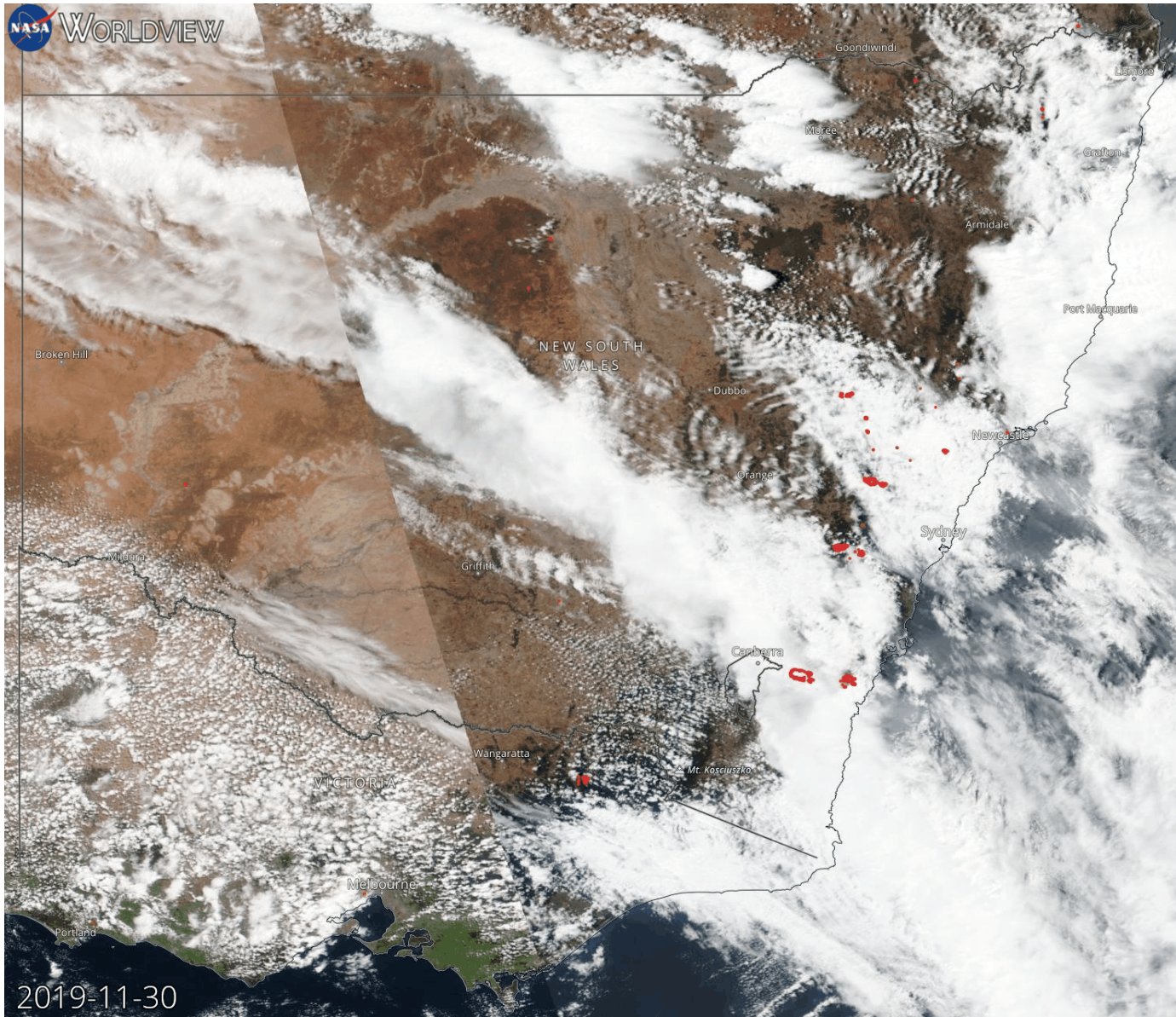
The Australian Wine Research Institute

Fortifying the future of NSW Wine

What the numbers mean, a regional snapshot of smoke taint data

Con Simos



Data interpretation

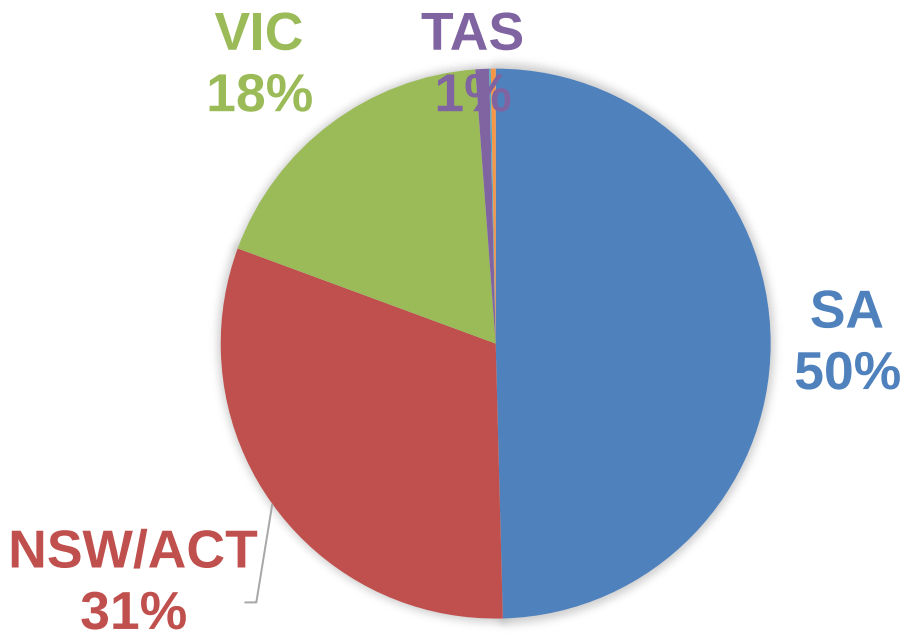
- The anonimised data is limited to samples analysed by AWRI Commercial Services and smoke taint interpretation reports issued by the AWRI Helpdesk.

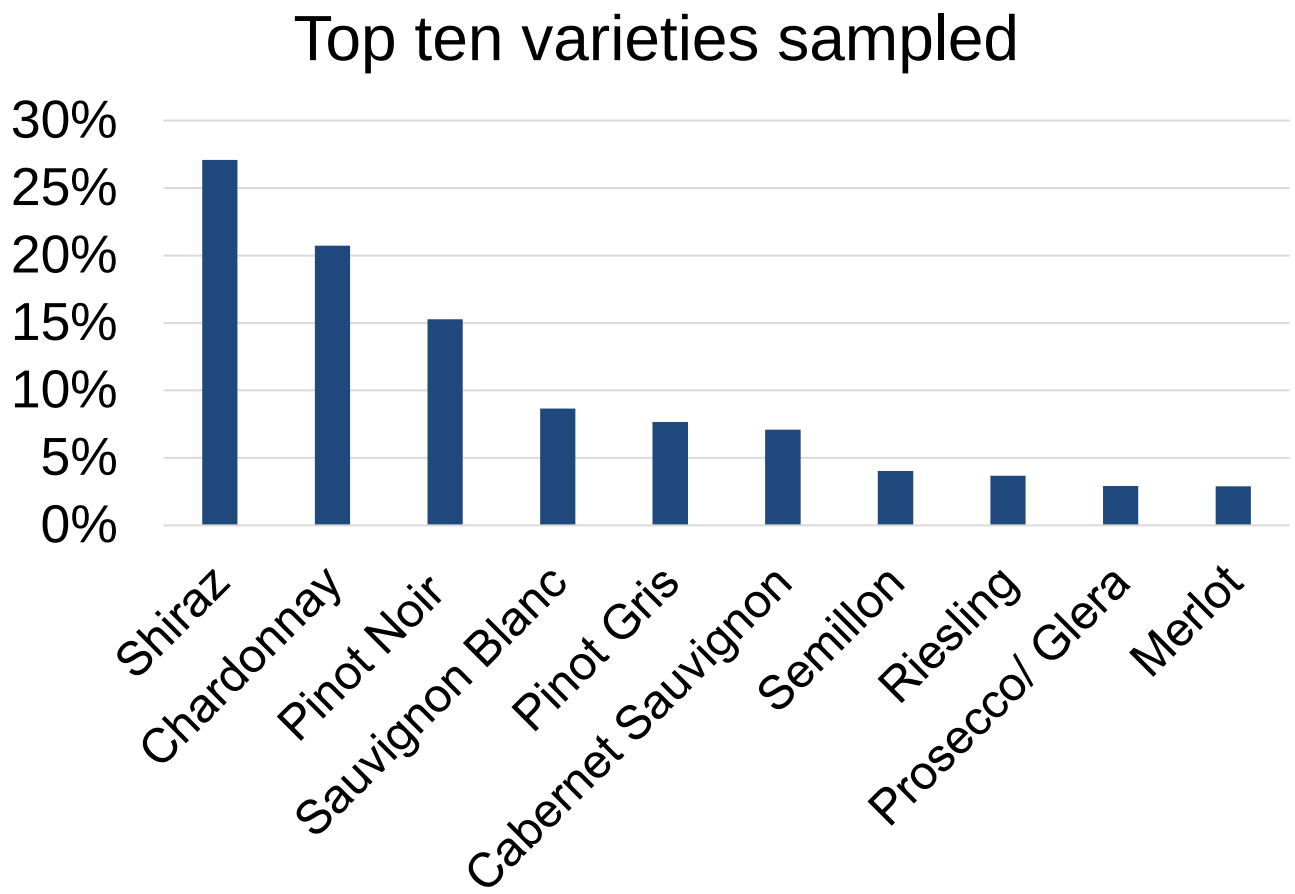
- Cross validation study was undertaken by AWRI Commercial Services and Vintessentials
  - Copy of report available for download
    - Smoke-analysis-cross-validation-report-FINAL-30-Nov-2020.pdf (awri.com.au)

- The AWRI technique analyses for
  - 7 volatile phenols
  - 6 bound glycosides

- For simplicity, results expressed as sum of ‘total glycosides’ for grape samples only.

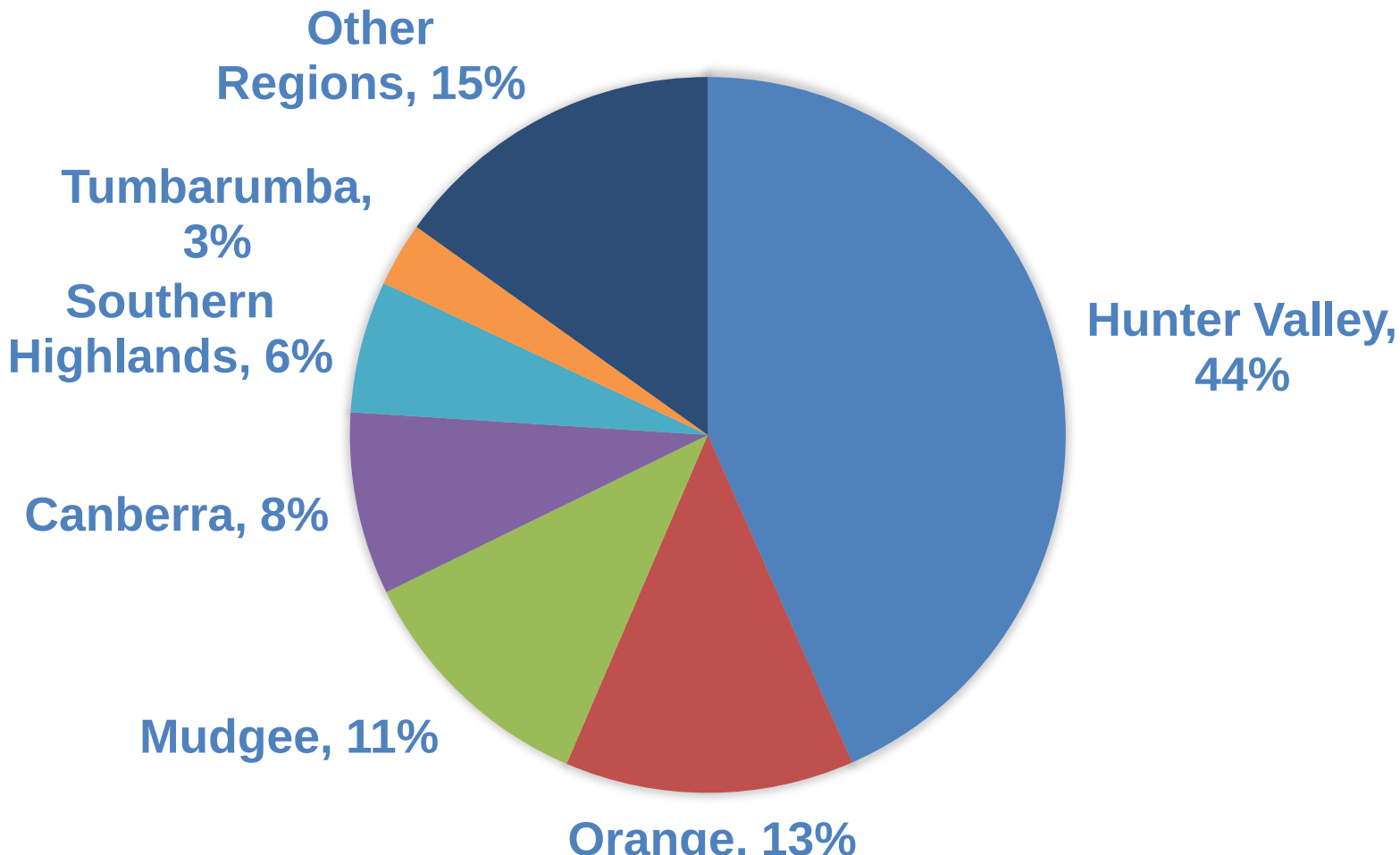
AWRI Helpdesk Smoke taint interpretations 2019 - 2020



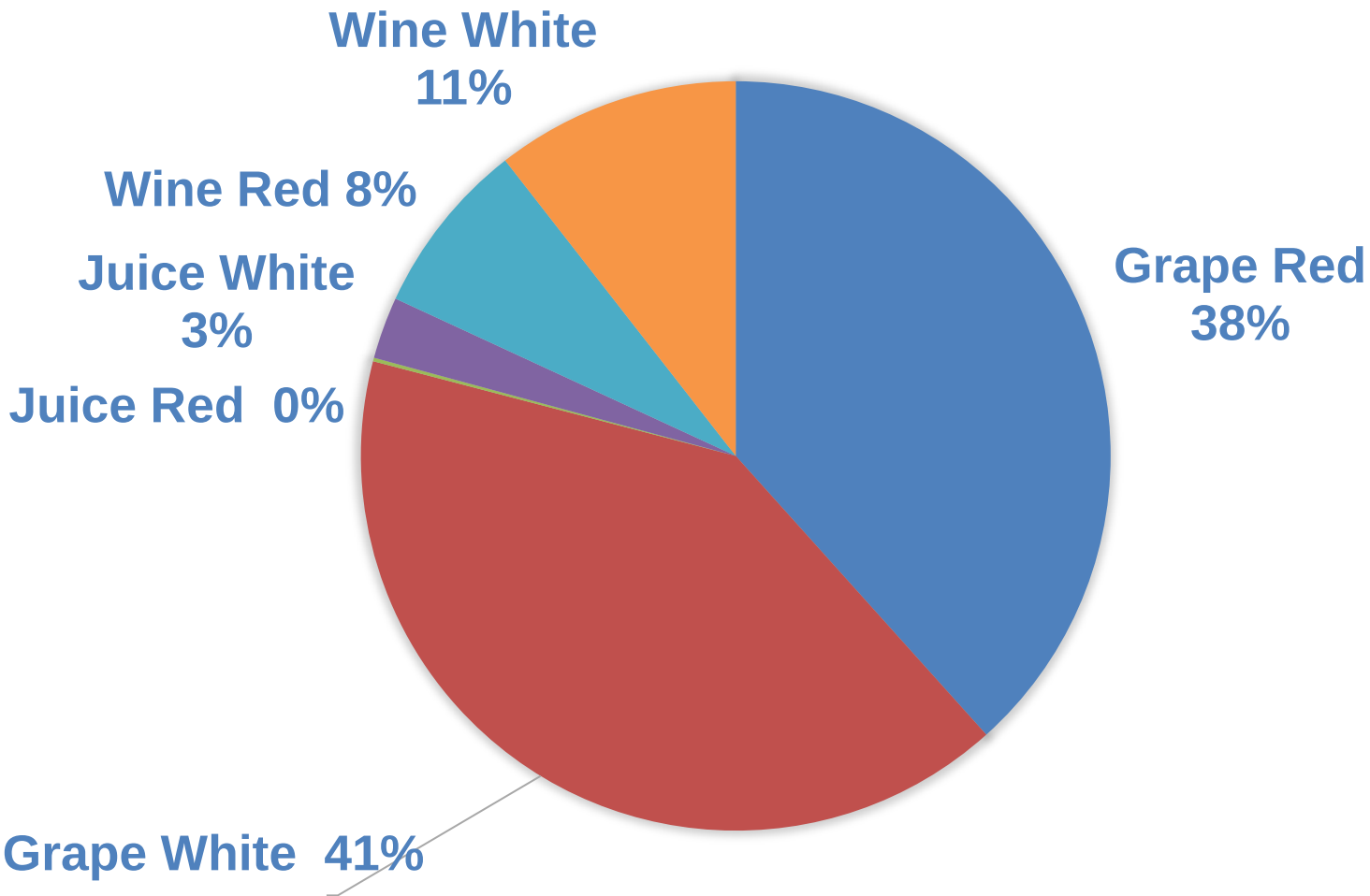


- From NSW
  - 1,305 samples
  - 221 producers
  - 45 varieties, 25 Red and 20 White

