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Analysis and Amelioration of Smoke Taint

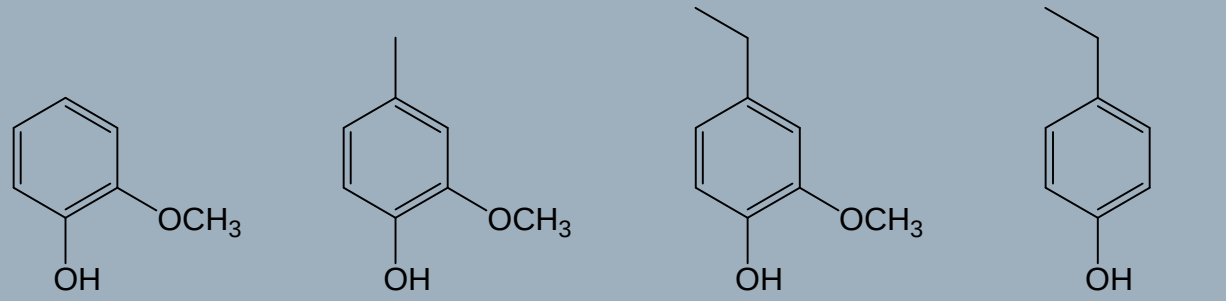
Dr Kerry Wilkinson

The University of Adelaide

Assessment of Smoke Taint

Smoke taint currently assessed by: 1) sensory evaluation of juice and wine

2) quantification of guaiacol by GC-MS



guaiacol 4-methylguaiacol 4-ethylguaiacol 4-ethylphenol

Volatile phenols identified in wine made from grapes exposed to smoke post-harvest[1]

Guaiacol and 4-methylguaiacol routinely identified in oak-aged wines

guaiacol: 10 to 100 μg/L 4-methylguaiacol: 1 to 20 μg/L

4-Ethylguaiacol and 4-ethylphenol associated with *Brettanomyces*/*Dekkera* spoilage

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[1]Kennison et al., *J. Agric. Food Chem.* **2007**, *55*, 10897-10901

Accumulation of smoke derived volatile phenols

Anecdotal evidence from industry that smoke taint intensifies during winemaking

Evolution of volatile phenols during fermentation investigated[2]

During fermentation of unsmoked (control) grapes:

only trace levels (< 5 μg/L) volatile phenols detected

	concentration (μg/L)			
	guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
free run juice	n.d.	n.d.	n.d.	n.d.
after alcoholic fermentation	1	tr.	n.d.	n.d.
after malo-lactic fermentation	4	n.d.	tr.	tr.

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[2]Kennison et al., *J. Agric. Food Chem.* **2008** (in press)

Accumulation of smoke derived volatile phenols

During fermentation of smoked grapes:

progressive release of volatile phenols observed

	concentration (μg/L)			
	guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
free run juice	1	tr.	n.d.	n.d.
after 1 day maceration	68	11	10	5
after 3 days maceration	168	26	8	5
after 5 days maceration	203	32	9	15
after 7 days maceration	249	42	9	17
after alcoholic fermentation	249	43	8	23
after malo-lactic fermentation	388	93	16	58

Accumulation of smoke derived volatile phenols

Release during primary fermentation could be attributed to extraction from skins

Except, phenol levels increased during malo-lactic fermentation (i.e. after pressing)

Results suggests: 1) the presence of precursor forms of volatile phenols in grapes

2) conjugation of volatile smoke components following smoke exposure

Hydrolytic release of volatile phenols investigated[2]

mild acid hydrolysis:	juice pH at 100°C for 1 hour
strong acid hydrolysis:	pH 1.0 at 100°C for 1 hour
enzyme hydrolysis:	β-glucosidase at 30°C for 24 hours

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[2]Kennison et al., *J. Agric. Food Chem.* **2008** (in press)

Accumulation of smoke derived volatile phenols

Phenols released from smoke affected juice under strong acid and enzyme hydrolysis

		concentration (μg/L)			
		guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
control	free run juice	n.d.	n.d.	n.d.	n.d.
	mild acid hydrolysate	tr.	tr.	tr.	tr.
	strong acid hydrolysate	tr.	tr.	tr.	tr.
	enzyme hydrolysate	tr.	tr.	tr.	tr.
smoked	free run juice	1	tr.	n.d.	n.d.
	mild acid hydrolysate	tr.	tr.	tr.	tr.
	strong acid hydrolysate	431	162	31	48
	enzyme hydrolysate	325	82	13	27

Implications?

