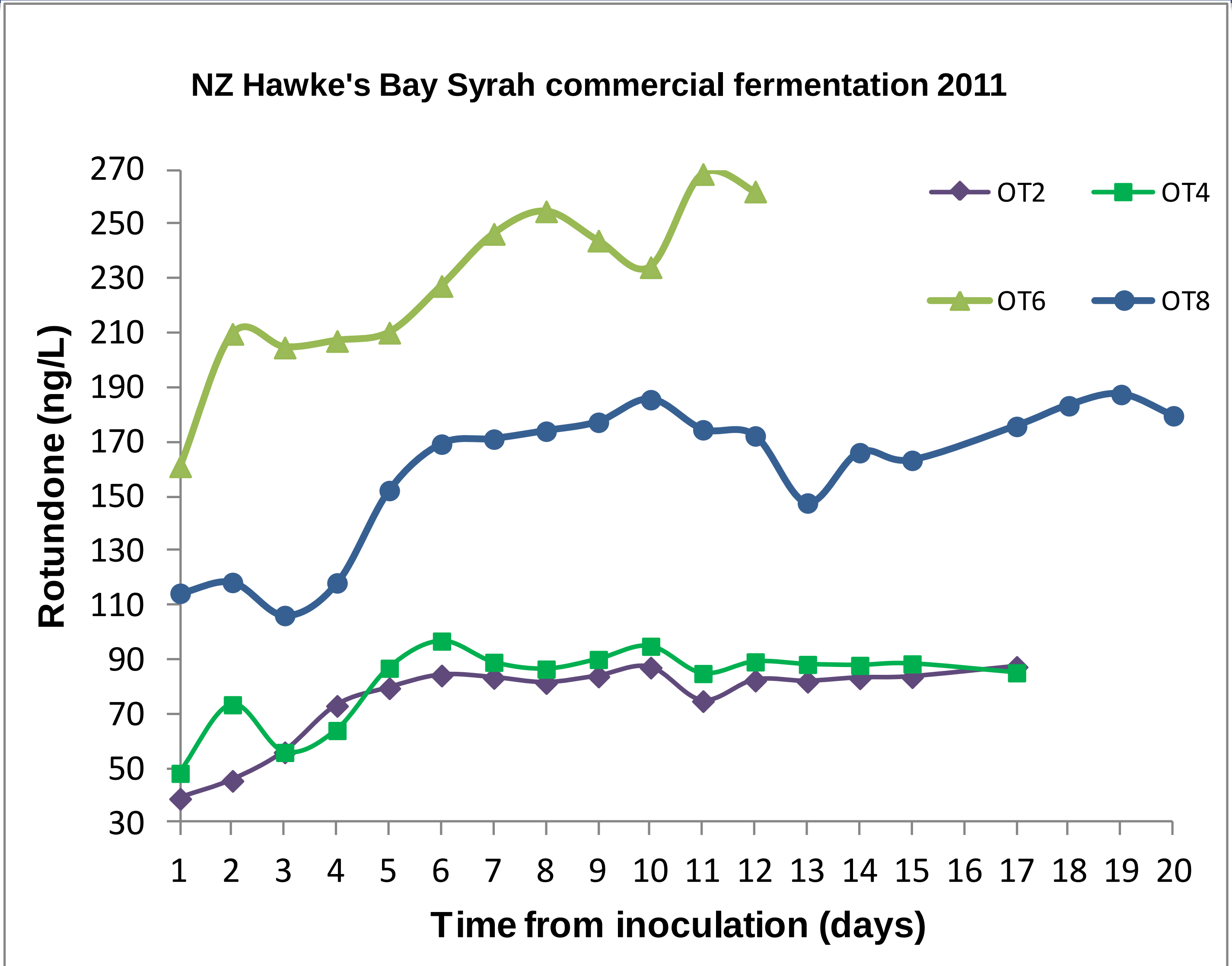

Can yeast affect rotundone levels during fermentation?