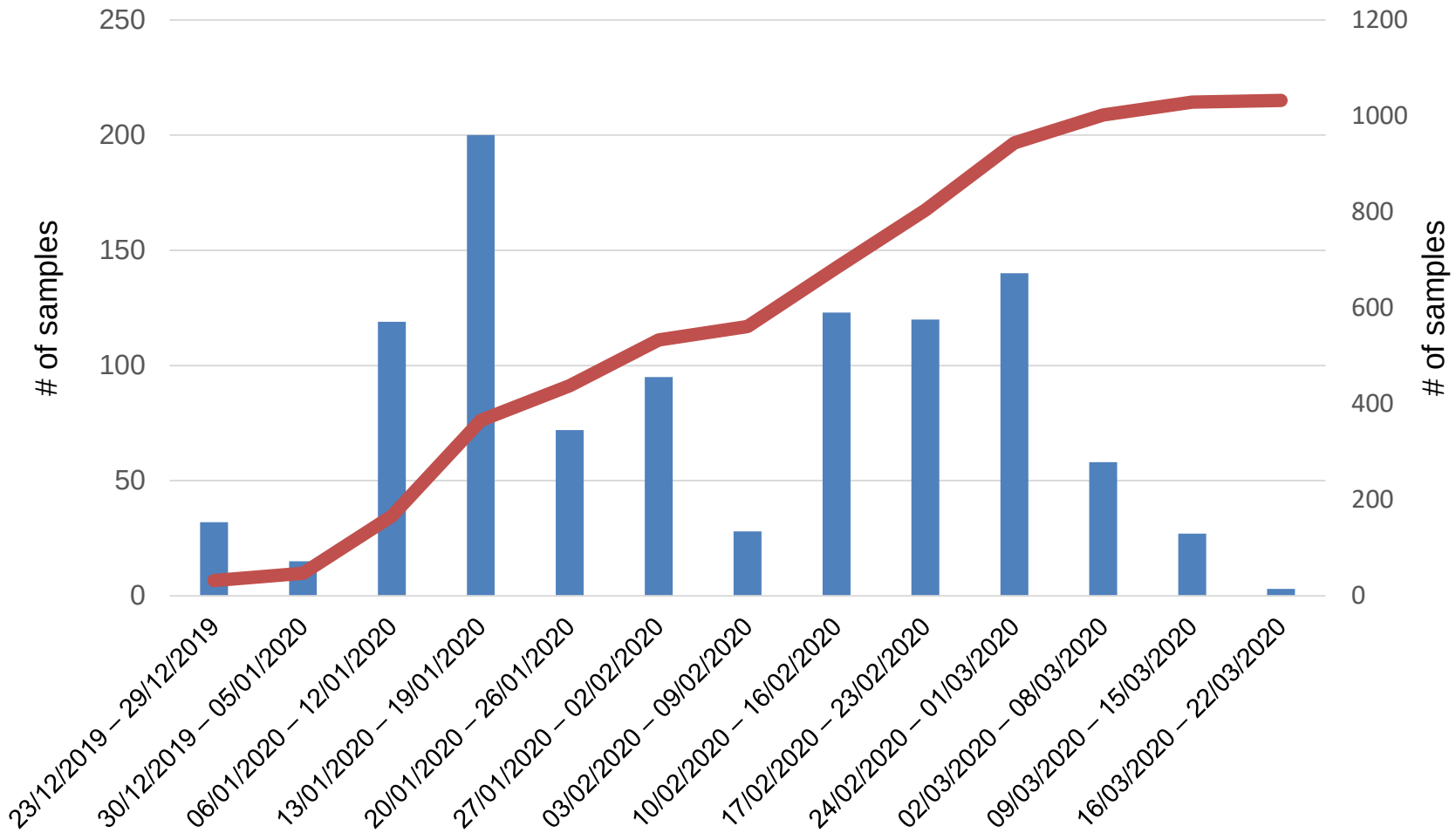
Samples analysed by origin - NSW



Breakdown by sample type - NSW



Sampling period



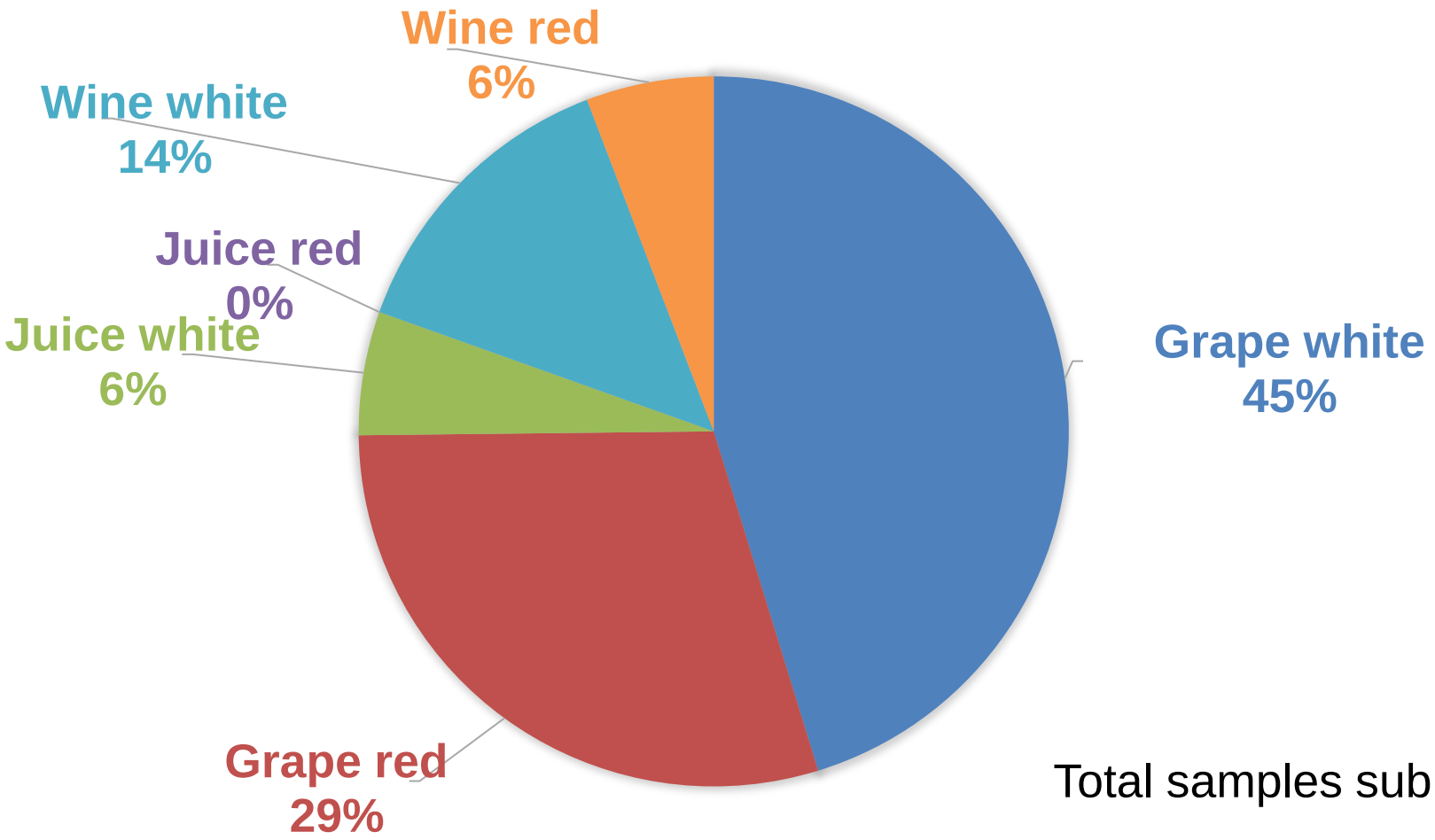
- 1,305 samples from NSW Dec 2019 – June 2020
- Grape samples were submitted from 23 Dec 2019 – 22 March 2020
- Actual sampling date would have been 7 – 10 days earlier

Range of total glycosides linked to assessed level of smoke risk

Smoke taint risk category (draft industry)	Total glycosides concentration (µg/kg)[1]	Grape samples in total: NSW dataset n=1,032	Grape samples in total: Adelaide Hills dataset n=642	Grape samples in total: All Helpdesk and all locations 2015 – 2019 dataset n=199
A	<30	5%	41%	56%
B	30 ≤ 80	20%	38%	33%
C	80 ≤ 150	19%	14%	4%
D	150 ≤ 300	22%	6%	3%
E	≥ 300	34%	1%	4%

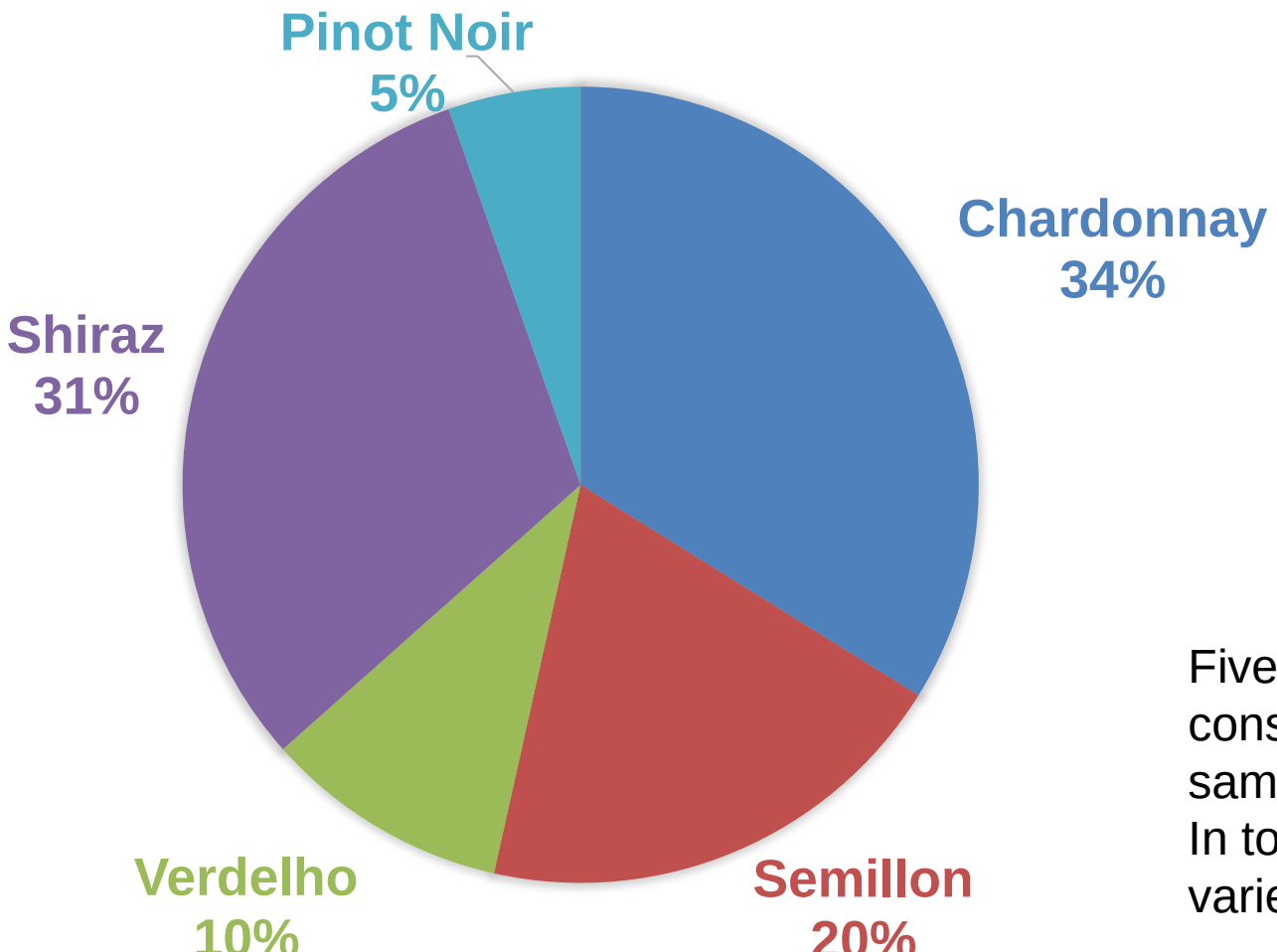
‘Total glycosides’ concentration is the sum of the six individual phenolic glycoside results for a sample.

Breakdown by sample type – Hunter Valley



Total samples submitted: 538

Samples analysed by variety – Hunter Valley



Five varieties listed constitute 88% of all samples submitted
In total, samples from 25 varieties were submitted

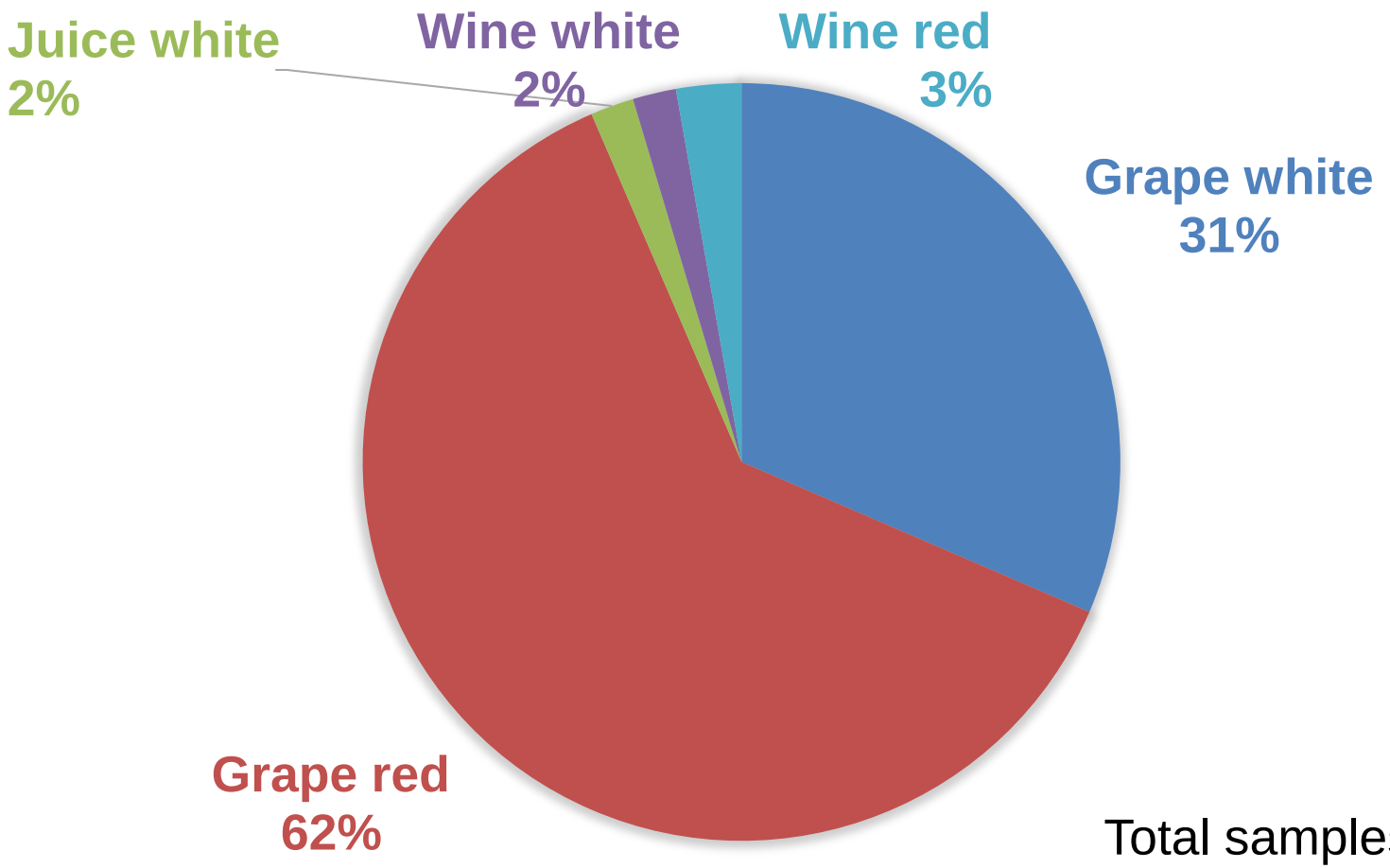
Total Glycosides[1] found in the most common varieties – Hunter Valley

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Chardonnay	3.5	2677	232	8.9	99%
Hunter Valley	Chardonnay	7	819	150	8.9	98%
NSW	Semillon	15	521	346	10	100%
Hunter Valley	Semillon	15	521	109	10	100%
NSW	Shiraz	16.5	1835	297	37.4	96%
Hunter Valley	Shiraz	16.5	1395	191	37.4	96%

1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.