Guaiacol released under enzymatic (β-glucosidase) and strong acid hydrolysis conditions

Sample preparation for assessment of smoke taint is crucial…

- Recommend enzyme hydrolysis of juice samples prior to analysis
- Strong acid conditions may not hydrolyse some precursors
- But may catalyse phenol degradative side reactions

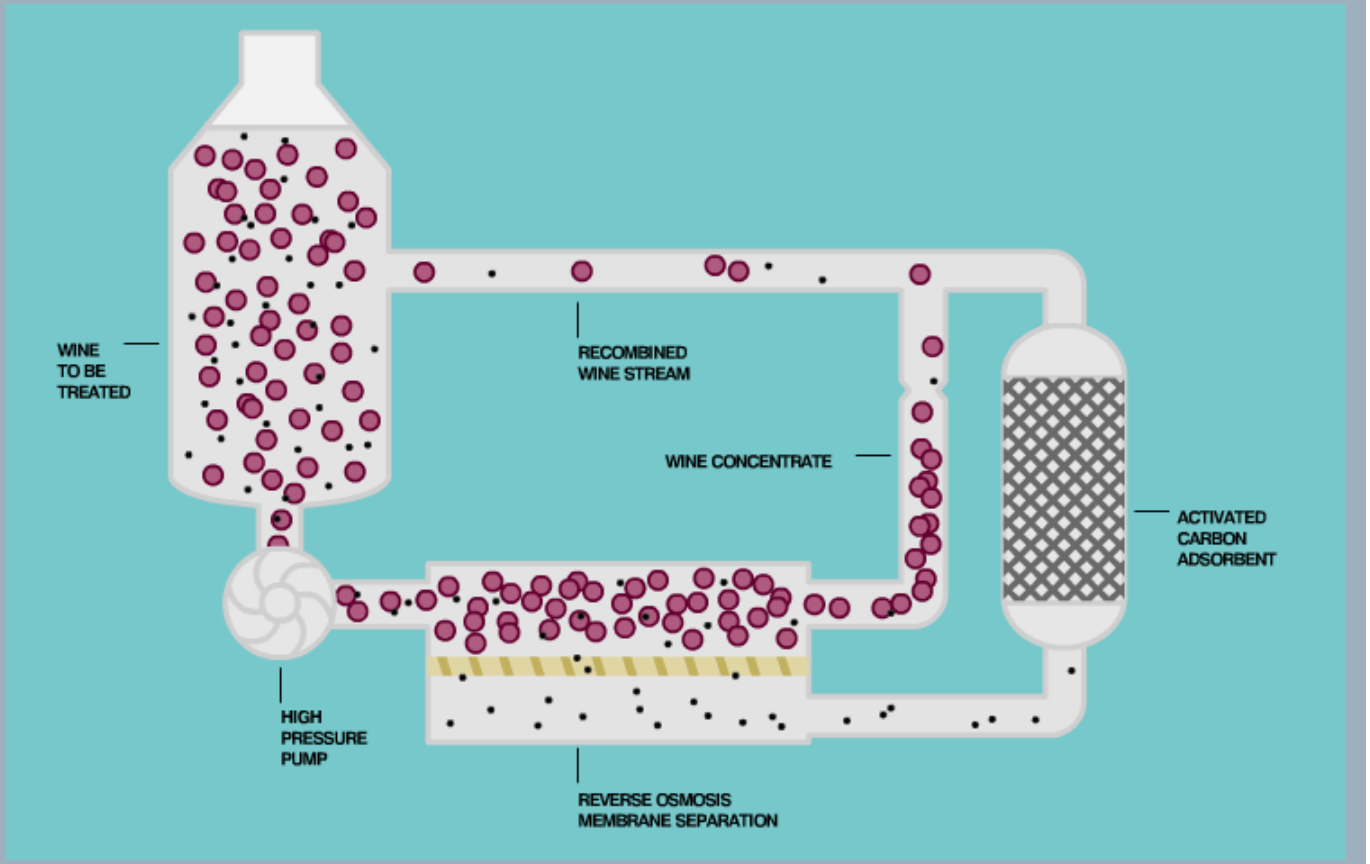
Amelioration of Smoke Taint in Wine

In 2007, GWRDC funded RDI grant to evaluate amelioration of smoke taint in wine

Commercial treatment process offered by Memstar

1) reverse osmosis *fractionate wine according to molecular weight*

2) solid phase adsorption *remove low MW wine components*



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Amelioration of Smoke Taint in Wine

Molecular weight cut-off ~ 200 amu

Compound	Molecular Weight
Water	18
Acetaldehyde	44
Ethanol	46
Acetic acid	60
Ethyl acetate	88
Lactic acid	90
Guaiacol	124
Malic acid	134
4-Methylguaiacol	138
Tartaric acid	150
Glucose	180
Flavonoids	>300

Amelioration of Smoke Taint in Wine

Treated 2007 Sauvignon Blanc from King Valley in Victoria

Samples collected from 5 treatment cycles:

whole wine

permeate pre-activated carbon treatment

post-activated carbon treatment

untreated wine permeate treated wine

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Amelioration of Smoke Taint in Wine