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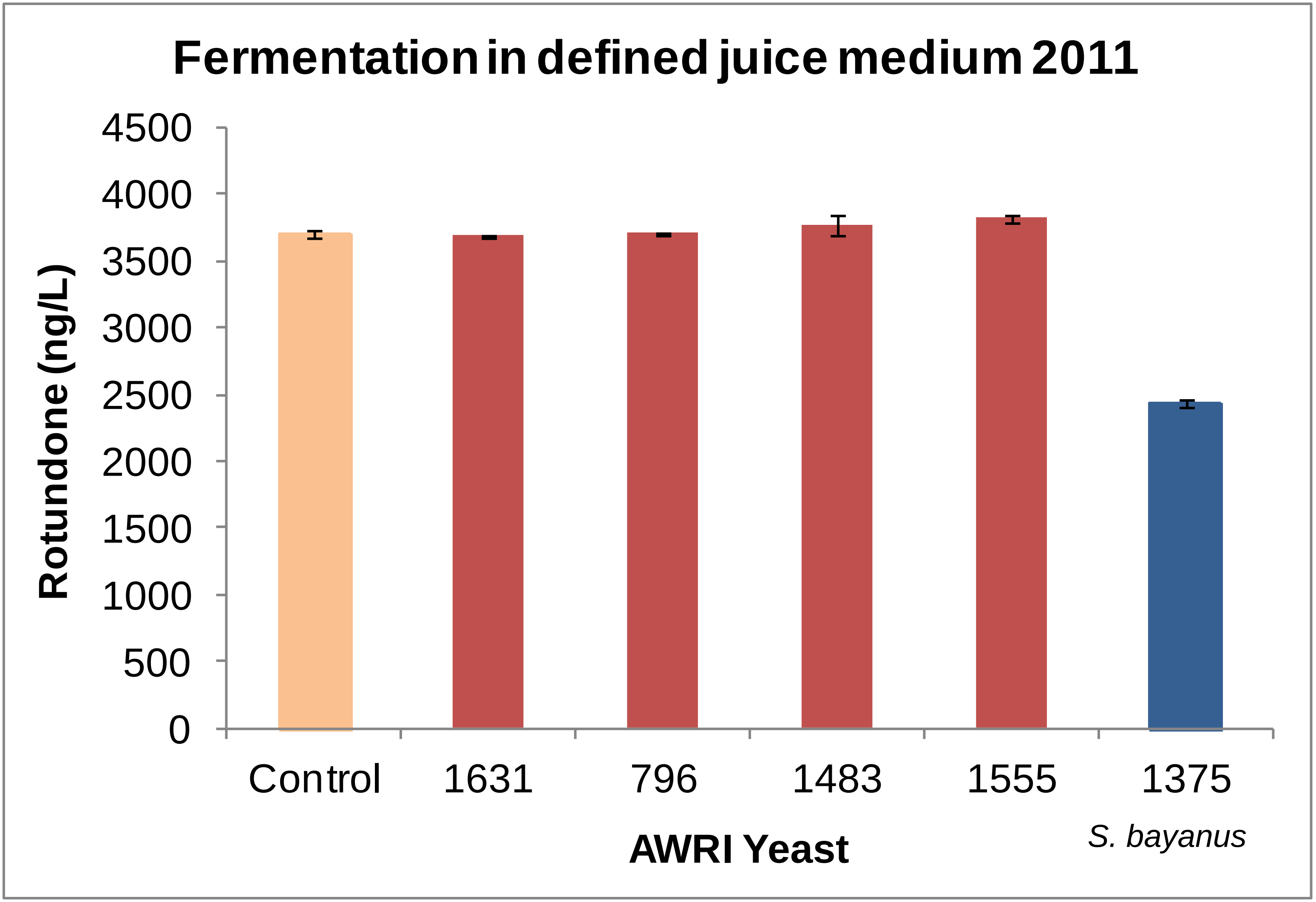