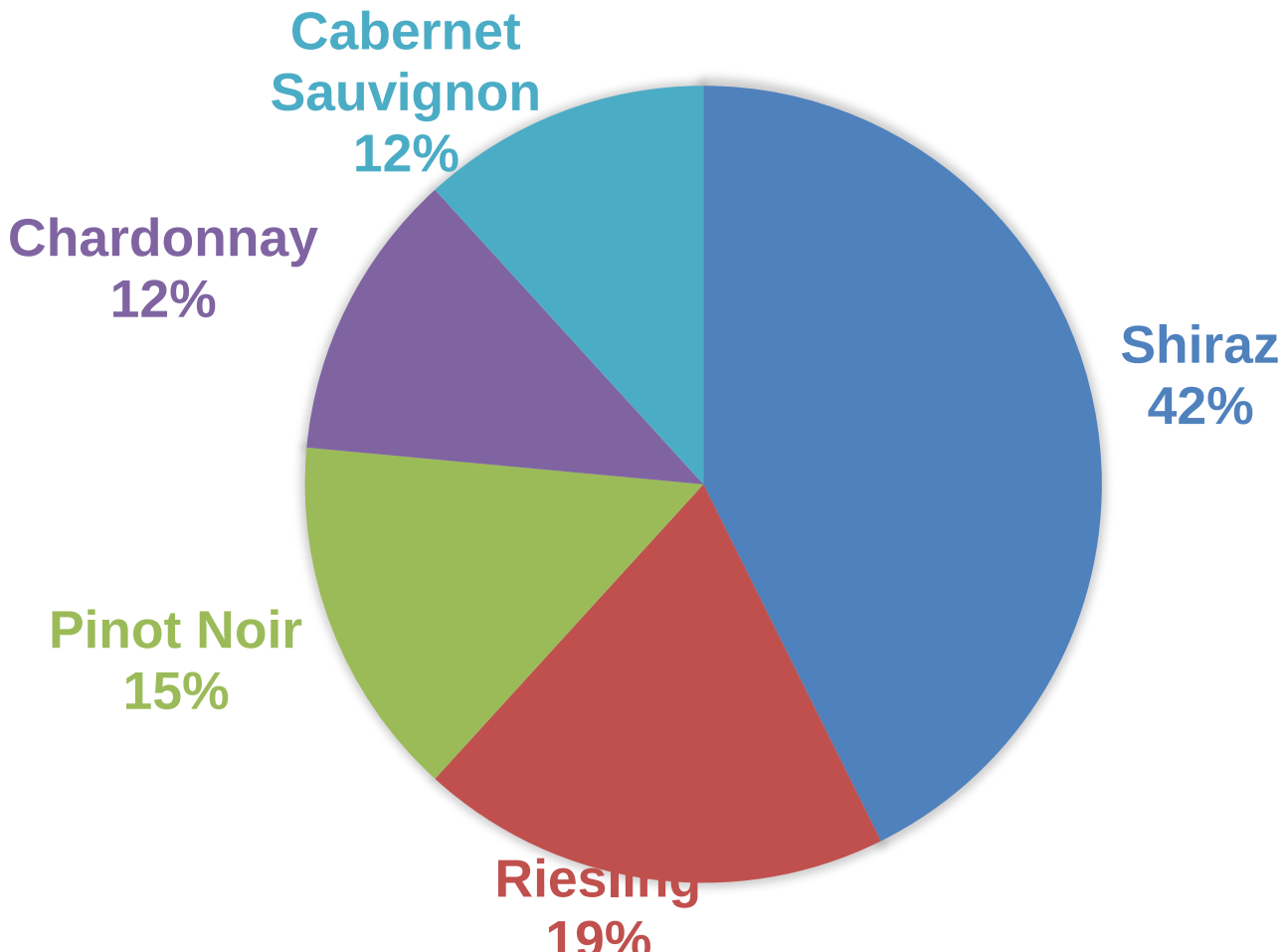
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Breakdown by sample type – Canberra



Total samples submitted: 108

Samples analysed by variety – Canberra



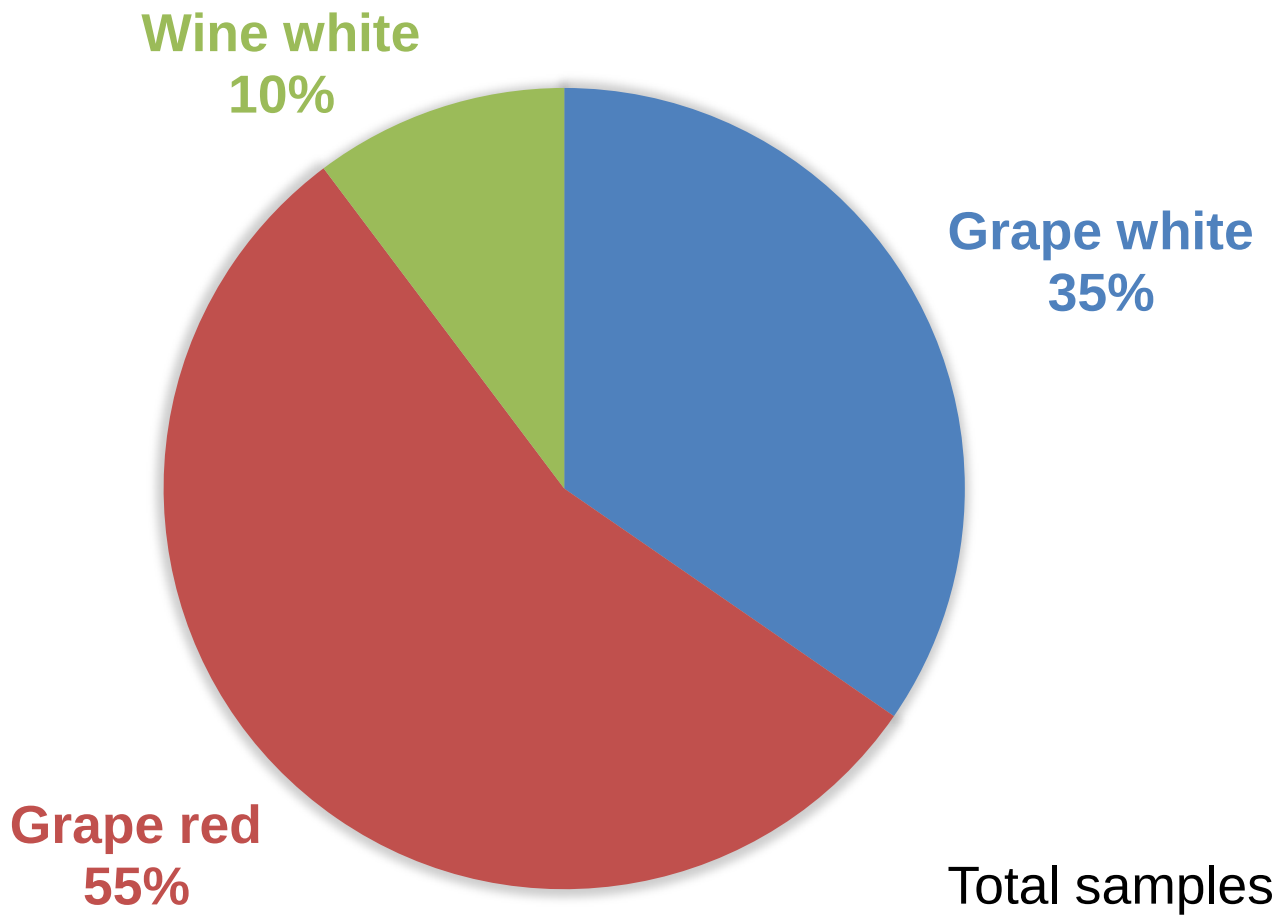
Five varieties listed constitute 68% of all samples submitted
In total, samples from 20 varieties were submitted

Total Glycosides[1] found in the most common varieties – Canberra

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Shiraz	16.5	1835	297	37.4	96%
Canberra	Shiraz	112	1193	693	37.4	100%
NSW	Riesling	61	1593	372	11.7	100%
Canberra	Riesling	584	1344	822	11.7	100%

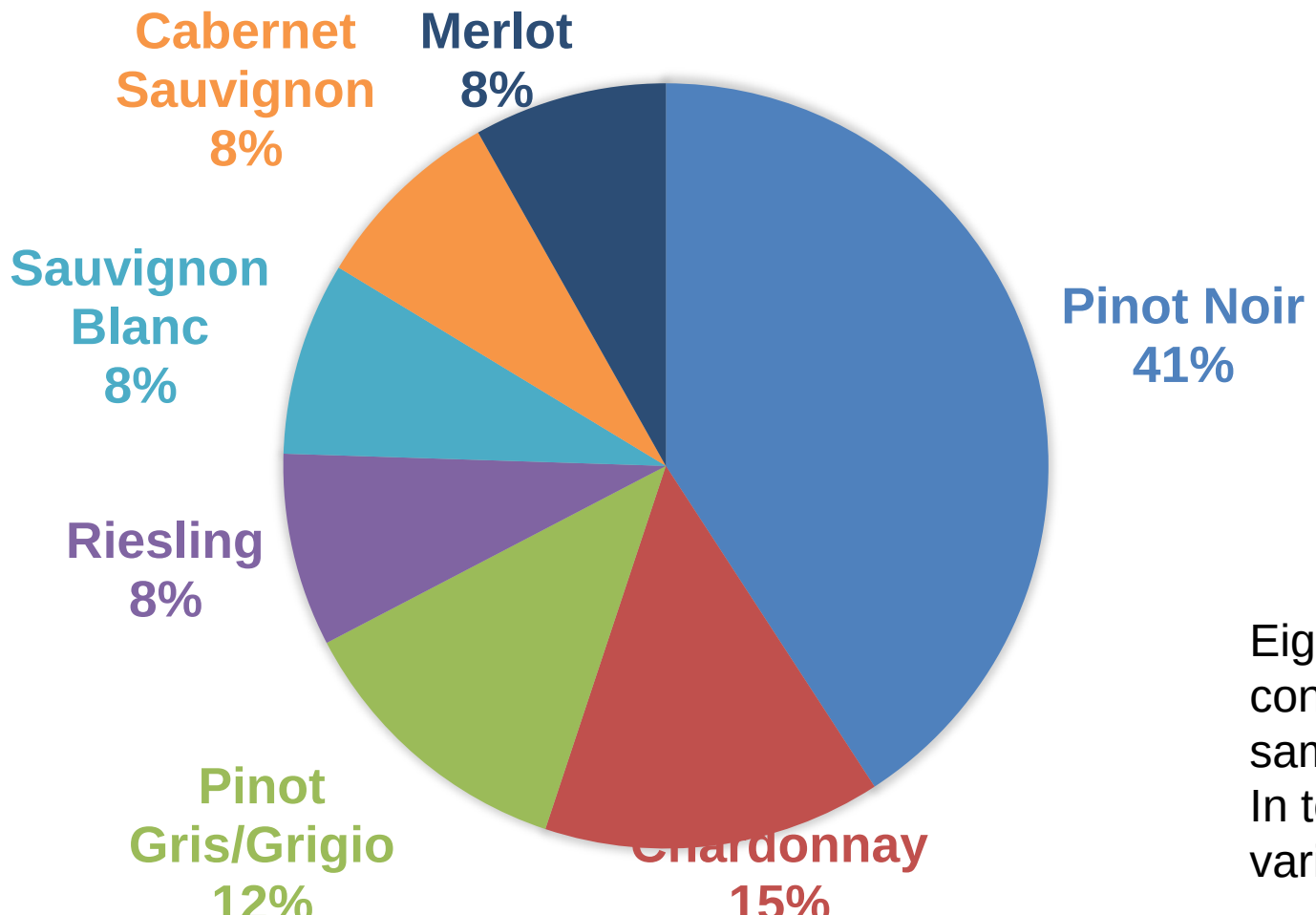
1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Breakdown by sample type – Southern Highlands



Total samples submitted: 78

Samples analysed by variety – Southern Highlands



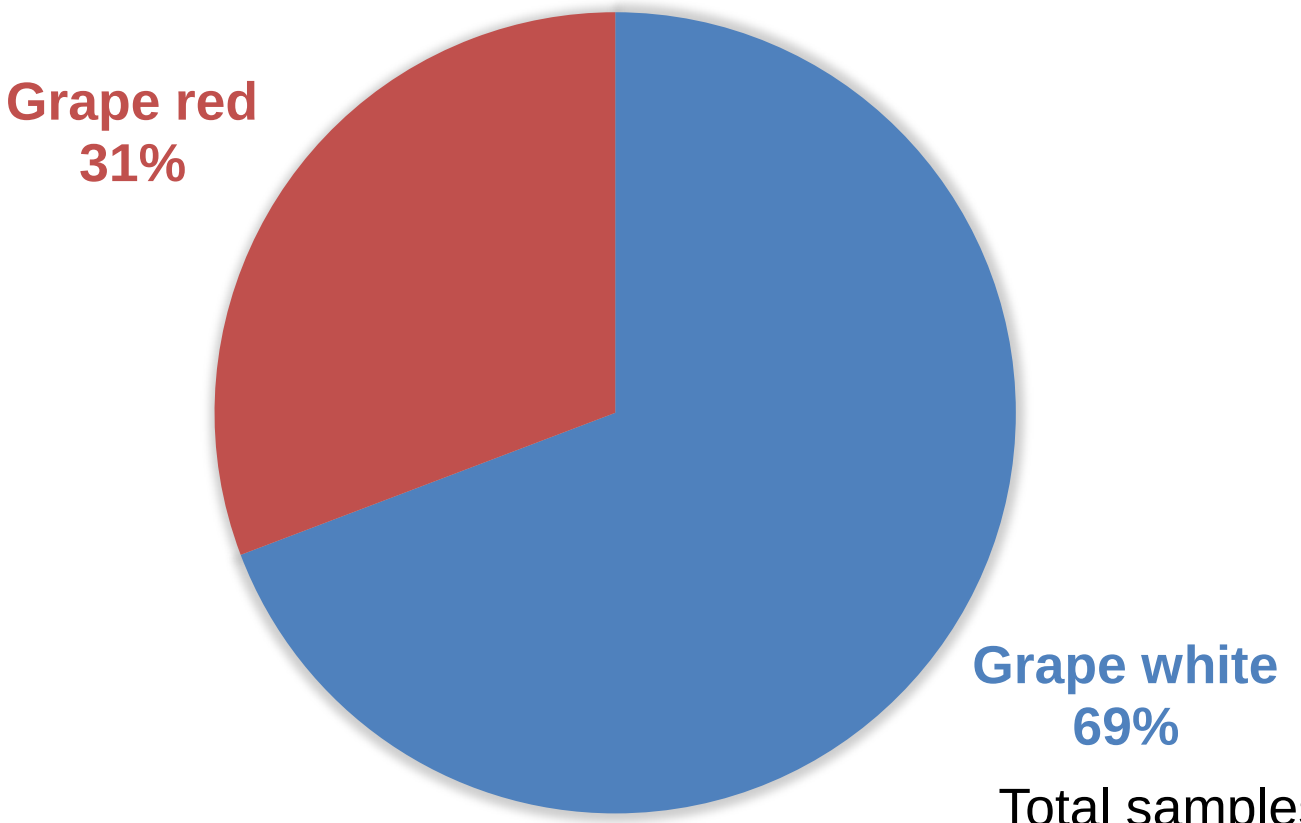
Eight varieties listed constitute 75% of all samples submitted
In total, samples from 23 varieties were submitted

Total Glycosides[1] found in the most common varieties – Southern Highlands

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Pinot Noir	12.5	1508	304	14.9	99%
Southern Highlands	Pinot Noir	112	1193	693	14.9	100%
NSW	Chardonnay	3.5	2677	232	8.9	99%
Southern Highlands	Chardonnay	322	1391	521	8.9	100%

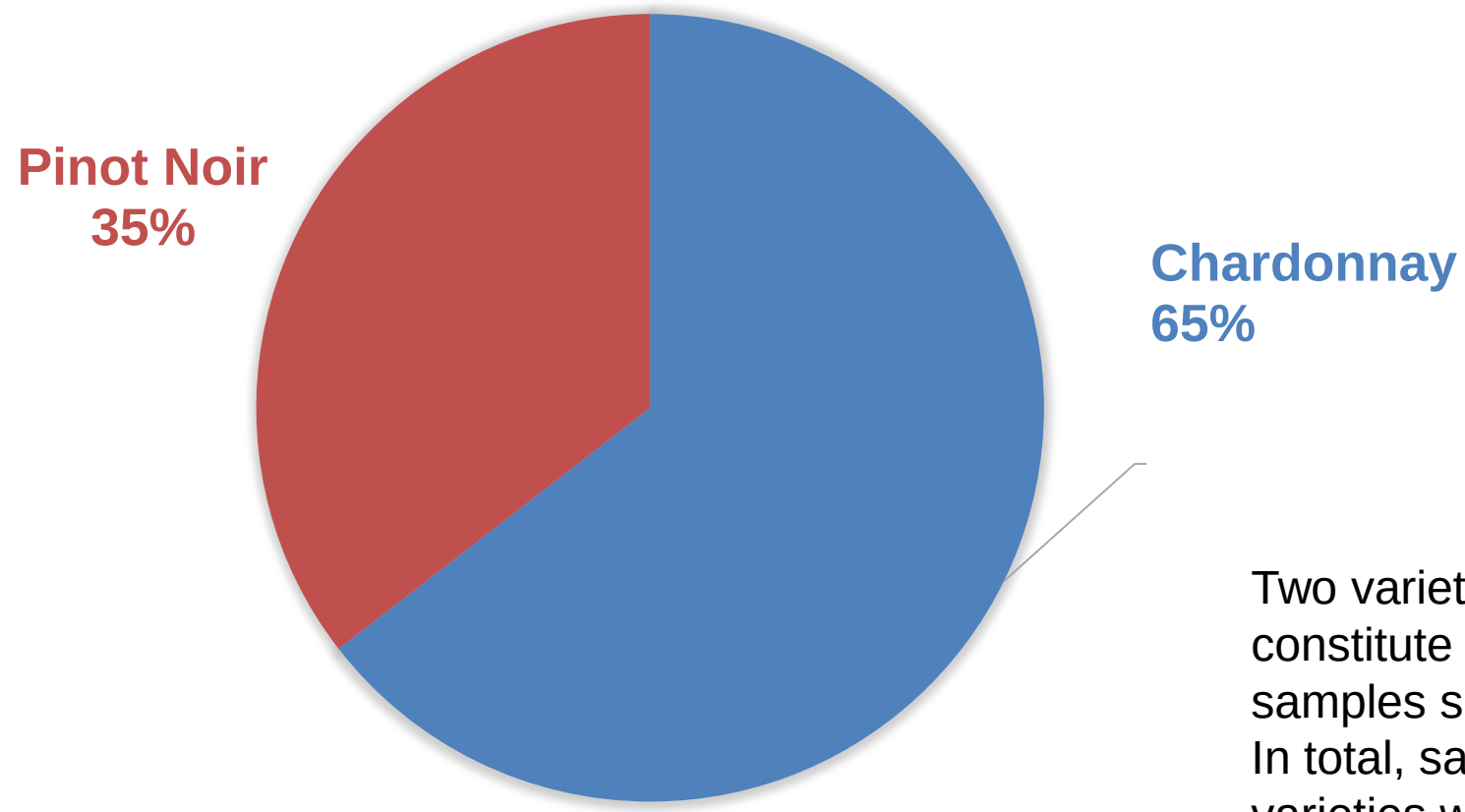
1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Breakdown by sample type – Tumbarumba