Wine quality parameters measured on wine and permeate samples

Treatment process did not affect wine pH, TA, sugar or alcohol content

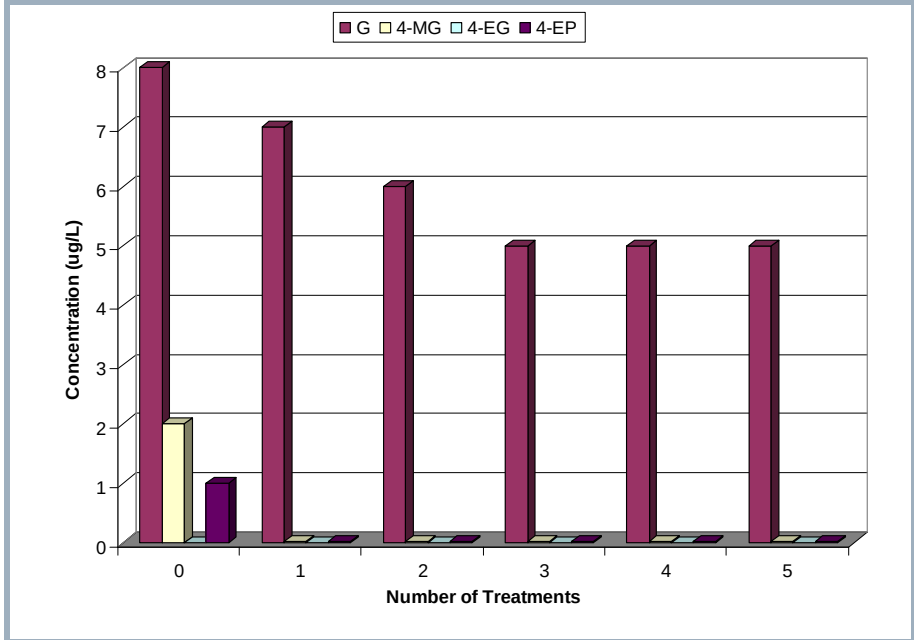
Wine phenolics decreased extraction of phenols by activated carbon?

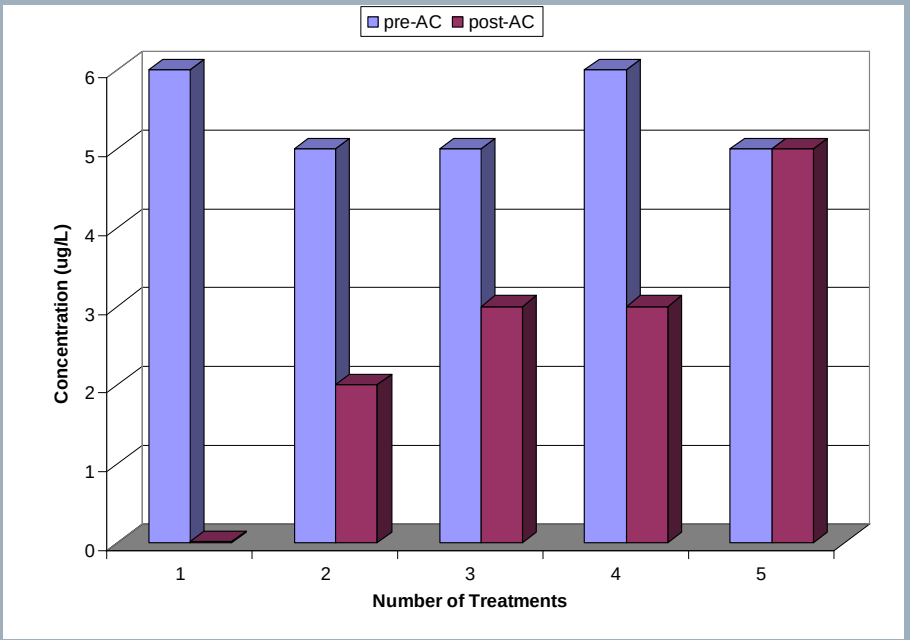
sample	pH	TA (g/L)	glucose (g/L)	ethanol (%)	phenolics (au)	brown pigments (au)
untreated wine	3.4	5.7	0.2	12.6	6.13	0.102
permeate (pre-AC)	3.5	2.4	0.0	---	-2.48	-0.006
permeate (post-AC)	3.5	2.4	0.0	---	-3.16	-0.012
treated wine	3.5	5.9	0.2	12.7	5.45	0.099

Amelioration of Smoke Taint in Wine

Volatile phenol concentrations measured in wine and permeate samples

Phenol levels decreased with treatment extraction of phenols by activated carbon





Low phenol levels – difficult to detect smoke taint – no useful sensory data

Experiment repeated using a Pinot Noir with evident smoke taint

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Amelioration of Smoke Taint in Wine

Treated 2007 Pinot Noir from King Valley in Victoria

Samples collected before and after treatment process:

untreated wine

reverse osmosis treated wine

Again, treatment process did not affect wine quality parameters

sample	pH	TA (g/L)	alcohol (% v/v)	colour density	colour hue	phenolics (au)	sugar (g/L)
untreated wine	3.4	9.0	14.1	5.2	0.8	39	0.8
RO treated wine	3.4	7.8	13.7	5.0	0.8	35	0.6

Amelioration of Smoke Taint in Wine

Smoke derived volatile phenols decreased following treatment

sample	concentration (μg/L)	
	guaiacol	4-methylguaiacol
untreated wine	12	3
RO treated wine	5	2

Treatment process had significant effect on wine sensory properties

Difference test: perceivable difference between untreated wine and RO treated wines

Consumer preference: improved consumer acceptability following RO treatment

Adsorption of ‘desirable’ wine components now being investigated

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