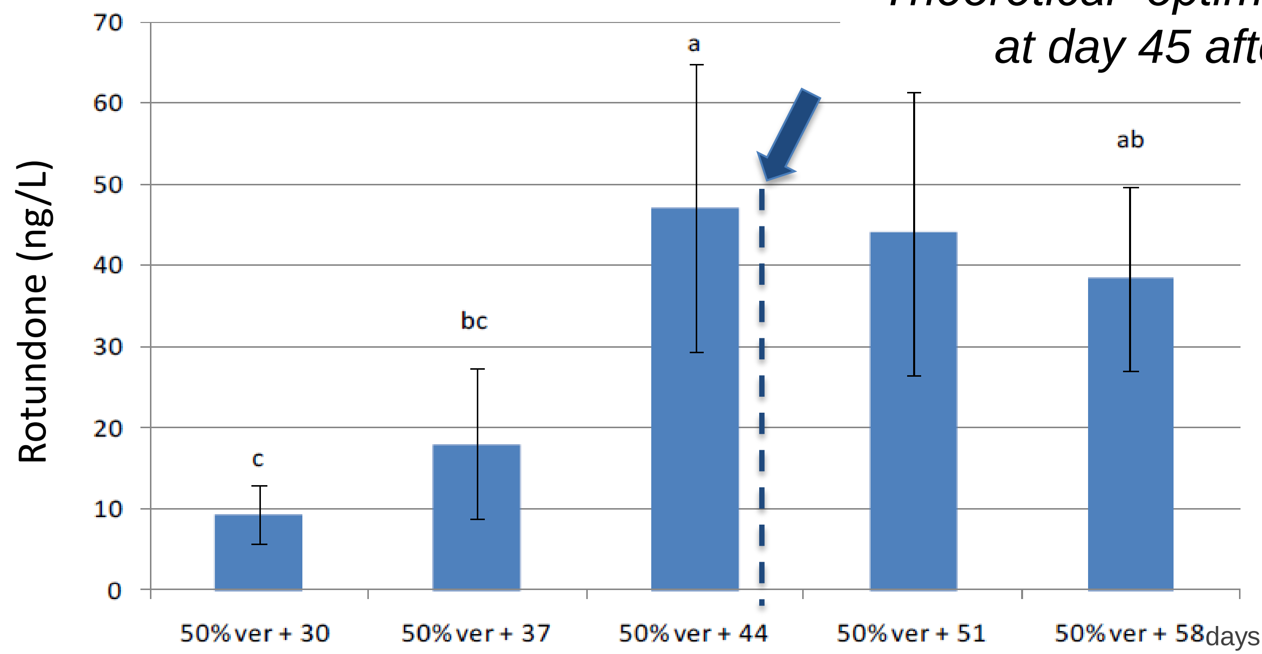
Rotundone in French Pyrenees wines

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



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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

Variability across the vineyard

Nathan Scarlett, RWG; Rob Bramley, CSIRO

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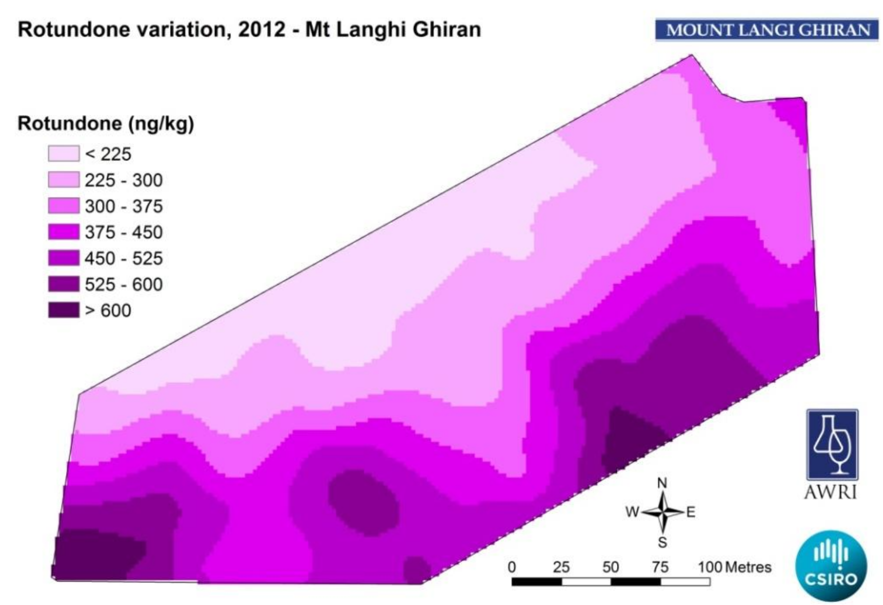
2012 Rotundone concentration in grapes