Total samples submitted: 39

Samples analysed by variety – Tumbarumba



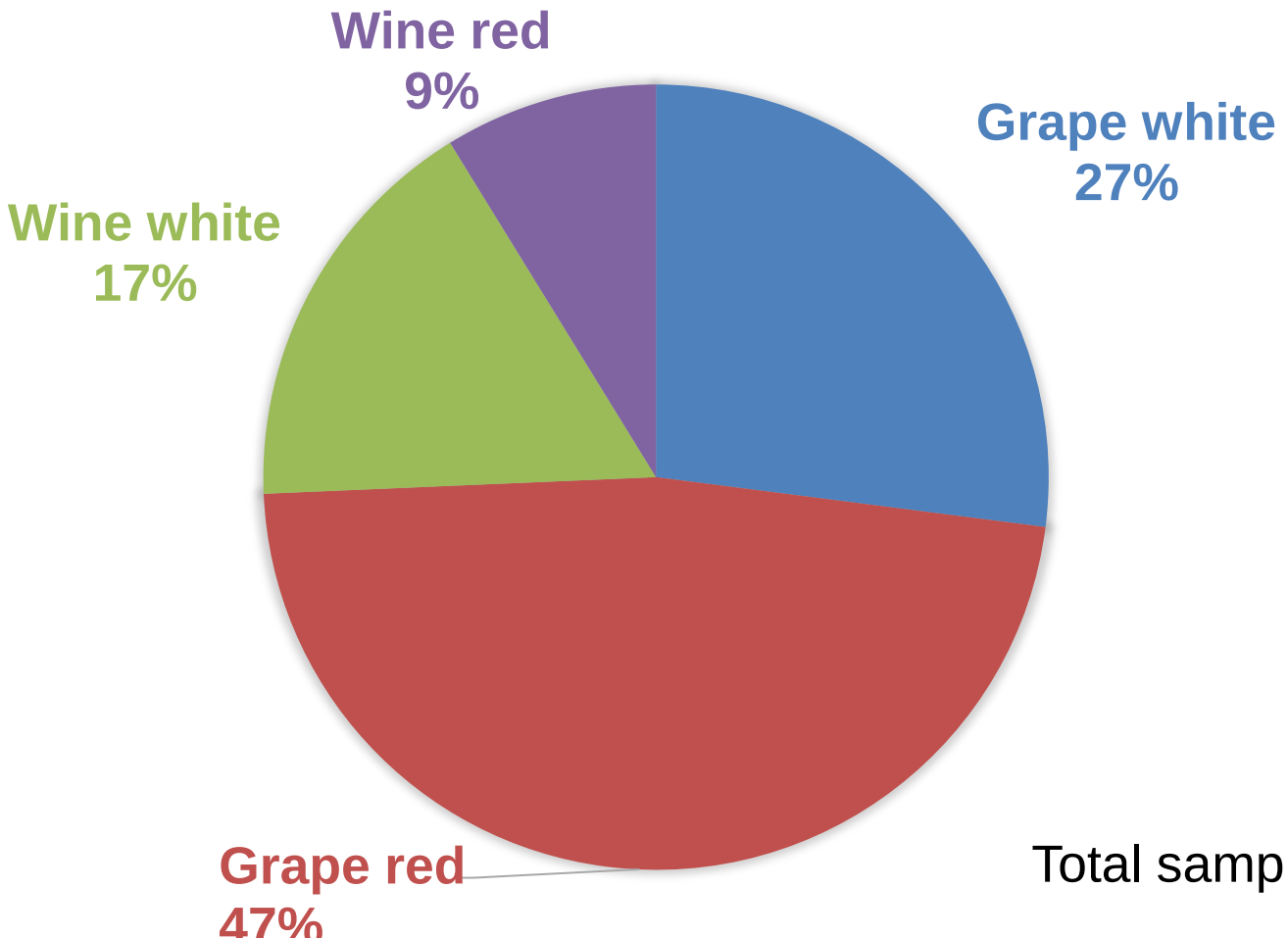
Two varieties listed constitute 80% of all samples submitted
In total, samples from 7 varieties were submitted

Total Glycosides[1] found in the most common varieties – Tumbarumba

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Pinot Noir	12.5	1508	304	14.9	99%
Tumbarumba	Pinot Noir	585	1376	944	14.9	100%
NSW	Chardonnay	3.5	2677	232	8.9	95%
Tumbarumba	Chardonnay	906	2677	1473	8.9	100%

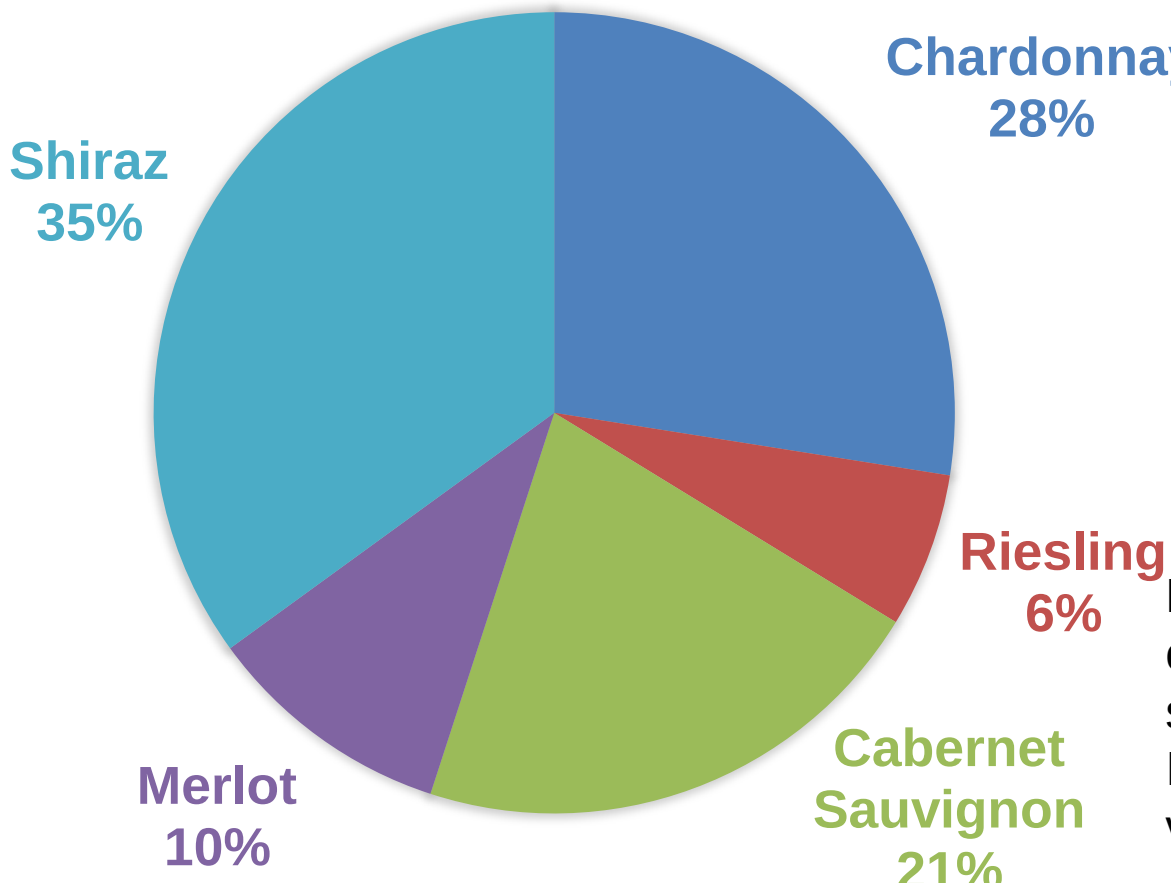
1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Breakdown by sample type – Mudgee



Total samples submitted: 148

Samples analysed by variety – Mudgee



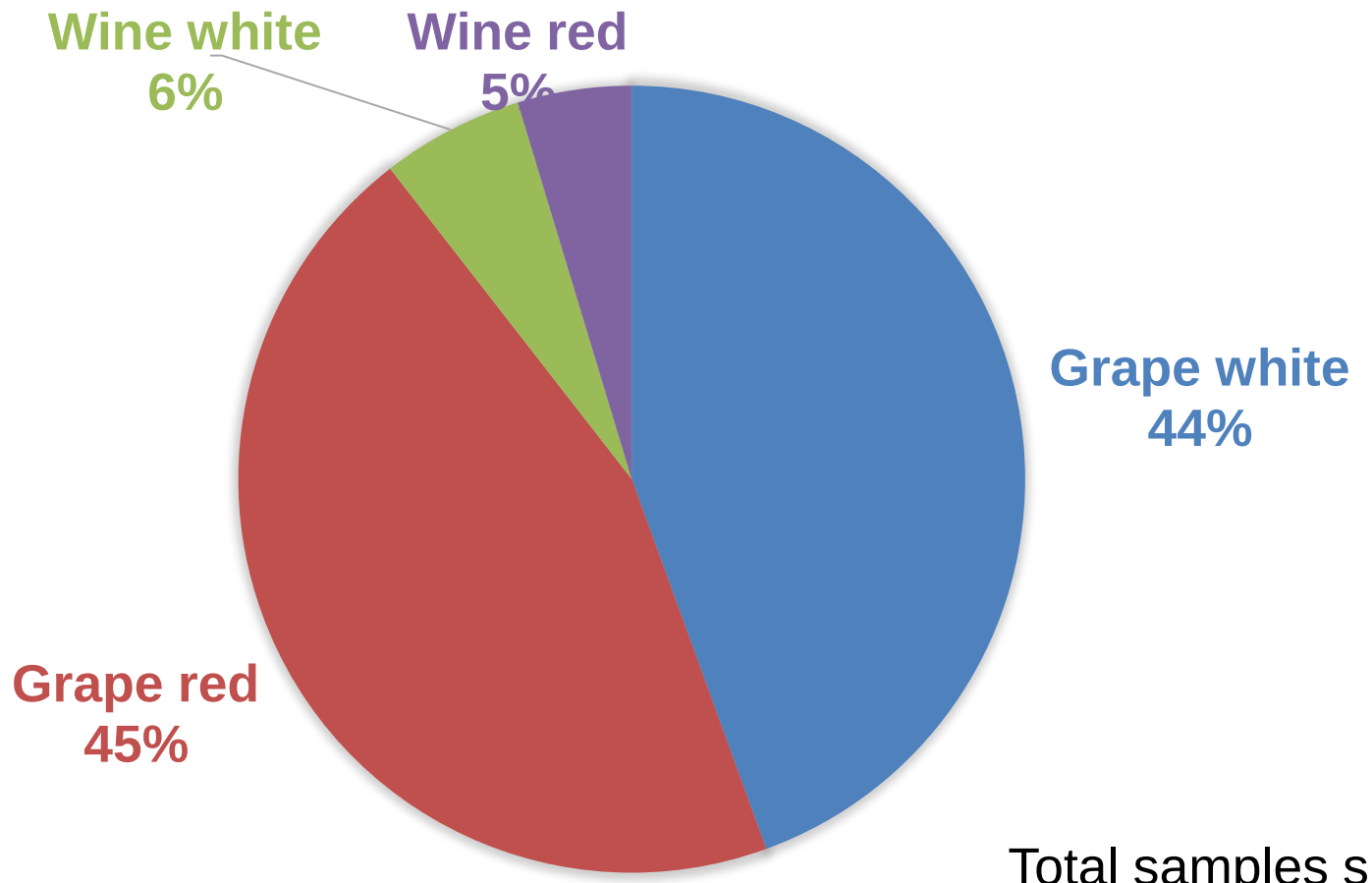
Five varieties listed constitute 73% of all samples submitted
In total, samples from 20 varieties were submitted

Total Glycosides[1] found in the most common varieties – Mudgee

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Shiraz	16.5	1835	297	37.4	96%
Mudgee	Shiraz	160	593	275	37.4	100%
NSW	Chardonnay	3.5	2677	372	8.9	99%
Mudgee	Chardonnay	104	776	336	8.9	100%

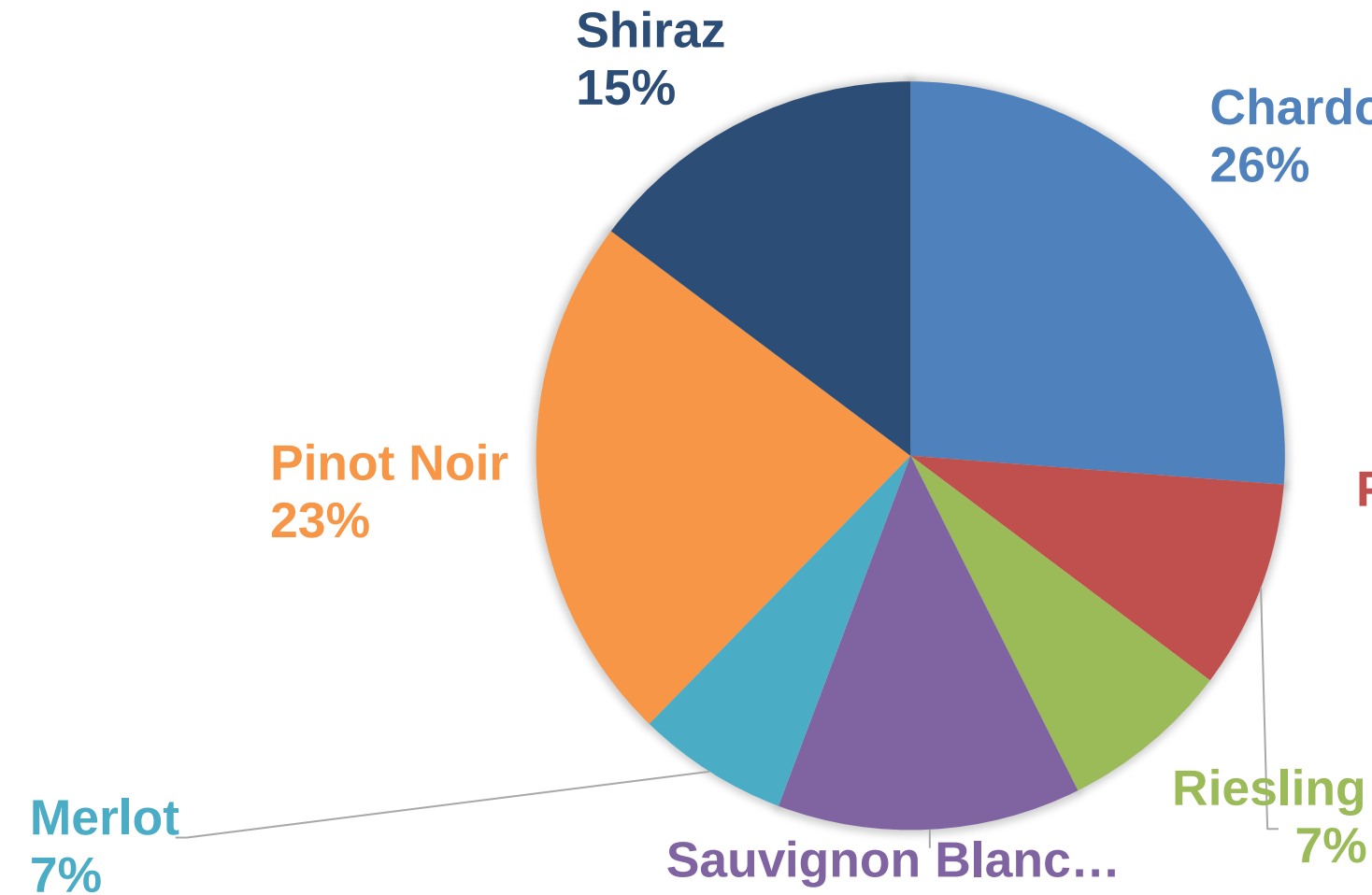
1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Breakdown by sample type – Orange



Total samples submitted: 171

Samples analysed by variety – Orange



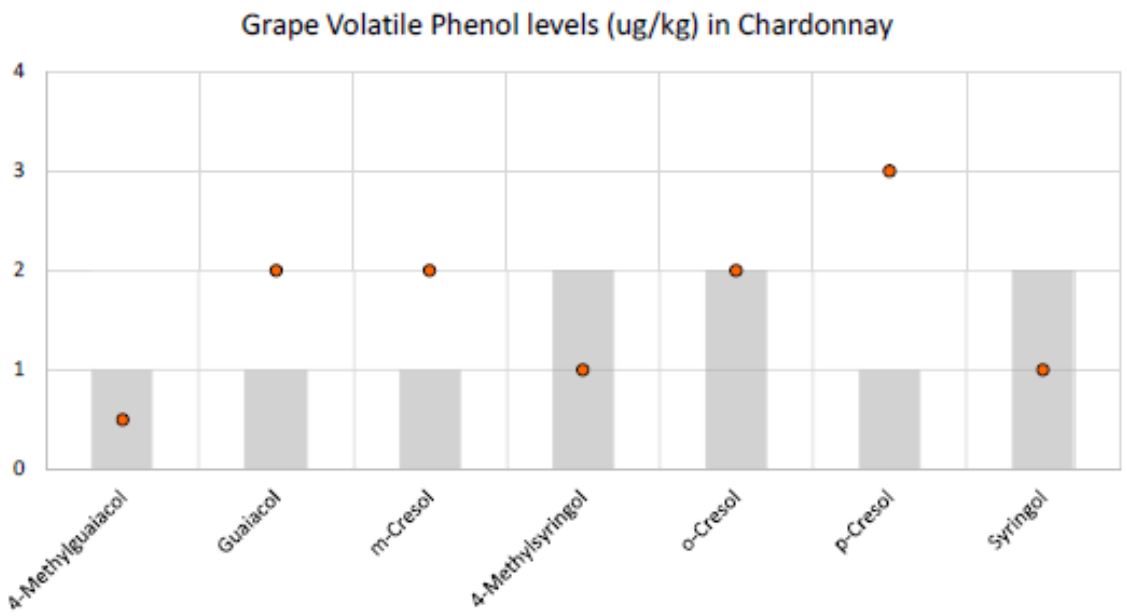
Seven varieties listed constitute 80% of all samples submitted
In total, samples from 25 varieties were submitted

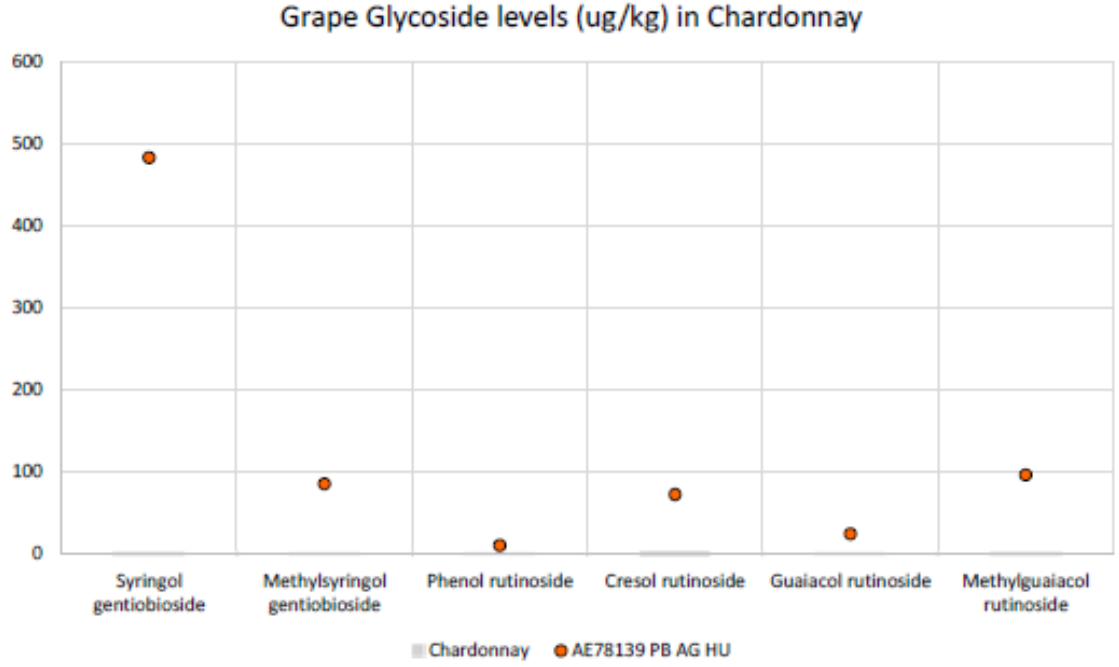
Total Glycosides[1] found in the most common varieties – Orange

Location	Variety	Minimum	Maximum	Average concentration	Background upper limit[2]	Percentage of samples above the background upper limit
NSW	Pinot Noir	12.5	1508	304	14.9	99%
Orange	Pinot Noir	42	202	151	14.9	100%
NSW	Chardonnay	3.5	2677	232	8.9	99%
Orange	Chardonnay	36	447	140	8.9	100%

1 Total glycosides' concentration is the sum of the individual glycoside results for a sample.
2 This is the maximum 'total glycosides' value that might be expected for non-smoke-exposed grapes.

Background levels database





- The background levels data for Australian grapes (pages 39–42)
  - https://www.wineaustralia.com/getmedia/57a45b58-3eb6-416a-bdf3-c54faeb2d766/AWR-1603-Final-Report-including-attachments.pdf

Background levels database with grape and wine data

White Varieties	Red Varieties
Chardonnay	Shiraz
Pinot Gris	Cabernet Sauvignon
Sauvignon Blanc	Pinot Noir
Viognier	Grenache
Riesling	Merlot
Muscat Gordo	Mataro
Gewürtztraminer	Durif
Verdelho	**Sangiovese**
Semillon	**Tempranillo**

Current database contains data for 548 grape samples and 517 wine samples, with at least two vintages (but up to four) except Mataro. This project will add five varieties, specific to NSW, consisting of 100 grape and 100 wine samples.

Acknowledgements

- The New South Wales Wine Industry Association has received funding from the NSW and the Commonwealth Government through the Bushfire Industry Recovery Package.

- For more information or assistance, contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8 313 6600.

NEW SOUTH WALES wine

NSW GOVERNMENT

Fortifying the future of NSW Wine

The Australian Wine Research Institute

Early season smoke exposure

learnings from 2019/20 bushfires for Hunter Valley and Adelaide Hills regions

Dr Markus Herderich, GM-Research

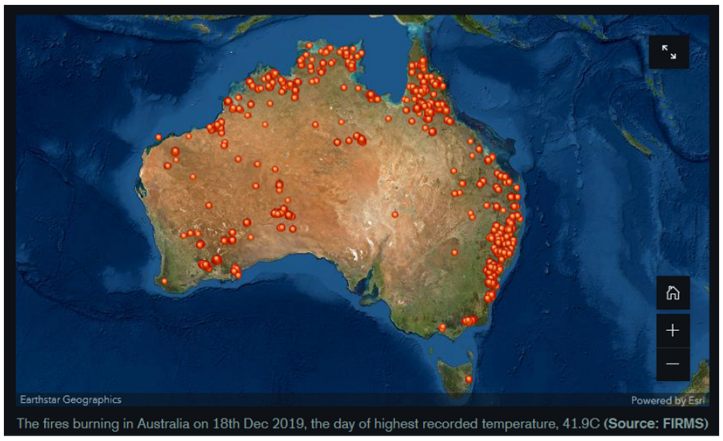
November 2021

1

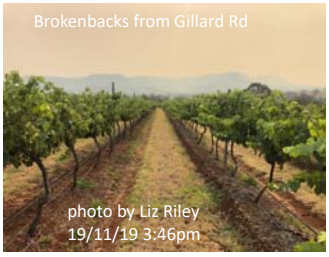
Looking back: Australian vintage 2019/20 ….

The Australian Wine Research Institute

- **prelude:** after years of drought…..



The fires burning in Australia on 18th Dec 2019, the day of highest recorded temperature, 41.9C **(Source: FIRMS)**



2

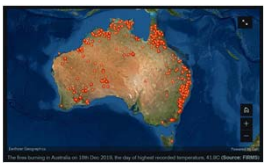
Looking back: Australian vintage 2019/20 ….

The Australian Wine Research Institute

- **prelude:** years of drought

- **very early start to the bushfire season in September 2019**
  => whats the risk of smoke taint
  if green pea-size pre-veraison berries get exposed?

- **scale and intensity of wildfires**
  186,000 square km,
  temperate rain forests burning
  weeks to months of smoke drift in some regions
  vineyards burning in fast&furious fires



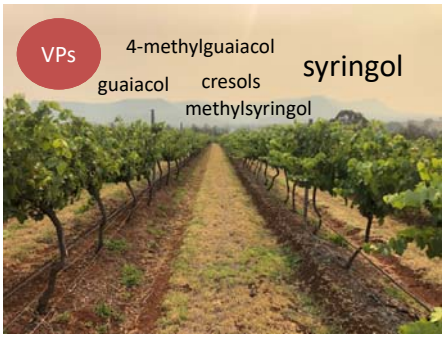
=> how to re-vitalise burnt vines & vineyards?

=> identify clean grapes ⇔ winemaking with grapes after some smoke exposure
=> smoke taint risk in bulk wine, reliable sensory assessment of smoke taint in wine

3

smoke exposure of unripe grapes

The Australian Wine Research Institute



uptake?

other storage forms?

conversion in grapes?

sugar
sugar
VPs

SyGG
syringol gentiobioside

retained or diluted?

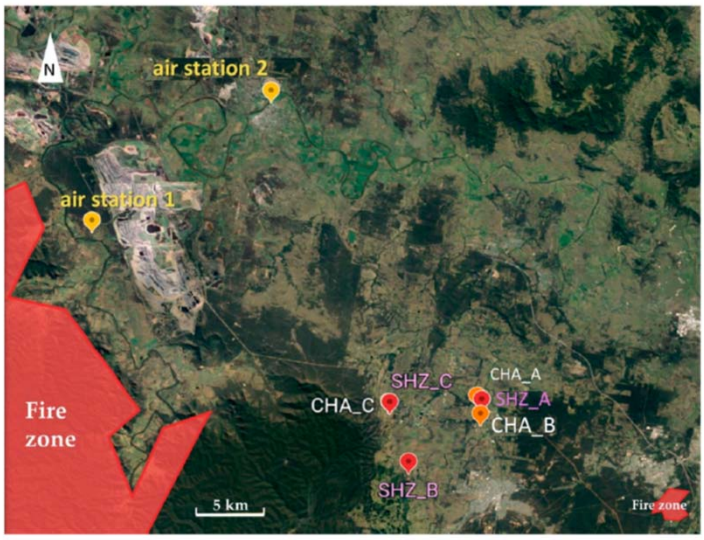
converted & disappear?

4

Hunter Valley 2019

Chardonnay & Shiraz grapes and leaves from 3 vineyards

The Australian Wine Research Institute



5x time points from 15 Nov to 10 Jan;
3 vineyard replicates
= 180 samples

EPA air stations @Bulga, Singleton;
PM_{10} as proxy for fine dust and haze

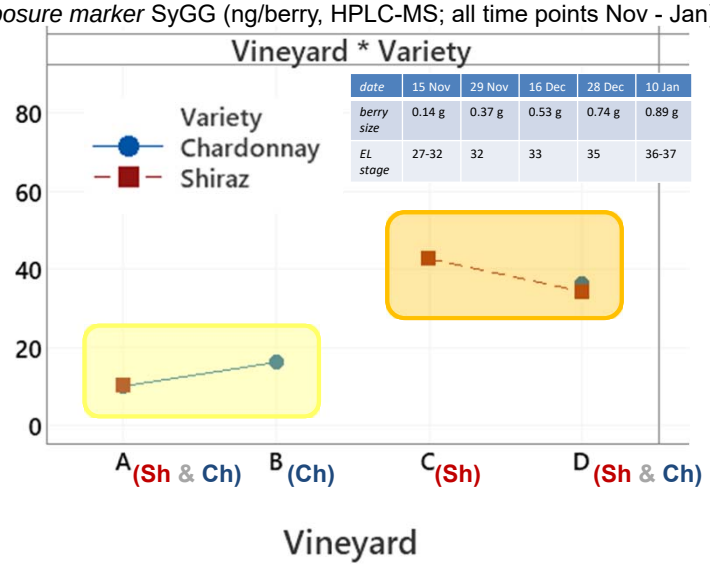
Citation: Jiang, W.; Parker, M.; Hayasaka, Y.; Simos, C.; Herderich, M. Compositional Changes in Grapes and Leaves as a Consequence of Smoke Exposure of Vineyards from Multiple Bushfires across a Ripening Season. *Molecules* **2021**, *26*, 3187. https://doi.org/10.3390/molecules26113187

5

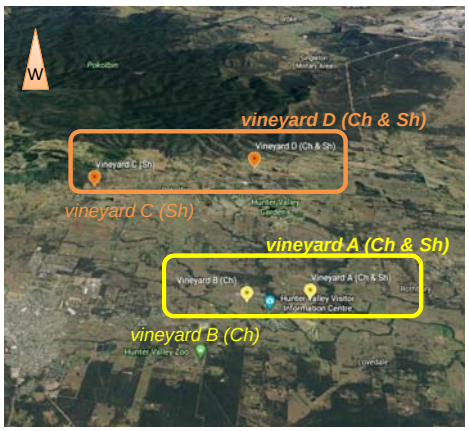
Hunter Valley vineyard monitoring
=> location matters

The Australian Wine Research Institute

exposure marker SyGG (ng/berry, HPLC-MS; all time points Nov - Jan)



date	15 Nov	29 Nov	16 Dec	28 Dec	10 Jan
berry size	0.14 g	0.37 g	0.53 g	0.74 g	0.89 g
EL stage	27-32	32	33	35	36-37

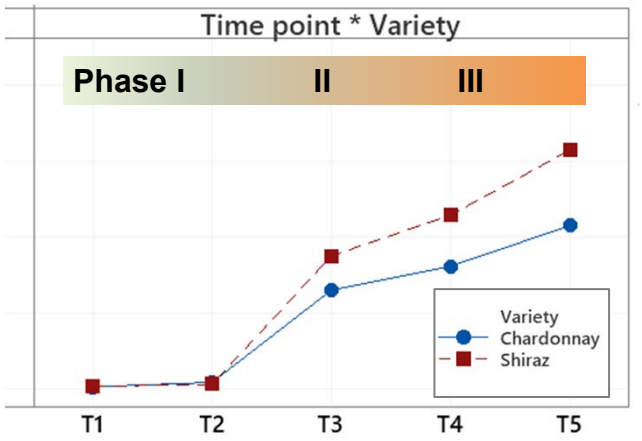


6

Hunter Valley – smoke exposure throughout ripening

exposure marker SyGG (ng/berry, HPLC-MS; all vineyards)

The Australian Wine Research Institute



date	15 Nov	29 Nov	16 Dec	28 Dec	10 Jan
berry size	0.14 g	0.37 g	0.53 g	0.74 g	0.89 g
EL stage	27-32	32	33	35	36-37

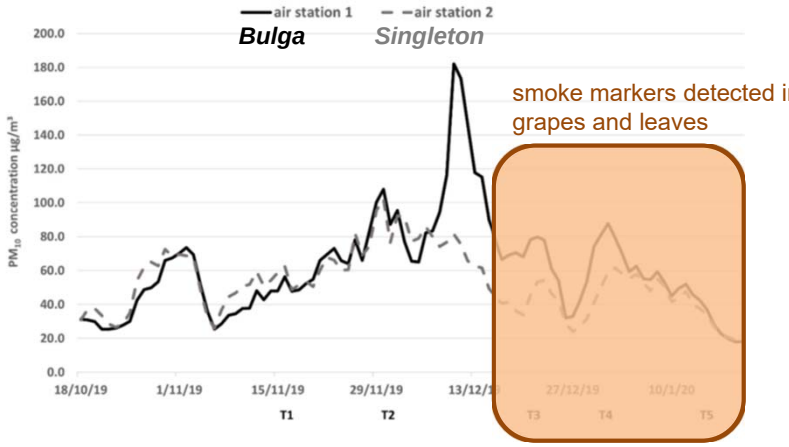
- ✓ **haze @T1,T2 ≠ taint markers in grapes**
  - leaves were also 'clean'
  - no evidence for other chemistries
- ✓ **peak fire activity and increase in smoke exposure markers in early December**
  - ❑ exposure in November, detected delayed in 16 December?
- ✓ **cumulative exposure December to January:** increasing smoke exposure markers, and berry size increases

7

Smoke haze & smoke markers in grapes & leaves:

Hunter Valley 2019, Chardonnay & Shiraz

The Australian Wine Research Institute



Nulkaba north of Cessnock

6th Dec 2:15pm

date	15 Nov	29 Nov	16 Dec	28 Dec	10 Jan
berry size	0.14 g	0.37 g	0.53 g	0.74 g	0.89 g
EL stage	***27-32***	***32***	33	35	36-37

watch out: ***data from Adelaide Hills***

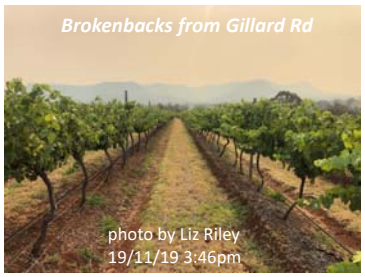
8

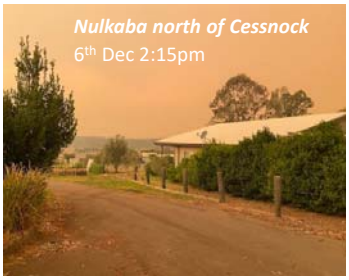
Smoke haze & smoky odours in air:
what you see is not what you smell or taste

The Australian Wine Research Institute

- guaiacol is ca 200,000x more potent in air than wine

guaiacol in wine		guaiacol odour threshold [ng/L air]			odour qualities
baseline (Shiraz wine)	odour threshold	median	range	factor (high/low)	smoky, vanilla, ham
5.9 µg/L	23 µg/L	0.084 ng/L air	0.007 – 3.7	529	
Coulter et al. AJGWR (2021) accepted	Parker et al. JAFC (2012)	Schranz et al. Food Chemistry 232 (2017) 808–819			





9

Early season smoke exposure:
Adelaide Hills - Cudlee Creek fire

The Australian Wine Research Institute

- **single fire event** 20 Dec 2019
- **berries ca EL29**

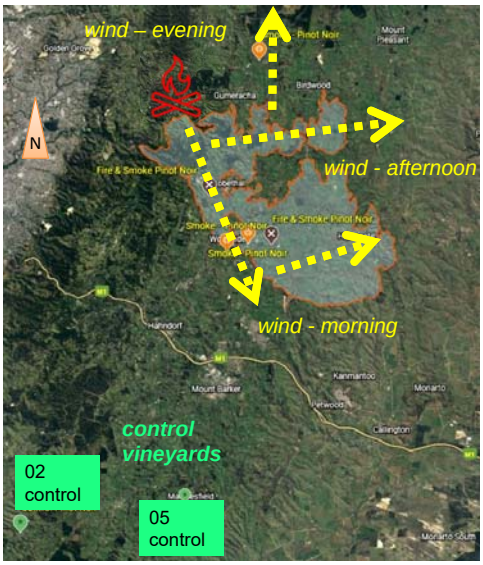
- fast & furious
- **fires burning nearby and within vineyards, plus smoke drift**
- **large volume of smoke during first 48 hours**
- 4 January 'contained'
- 22 January 'safe' (out)

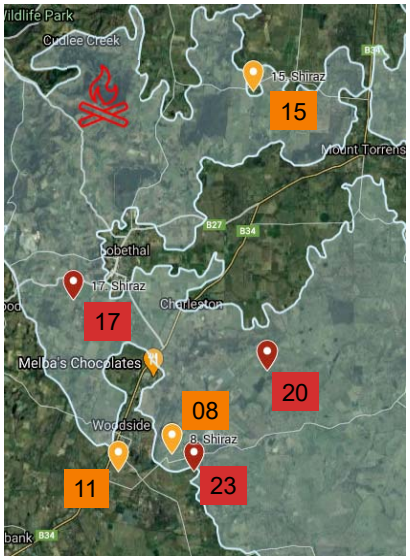
- grape – wine – sensory data
  Shiraz, Pinot Noir, Chardonnay
  24 blocks

10

Early season smoke exposure:
Adelaide Hills Shiraz blocks- Cudlee Creek fire

The Australian Wine Research Institute

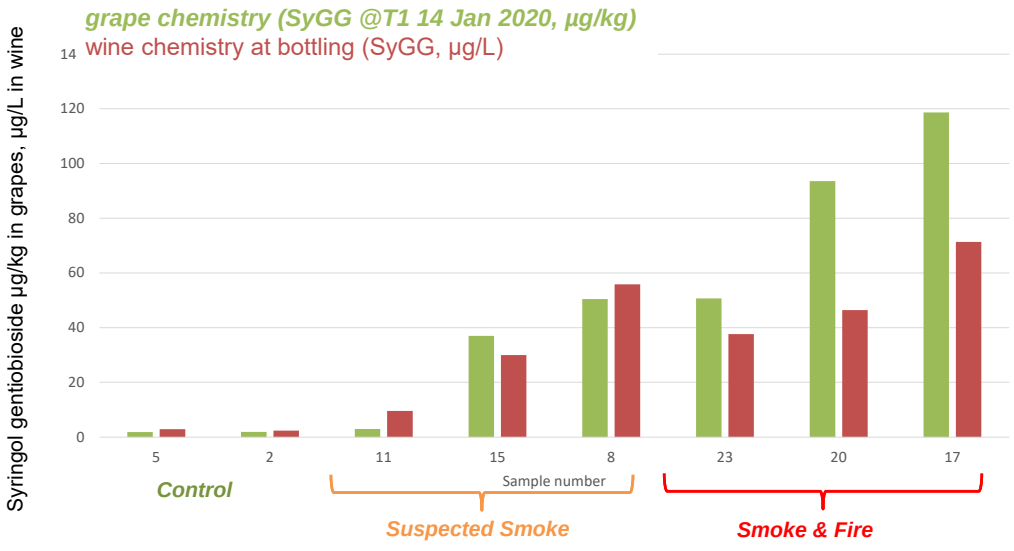




11

Early season smoke exposure: grapes – wine – sensory
Adelaide Hills Shiraz from Cudlee Creek fire