- 177 vines sampled
- 74 – 1081 ng/kg

2014: 6-15 ng/kg



Scarlett, N.J., Bramley, R.G.V., Siebert, T.E. 2014. Within-vineyard variation in the 'pepper' compound rotundone is spatially structured and related to variation in the land underlying the vineyard. *Australian Journal of Grape and Wine Research.*

Mean January temperature is associated with rotundone concentration in wines

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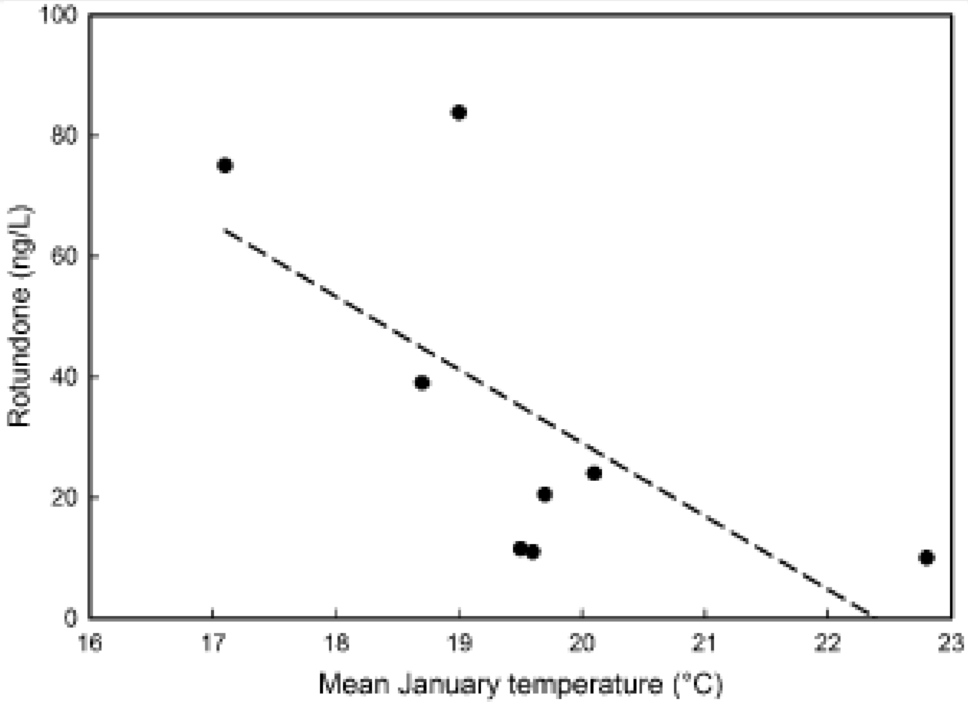

Relationship between mean January temperature and the mean rotundone concentration in Shiraz wine samples from eight selected Australian wine regions. Plotted from the data of Jeffery et al. (2009) and the Australian Bureau of Meteorology. The equation to the dotted line is $y = 272–12.1x$ ($R^2 = 0.44$, $P = 0.075$).

Within-vineyard variation in the 'pepper' compound rotundone is spatially structured and related to variation in the land underlying the vineyard Australian Journal of Grape and Wine Research
Scarlett, Bramley and Siebert
Volume 20, Issue 2, pages 214-222, 16 APR 2014 DOI: 10.1111/ajgw.12075
http://onlinelibrary.wiley.com/doi/10.1111/ajgw.12075/full#ajgw12075-fig-0005

Conclusions

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- Viticultural parameters affected rotundone levels: Picking date, clone, vigour, leaf removal & crop load
- Rotundone is a very stable compound, easily extracted from skins
- Why does rotundone occur in Shiraz more often than other varieties?
- Is temperature during berry development a major influence?

Acknowledgements

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- Symrise, Germany

AWRI

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

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

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