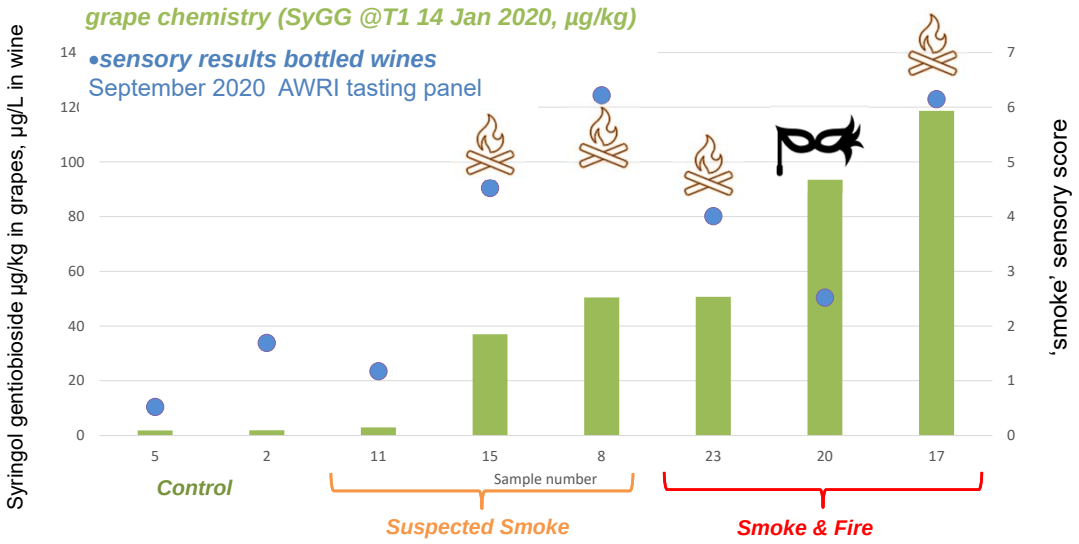
The Australian Wine Research Institute



12

Early season smoke exposure: grapes – wine – sensory
Adelaide Hills Shiraz from Cudlee Creek fire

The Australian Wine Research Institute



Early season smoke exposure:
learnings from bushfire season 20219/20 Hunter Valley and Adelaide Hills

The Australian Wine Research Institute

- ✓ *significant risk of smoke taint in wine after green pea-size pre-veraison berries get exposed*
- ✓ *vineyard location matters*
- ❑ variety, phenology effects?
- ❑ *unexpected observations (Adl Hills):*
  - ❑ *berry size increase did not result in 'dilution' of smoke markers in grapes*
  - ❑ *changes in smoke exposure marker profiles in grapes between January 2020 and March 2020*

Early season smoke exposure: Acknowledgements – thank you!

The Australian Wine Research Institute

- *Many growers and winemakers*
- *Peter Leske, Liz Riley*

- *Team AWRI*
  Maddy, Sheridan, Yoji / John and Lieke / Damian, Eleanor and Patricia
  Con and IDS team, AWRI Commercial Services, Metabolomics Australia

- *Funding:*
  AWRI
  PIRSA & SA Government
  Wine Australia
  NSW Wine & NSW Government
  Bioplatforms Australia & NCRIS

The Australian Wine Research Institute

Predicting smoke taint in wine. Are we there yet?

Mango Parker

Research Scientist
The Australian Wine Research Institute

1

Acknowledgements

The Australian Wine Research Institute

- Many growers and winemakers
- NSW wine
- John Blackman and Leigh Schmidtke (NWGIC, CSU)
- Wine Victoria
- Wine Australia
- Team AWRI
  Markus, Con and team, Maddy, Sheridan, Yoji, John and Lieke, Damian, Eleanor and Patricia, WIC winemaking, AWRI Commercial Services, Metabolomics Australia

2

Rewind to late 2019

The Australian Wine Research Institute

- Pre-veraison smoke low risk
- Smoke exposure markers
  - 7 volatile phenols
  - 6 glycosides
  - Known abundance of markers in non-smoke exposed berries and wine
- But what concentration is likely to result in 'smoke taint' in wine?
  - Individually, guaiacol, *m*-cresol most potent
  - Subthreshold additive effects
  - Glycosides can give flavour in mouth, due to enzyme released volatiles
- When to try remediation?

3

Research trial initiated

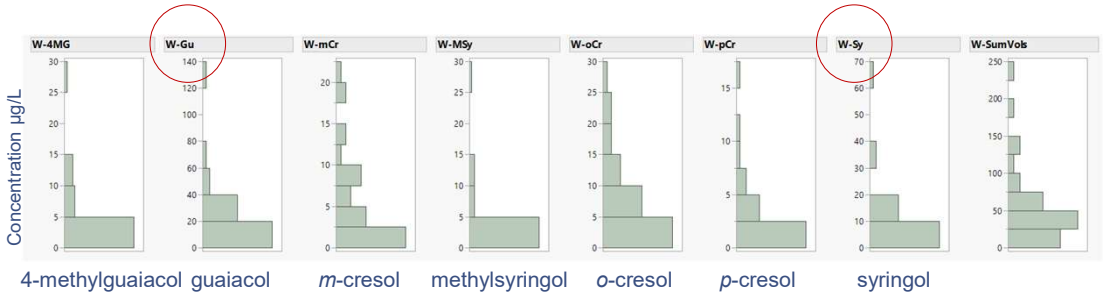
The Australian Wine Research Institute

- Aim: to link grape composition, wine composition, wine sensory
- Targeting the 'grey zone'
- Chardonnay, Pinot Noir and Shiraz
- 42 grape and wine pairs, with smoke sensory rating
- No remediation, 50 kg standard research winemaking (whites off skins)
- Including clean controls
- No oak

4

Smoke markers in wine –research wines

The Australian Wine Research Institute



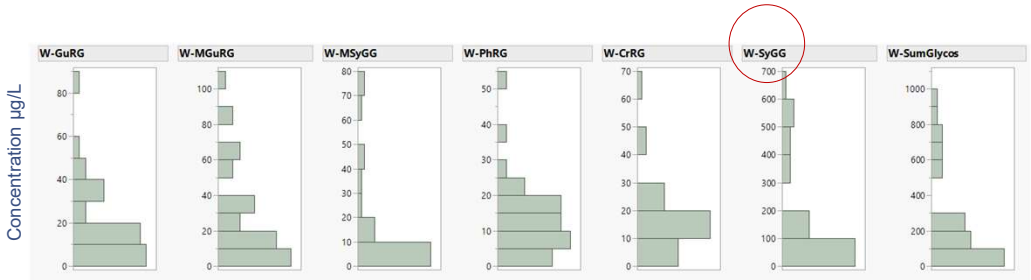
- Most abundant are guaiacol, syringol, *o*-cresol and *m*-cresol
- SumVols sum of these seven volatile phenols

- Controls removed, just 34 smoke exposed samples

5

Smoke markers in wine –research wines

The Australian Wine Research Institute



- Syringol gentiobioside (SyGG) most abundant in smoke affected wines
- SumGlycos sum of these six glycosides

- Controls removed, just 34 smoke exposed samples

6

Can we predict smoke taint?

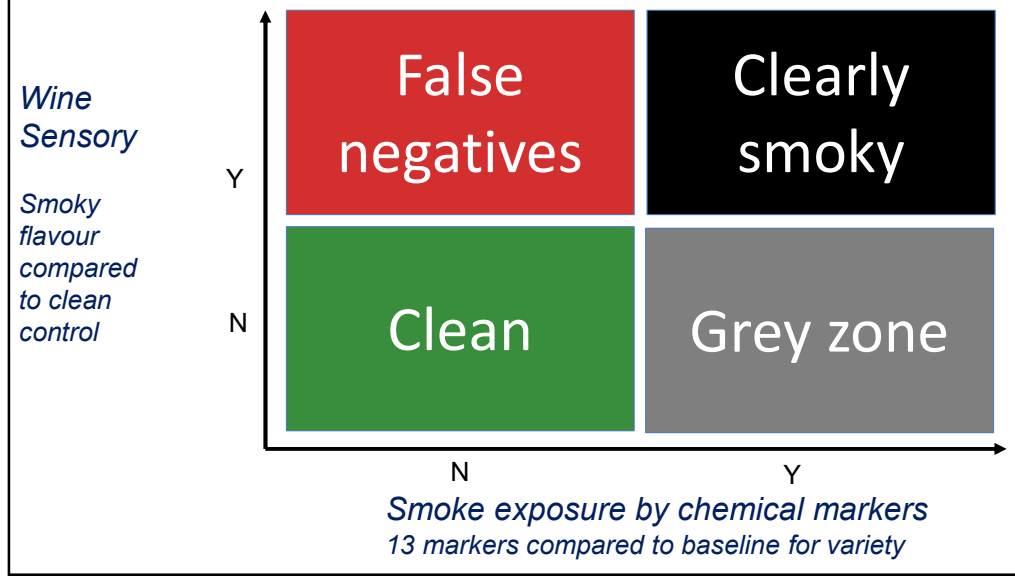
The Australian Wine Research Institute

- Wine composition and sensory
- NB Variations in basic wine chemistry, pH, TA, alcohol

7

Smoke exposure markers vs wine sensory

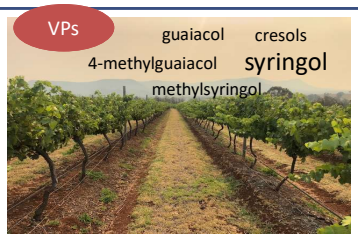
The Australian Wine Research Institute



8

Smoke compounds in grapes and wine

The Australian Wine Research Institute



uptake

conversion in grapes

Glycosides

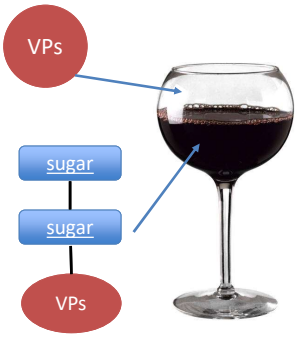
Biomarker SyGG

syringol gentiobioside

Smoky aroma

Smoky aftertaste

release of VPs from glycosides in-mouth



release of VPs from glycosides

9

Markers for smoke exposure

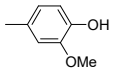
The Australian Wine Research Institute

Guaiacol **23 µg/L**

‘smoky’, ‘sweet smoke’, ‘smoky bacon’

4-Methylguaiacol 65 µg/L

‘smoky’, ‘spicy’

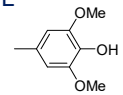


Syringol 570 µg/L (10% ethanol)

‘smoky’, ‘charry’

4-Methylsyringol 10,000 µg/L (water)

‘smoky’, ‘charry’



o-Cresol 62 µg/L

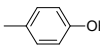
‘phenol’, ‘plastic’

***m*-Cresol** **20 µg/L**

‘smoky, phenolic’, ‘smoky bandaid’, ‘plastic’

p-Cresol 64 µg/L

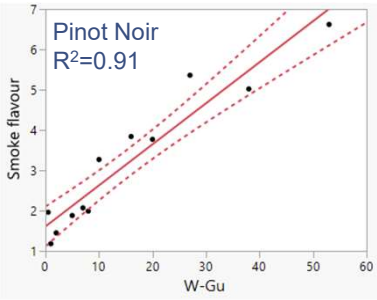
‘faecal, horse stable-like’, ‘medicinal’



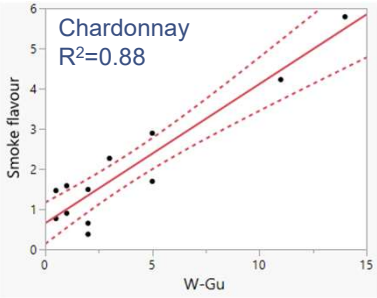
10

Smoke flavour and guaiacol per variety

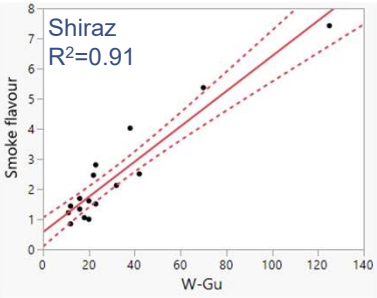
The Australian Wine Research Institute



Guaicol in wine (µg/L)



Guaicol in wine (µg/L)



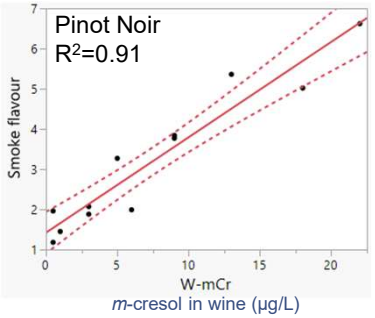
Guaicol in wine (µg/L)

- Consumers didn't mind 25 µg/L guaiacol alone spiked into Merlot but many disliked 50 µg/L
- Guaiacol is not unpleasant by itself at moderate concentration, but is a major part of the smoke taint puzzle
- All **unoaked** wines

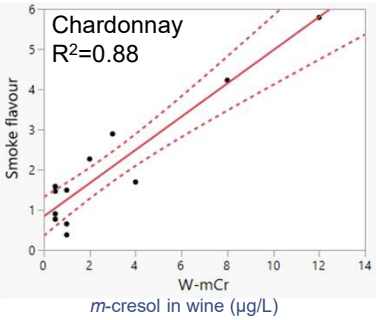
11

Smoke flavour and *m*-cresol per variety

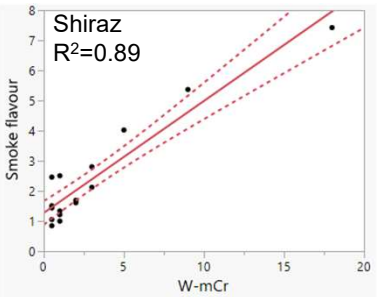
The Australian Wine Research Institute



m-cresol in wine (µg/L)



m-cresol in wine (µg/L)



m-cresol in wine (µg/L)

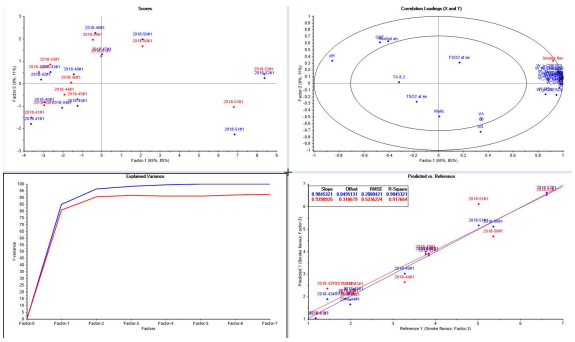
- GuRG and MGuRG also highly correlated with smoke flavour
- PhRG generally less correlated with smoke flavour
- *o*-cresol also highly correlated in Pinot Noir, and *p*-cresol in Shiraz
- Syringol and methylsyringol not correlated with smoke flavour

12

More complex predictive models

The Australian Wine Research Institute

- PLS regression models with multiple compounds improve prediction
  - Chardonnay PLS R^2=0.93
  - Pinot Noir PLS R^2=0.98
  - Shiraz PLS R^2=0.96
- Guaiacol, *m*-cresol, *p*-cresol, GuRG are important
- NB all UNOAKED wines



13

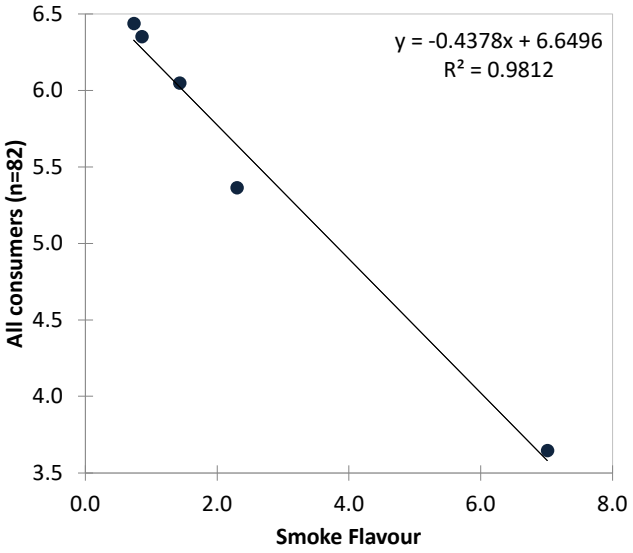
Do consumers dislike smoky wines?

The Australian Wine Research Institute

14

Consumer liking and Smoke flavour by AWRI Panel

The Australian Wine Research Institute

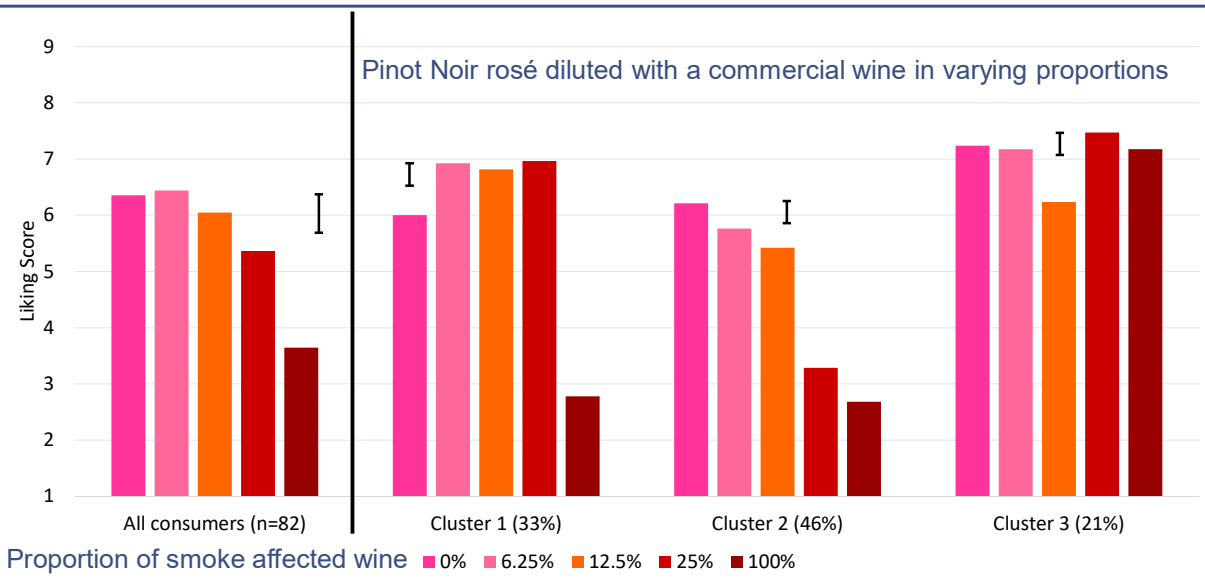


- Pinot Noir rosé diluted with a commercial wine in varying proportions
- Liking (inversely) correlated with smoke flavour rating from a separate trained sensory panel

15

Pinot Noir Rosé – Consumer clusters

The Australian Wine Research Institute



16

Conclusions

The Australian Wine Research Institute

- Markers are working well
  - To identify clean vs smoke exposed
  - To predict smoky flavour
  - Guaiacol, cresols, guaiacol glycosides most important
  - Separate varieties
- Rigorous sensory is important
- Consumer liking is strongly (negatively) correlated with smoke flavour
- Now establishing limits based on chemistry, smoke flavour intensity and consumer liking scores, to define 'taint'

17

Acknowledgements

The Australian Wine Research Institute

- Many growers and winemakers
- NSW wine
- John Blackman and Leigh Schmidtke (NWGIC, CSU)
- Wine Victoria
- Wine Australia
- Team AWRI

Markus, Con and team, Maddy, Sheridan, Yoji, John and Lieke, Damian, Eleanor and Patricia, WIC winemaking, AWRI Commercial Services, Metabolomics Australia

Wine Australia for Australian Wine

The New South Wales Wine Industry Association has received funding form the NSW and the Commonwealth through the Bushfire Industry Recovery Package.

This work is supported by Australia's grapegrowers and winemakers through their investment body Wine Australia, with matching funds from the Australian Government. The AWRI is a member of the Wine Innovation Cluster in Adelaide.

NEW SOUTH WALES wine

NSW GOVERNMENT

18

Resources

The Australian Wine Research Institute

- www.awri.com.au smoke taint page, fact sheets, articles, videos including best practice sensory methods
- Parker, M., Osidacz, P., Baldock, G. A., Hayasaka, Y., Black, C. A., Pardon, K. H., Jeffery, D. W., Geue, J. P., Herderich, M. J. and Francis, I. L. 2012. Contribution of several volatile phenols and their glycoconjugates to smoke-related sensory properties of red wine. *J. Agric. Food Chem.*, 60 (10): 2629-2637.
- Herderich, M. J., Siebert, T. E., Parker, M., Capone, D. L., Jeffery, D. W., Osidacz, P. and Francis, I. L. Spice Up Your Life: Analysis of Key Aroma Compounds in Shiraz. *In:* Qian, M., ed. Flavor Chemistry of Wine and Other Alcoholic Beverages, 2012. ACS, 3-13.
- Mayr, C. M., Parker, M., Baldock, G. A., Black, C. A., Pardon, K. H., Williamson, P. O., Herderich, M. J. and Francis, I. L. 2014. Determination of the Importance of In-Mouth Release of Volatile Phenol Glycoconjugates to the Flavor of Smoke-Tainted Wines. *J. Agric. Food Chem.*, 62 (11): 2327-2336.

The Australian Wine Research Institute

Fortifying the future of NSW Wine

Do winemaking remediation treatments work?

Dr. Julie Culbert
Research Scientist
julie.culbert@awri.com.au

Do winemaking remediation treatments work?

- In some instances, yes!
- It’s not black and white, lots of grey
- Dependent on level of taint
- Easier for whites than for reds

Useful resources and contacts

The Australian Wine Research Institute

AWRI Smoke Taint Resources

https://www.awri.com.au/industry_support/winemaking_resources/smoke-taint/

On the AWRI website – click on winemaking and scroll down to the smoke taint icon

AWRI Helpdesk

Phone: 08 8313 6600 (during business hours)

Email: helpdesk@awri.com.au

Dr. Julie Culbert

Phone: 08 8313 6600 (during business hours)

julie.culbert@awri.com.au

Remediation methods evaluated

- Carbon treatment of juice
- Carbon treatment of wine
- Nanofiltration of wine (with and without enzyme treatment)
- Treatment of wine with glycosidases (in conjunction with carbon or NF)
- Dilution with non-smoke-affected wine
- Use of untoasted oak chips

Carbons tested in juice & wine – R&D4P Smoke Taint Project

The Australian Wine Research Institute

Manufacturer/supplier of carbon	Name of carbon
Activated Carbon Technologies	Acticarb PC1000
Activated Carbon Technologies	Acticarb PS1000
Activated Carbon Technologies	Acticarb PS1300
Carbochem	CA50
Carbochem	P-1000
Carbochem	PC-900
Vason/IMCD Australia Ltd	Carbochromos
Vason/IMCD Australia Ltd	FPS
Vason/IMCD Australia Ltd	Smartvin
Laffort	Toxical
Cabot/IMCD Australia Ltd	Norit D10
Cabot/IMCD Australia Ltd	Norit SX Plus
Cabot/IMCD Australia Ltd	Bentonorit DX

Supplier of carbon	Name of carbon
Cabot/IMCD Australia Ltd	Norit CASPF
EnolTech	Deobrett
Enartis	Black PF
Enartis	Fenol Free
Enartis	Enoblack

Carbon treatment of smoke-affected juice

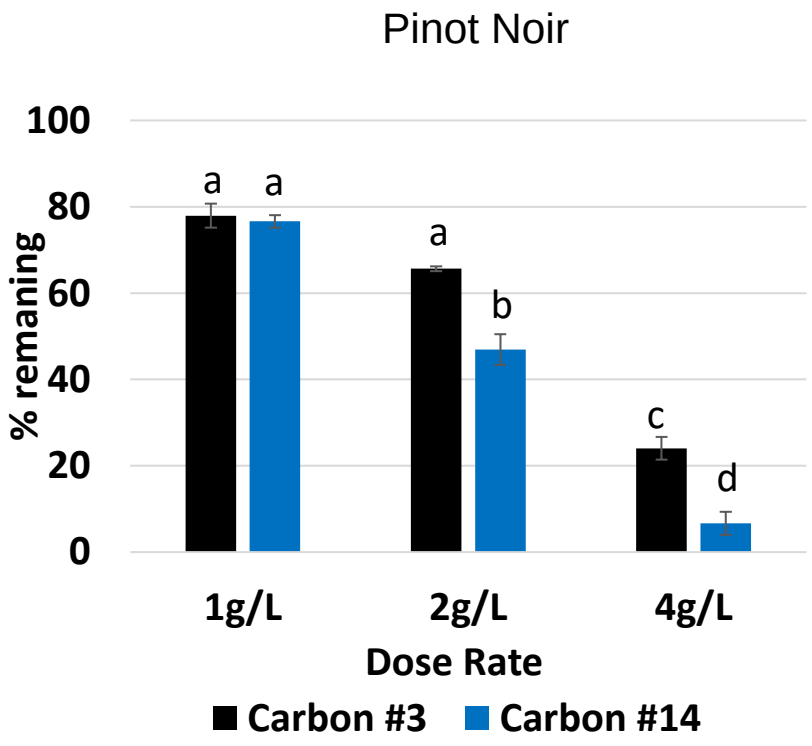
The Australian Wine Research Institute

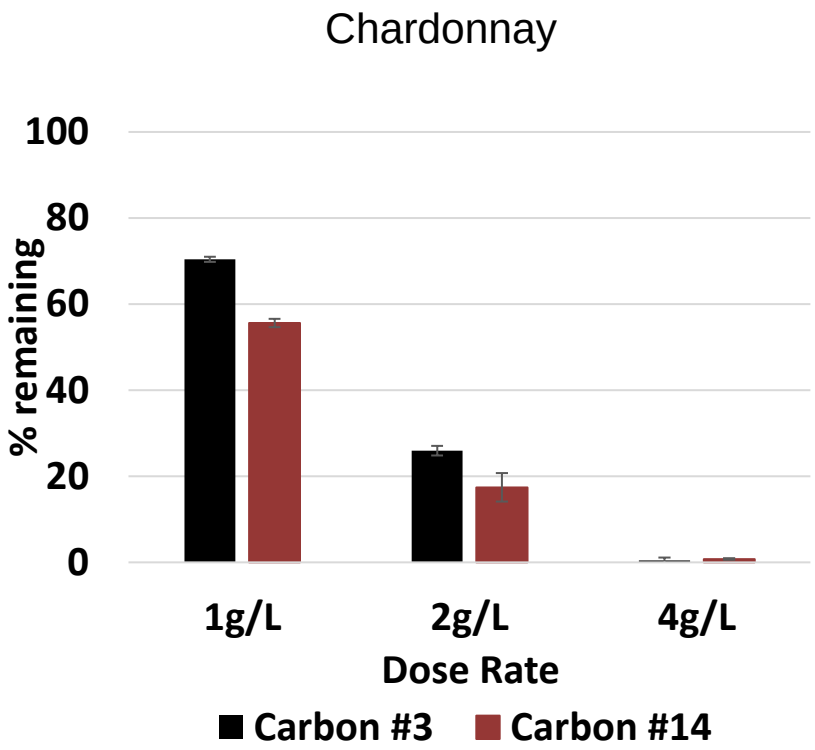
- Two activated carbon products were selected for small-scale (50 Litres) winemaking trials
  - 2019 smoke affected Chardonnay and Pinot Noir juice
  - Carbon treatment prior to fermentation (1, 2 & 4 g/L)
  - Sensory analysis to evaluate sensory impact of treatments

Impact on smoke glycosides

The Australian Wine Research Institute

- Percentage of total phenolic glycosides (n=6) remaining in free run juice after activated carbon treatment

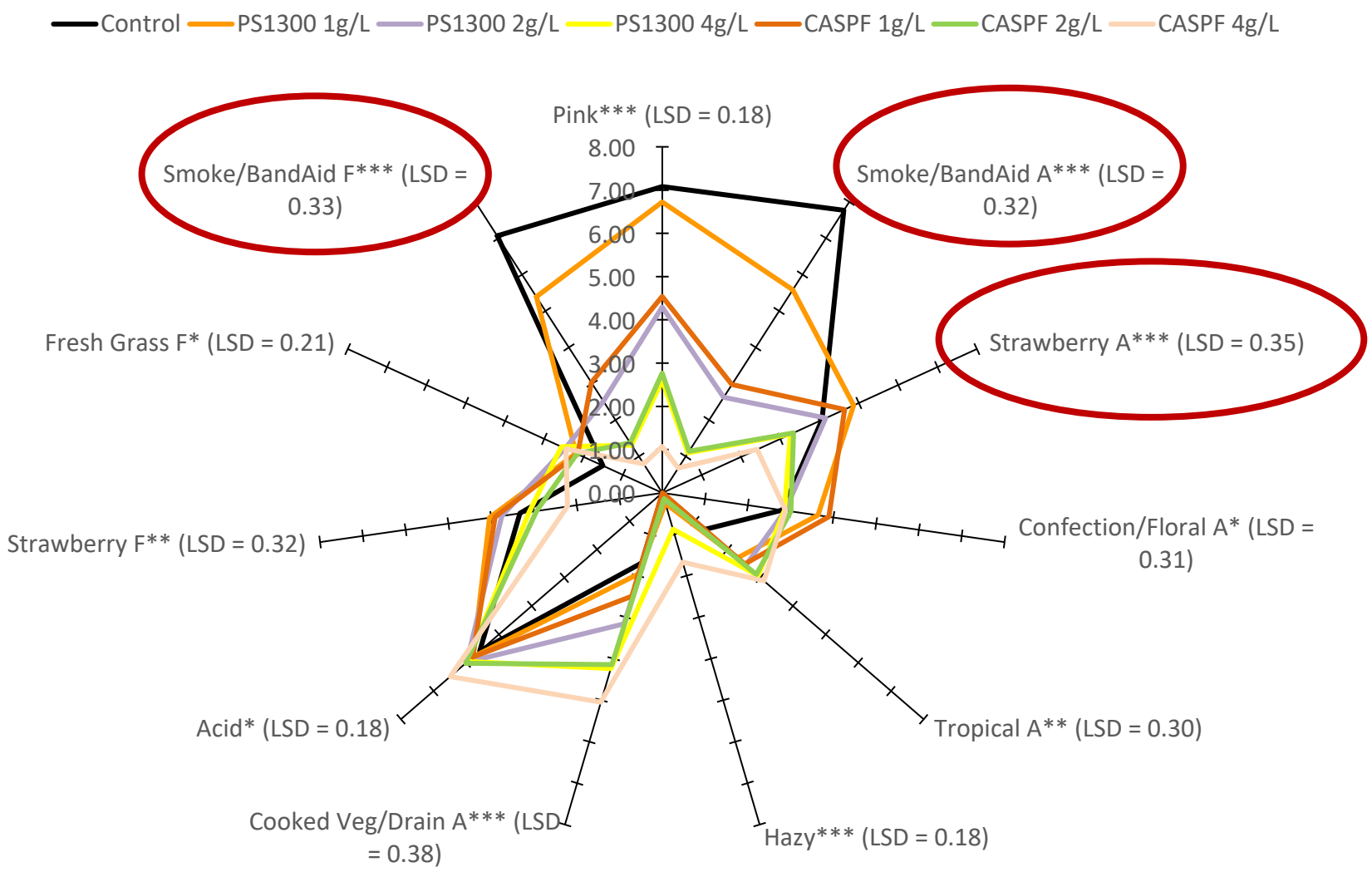




Starting total phenolic glycosides – 335 µg/L for Pinot Noir; 253 µg/L for Chardonnay

Sensory analysis results - Pinot Noir Rosé

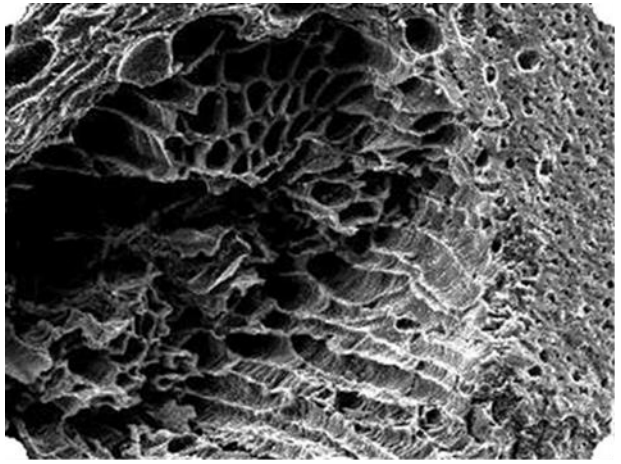
The Australian Wine Research Institute



Carbons tested in wine – Victorian remediation trials

The Australian Wine Research Institute

Supplier of carbon	Name of carbon
Victus International	Granucol FA
Victus International	Granucol GE
Enartis	Black PF
Enartis	Fenol Free
Enartis	Enoblack
Grapeworks	Carbine T Poudre
Grapeworks	Noir Activa Max
Vason	FPS
Carbochem	CA50
Cabot	CASPF
IOC (Winequip)	Otaclean
IOC (Winequip)	Acticarbone
IOC (Winequip)	Flavoclean
Grapeworks	ProVGreen



Winemaker thoughts – carbon treatment of wine

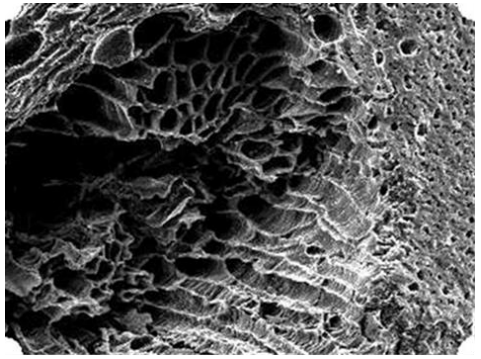
The Australian Wine Research Institute

Winemaker comments:

- Some carbons appeared to strip the positive attributes of the wine, yet the smoke characters remained in the wine
- The best performing carbons were the ones most respectful of the fruit, as well as reducing some of those smoke characters

The most favoured carbons by winemakers in trials were:

- Enartis Fenol Free
- Vason FPS
- Enartis Black PF
- Victus International Granucol GE

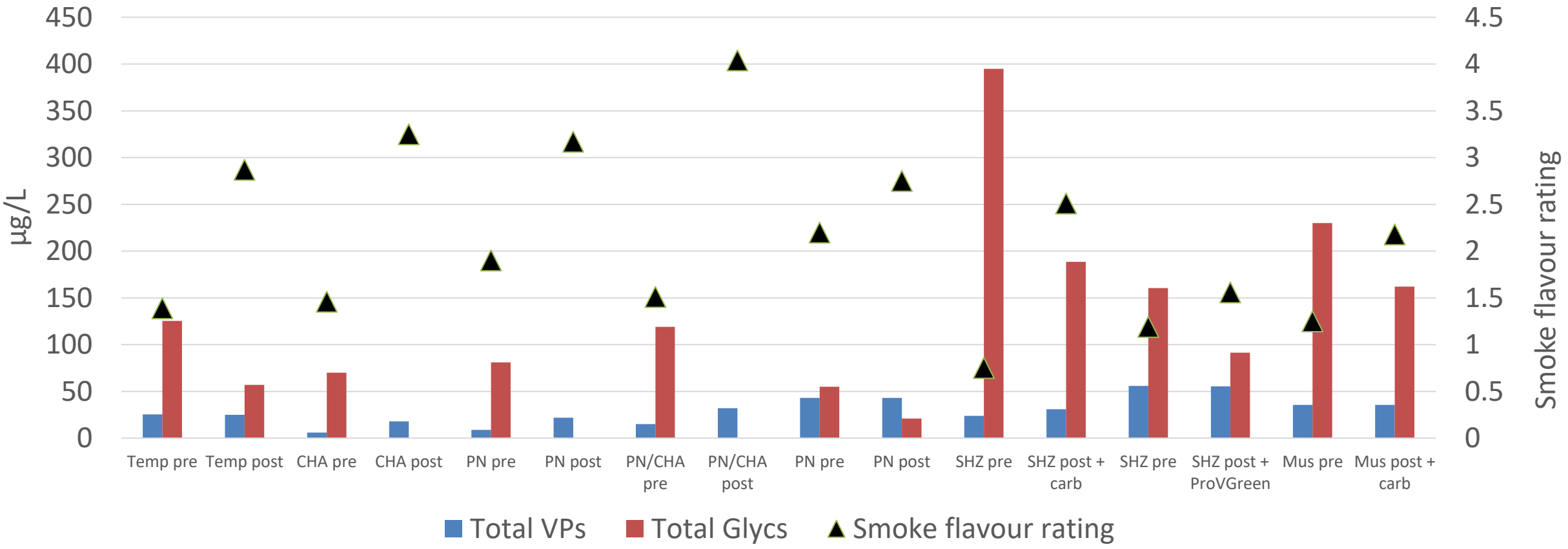


DOSE MATTERS! It's important to optimise

Results from glycosidase use

The Australian Wine Research Institute

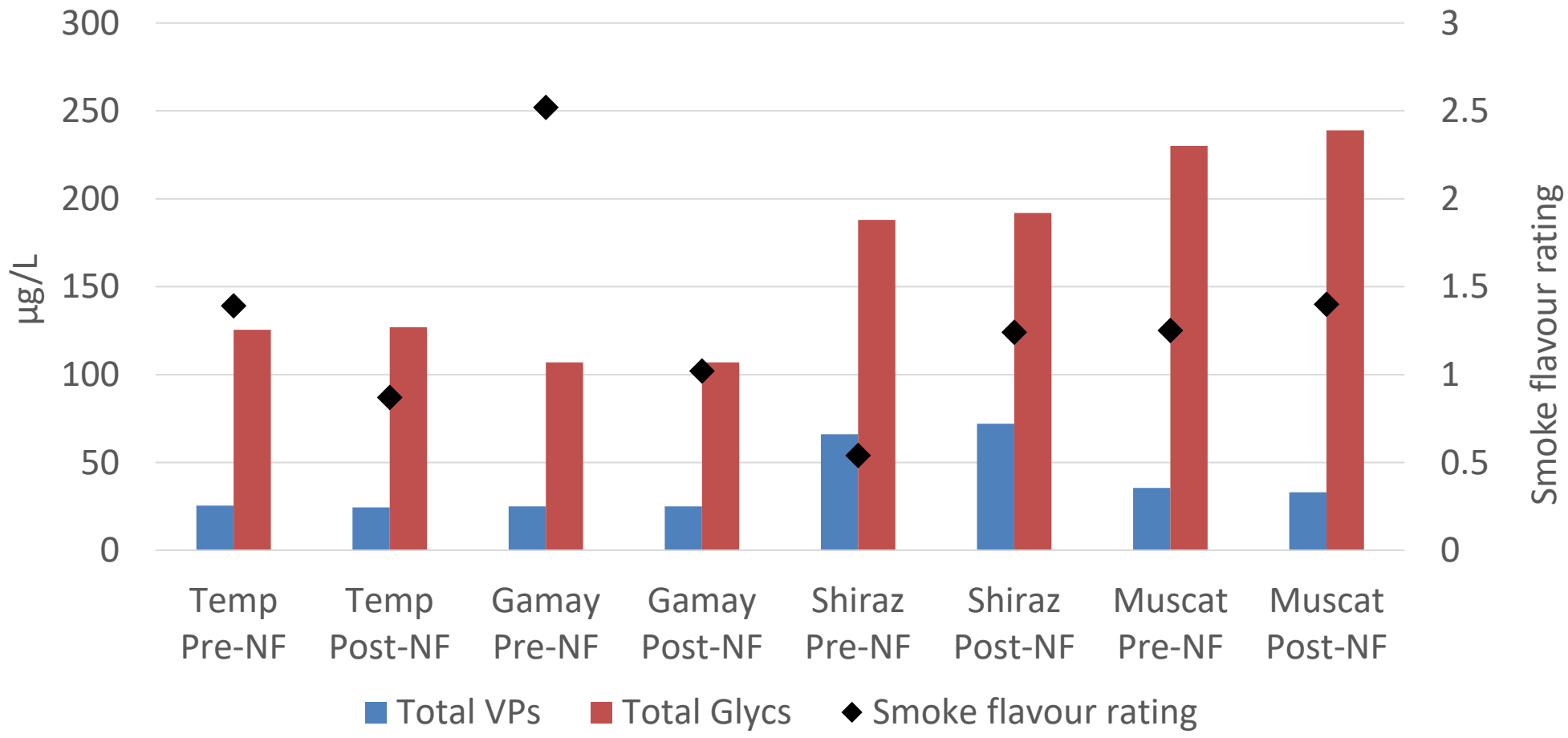
Comparison of control (pre) and enzyme treated (post) wines



Temp = Tempranillo; CHA = Chardonnay; PN = Pinot Noir; SHZ = Shiraz; Mus = Muscat;
VPs = volatile phenols; Glycs = glycosides

Results for nanofiltration

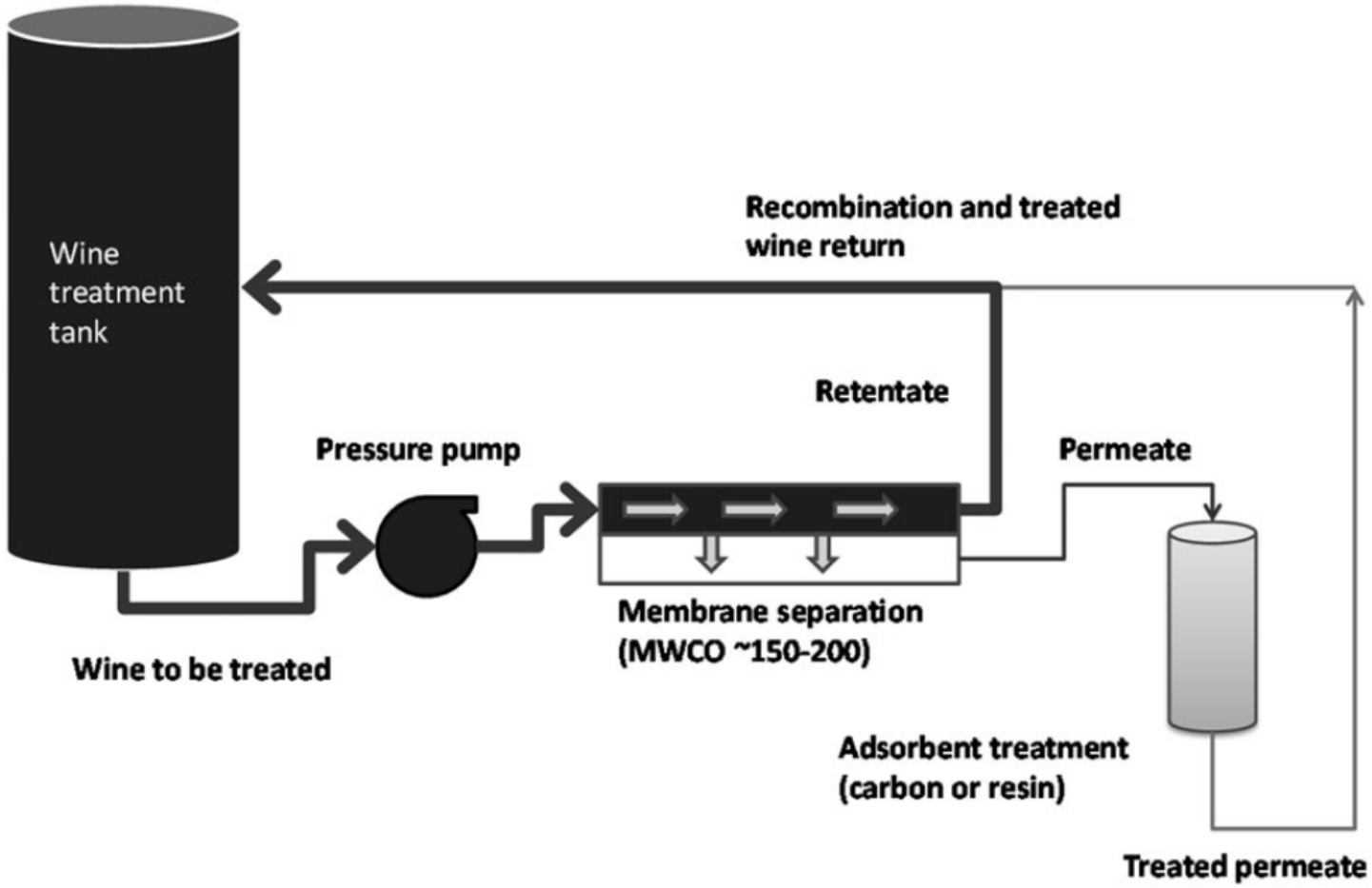
The Australian Wine Research Institute



Temp = Tempranillo; NF = nanofiltration; VPs = volatile phenols; Glycs = glycosides

The nanofiltration process

The Australian Wine Research Institute



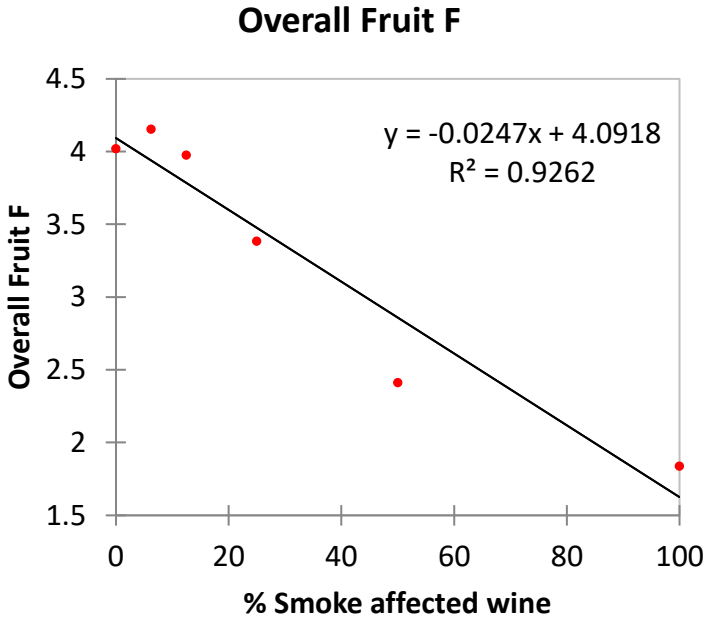
Source: Fudge, A.L., Ristic, R., Wollan, D. and Wilkinson, K.L. (2011) Amelioration of smoke taint in wine by reverse osmosis and solid phase adsorption. *Australian Journal of Grape and Wine Research* 17, S41–S48.

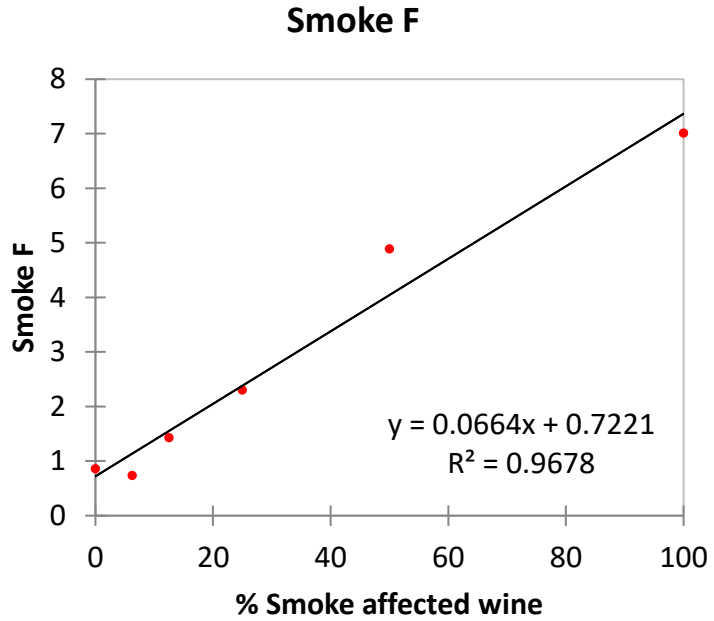
Dilution studies

The Australian Wine Research Institute

- % of smoke affected wine – 100, 50, 25, 12.5 6.25 and 0

Flavour attributes





Smoke affected wine
57 µg/L total volatile phenols (n=7)
209 µg/L total phenolic glycosides (n=6)

Case studies

The Australian Wine Research Institute

Case Study 1

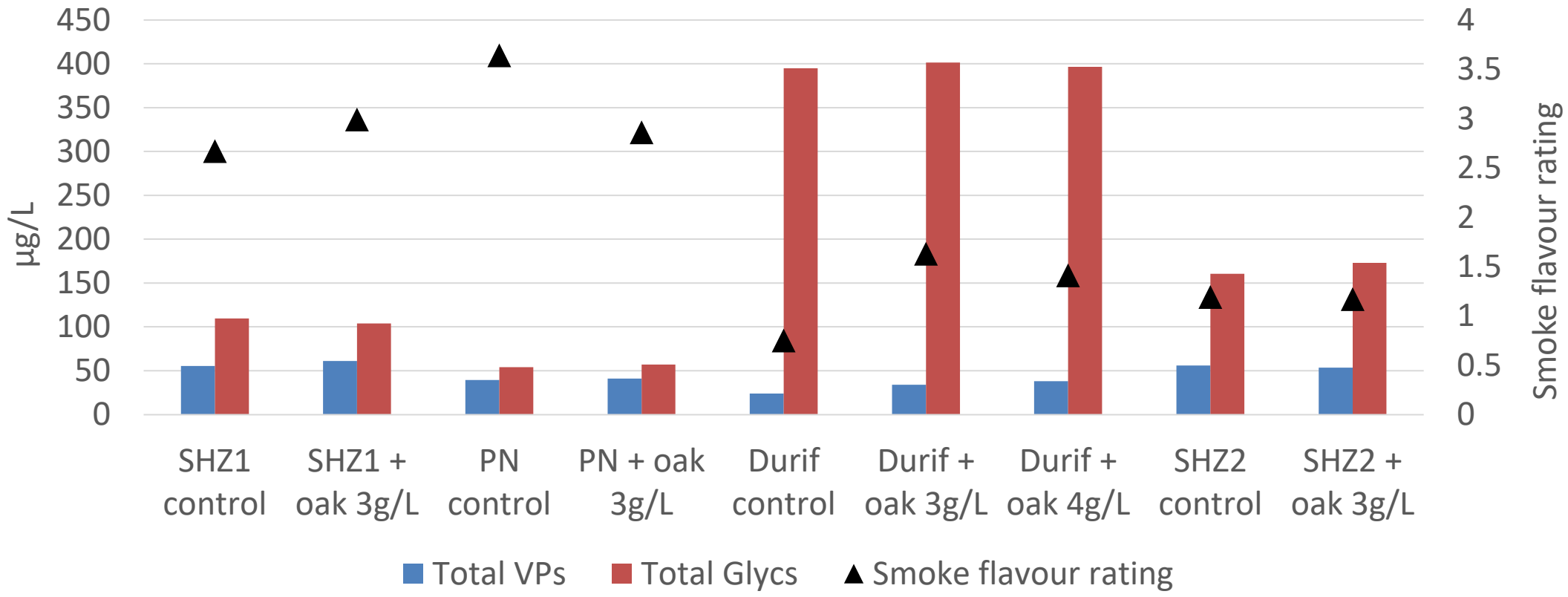
- Smoke-affected Pinot Noir wine
- 2 x 70,000L tanks
- Treated by nanofiltration and carbon (Flavoclean IOC 0.25 g/L)
- Blended – smoke-affected wine was 83% of the final blend
- Other additions (Uvagum APG 2400 (colour); Copper; Maxigum Arabic 20% liquid)
- Entered into numerous wine shows and no mention of smoke
- Being sold through a large supermarket chain who is buying pallets and pallets of the wine

Case study 2

- Grapes with low level smoke exposure
- 400,000 L of Prosecco juice treated with carbon (PS1300 0.5 g/L)
- Production of wine without any detectable smoke character – slightly stripped of fruit but it was a usable product that could be blended

Other treatments - untoasted oak

The Australian Wine Research Institute



SHZ1 = Shiraz 1; PN = Pinot Noir; SHZ2 = Shiraz 2; VPs = volatile phenols; Glycs = glycosides

For SHZ1, PN and SHZ2 untoasted oak chips were BF Boise supplied by Grapeworks

For Durif, untoasted oak chips were Oenofirst ROO supplied by Seguin Moreau

Take away messages

The Australian Wine Research Institute

- Remediation of smoke-affected wine is challenging – there is not a quick fix
  - Harder for reds than for whites
- Minimising skin contact and using only free run juice will reduce the levels of smoke compounds in the juice
- Carbon can be used to treat smoke affected juice prior to fermentation
  - Reduction in smoke sensory attributes in the resulting wine
  - Reduction in colour depending on carbon type and dose
- Carbon can reduce the concentrations of volatile phenols in smoke affected wine and reduce the perception of smoke attributes
  - Perform carbon bench trials – optimise dose rate; find the best performing carbon for your wine type
  - Aiming to reduce the smokey attributes while still maintaining some desirable fruit characteristics
- Not all carbons are equal

Take away messages

The Australian Wine Research Institute

- In recent studies with Victorian producers nanofiltration did not effectively improve wines impacted by smoke
  - Working with the supplier to determine where the problems are situated in their process
- Dilution of smoke affected wine with non affected wine can reduce the perception of smoke attributes in the resulting wine
- The sole use of glycosidases will exacerbate the smoke taint problem unless it is used with some other material which removes the volatile phenols liberated
  - The use of glycosidases and carbon may be a suitable mitigation strategy for smoke affected red wine
- Untoasted oak chips don’t reduce the concentrations of smoke compounds but they may add complexity which distracts from the smoke attributes (sweetness, freshness, more fruit) – but dose is important

Future management

The Australian Wine Research Institute

- Have a bushfire management plan which incorporates decisions on winemaking
  - Proactive rather than reactive
- What can your winery tolerate?
  - Whites are easier to remediate than reds
- How much smoke-affected wine can you make?
  - Is this cost-beneficial?
  - How much can be blended away if that is your only option?
- Take opportunities to build knowledge where you can
  - Utilise what information is already out there
  - If possible, perform your own trials
  - Speak to other winemakers and their experiences

Acknowledgements

- Maddy Jiang; Markus Herderich; Mark Krstic
- The R&D4P smoke taint project was supported by the AWRI, through funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme and Wine Australia
- Victorian smoke taint remediation trials: Wine Victoria has received funding from the Victorian Government to facilitate the Bushfire Technical Response Program
- WIC winemaking, Victorian winemakers and sensory panellists
- The New South Wales Wine Industry Association has received funding form the NSW and the Commonwealth through the Bushfire Industry Recovery Package.

NEW SOUTH WALES wine

NSW GOVERNMENT