Identifying the chemical and sensory drivers of consumer preference for Australian sparkling wine

Assoc Prof Kerry Wilkinson & Dr Julie Culbert

THE UNIVERSITY of ADELAIDE

Project Aims:

- Employ a range of chemical and sensory analyses to characterise the compositional/sensory diversity amongst Australian sparkling white wine styles
- Identify consumer preferences for different styles of Australian sparkling white wine

Approach:

- 50 Australian sparkling white wines sourced
  10 x carbonated, 10 x Charmat, 10 x transfer, 20 x Méthode Traditionelle
  representative of different price points, regions and prominent brands
- Basic chemical analysis (pH, TA, residual sugar, alcohol, phenolics)
- Descriptive analysis with a trained panel (n=10)
- Quality rating with an expert panel (n=19)
- Statistical analysis identified a subset of wines for consumer acceptance test (n=150)
- Compositional analysis (amino acid, protein, polysaccharide, volatile profiling) and foaming

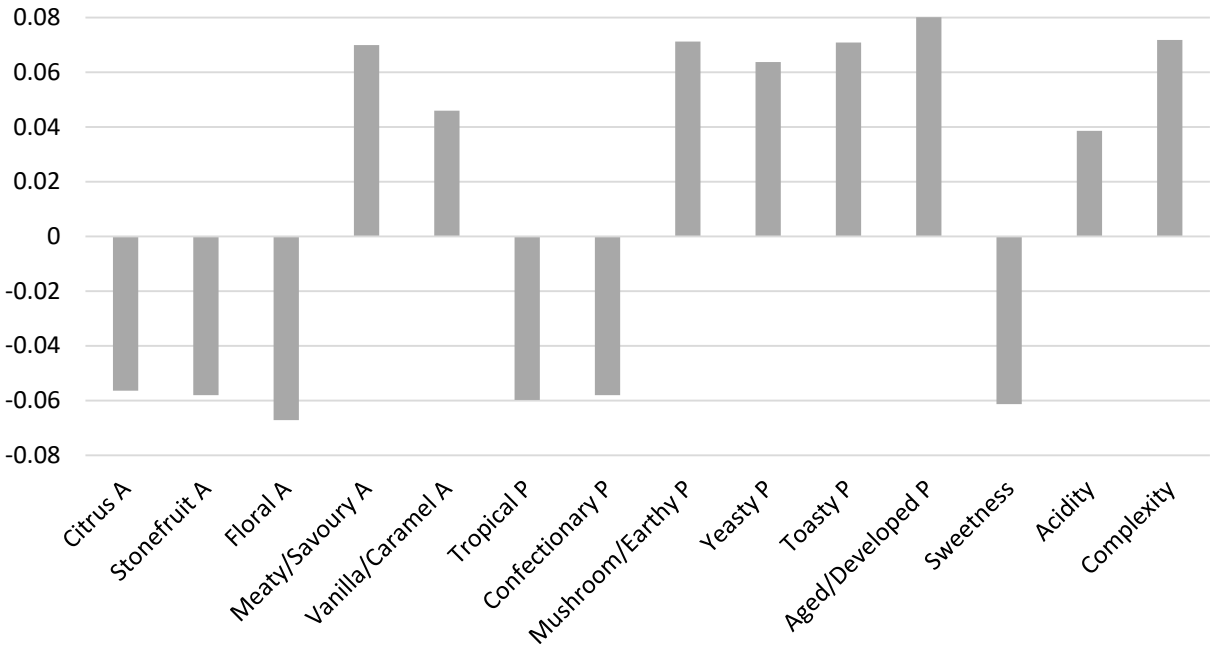
Sensory profiles and consumer acceptance of different sparkling white wines

Composition, price and quality of sparkling white wines, by production method

		pH	TA (g/L)	Residual Sugar (g/L)	Alcohol (% abv)	Total Phenolics (au)	Price (AUD)	Quality Ratings (/20)
Méthode Traditionelle (n=20)	range	2.9–3.4	6.4–9.6	0.5–13.1	11.2–13.0	0.3–4.9	$25–$90	13.9–17.4
	mean	3.2	8.0	8.8	12.3	2.2	$43	15.8 ± 0.2
Transfer (n=10)	range	3.1–3.5	5.8–7.6	3.9–15.8	11.0–13.1	0.9–4.3	$10–$31	14.1–15.6
	mean	3.2	6.9	12.0	12.0	2.4	$23	15.0 ± 0.1
Charmat (n=10)	range	3.2–3.5	6.1–7.4	8.5–19.0	11.0–12.2	0.5–4.5	$8–$23	14.4–15.2
	mean	3.3	6.8	14.0	11.6	2.9	$15	14.7 ± 0.1
Carbonated (n=10)	range	3.1–3.4	6.4–9.2	7.9–13.5	10.3–12.5	2.5–5.8	$5–$24	14.1–15.2
	mean	3.3	7.6	12.4	11.1	4.7	$10	14.6 ± 0.1

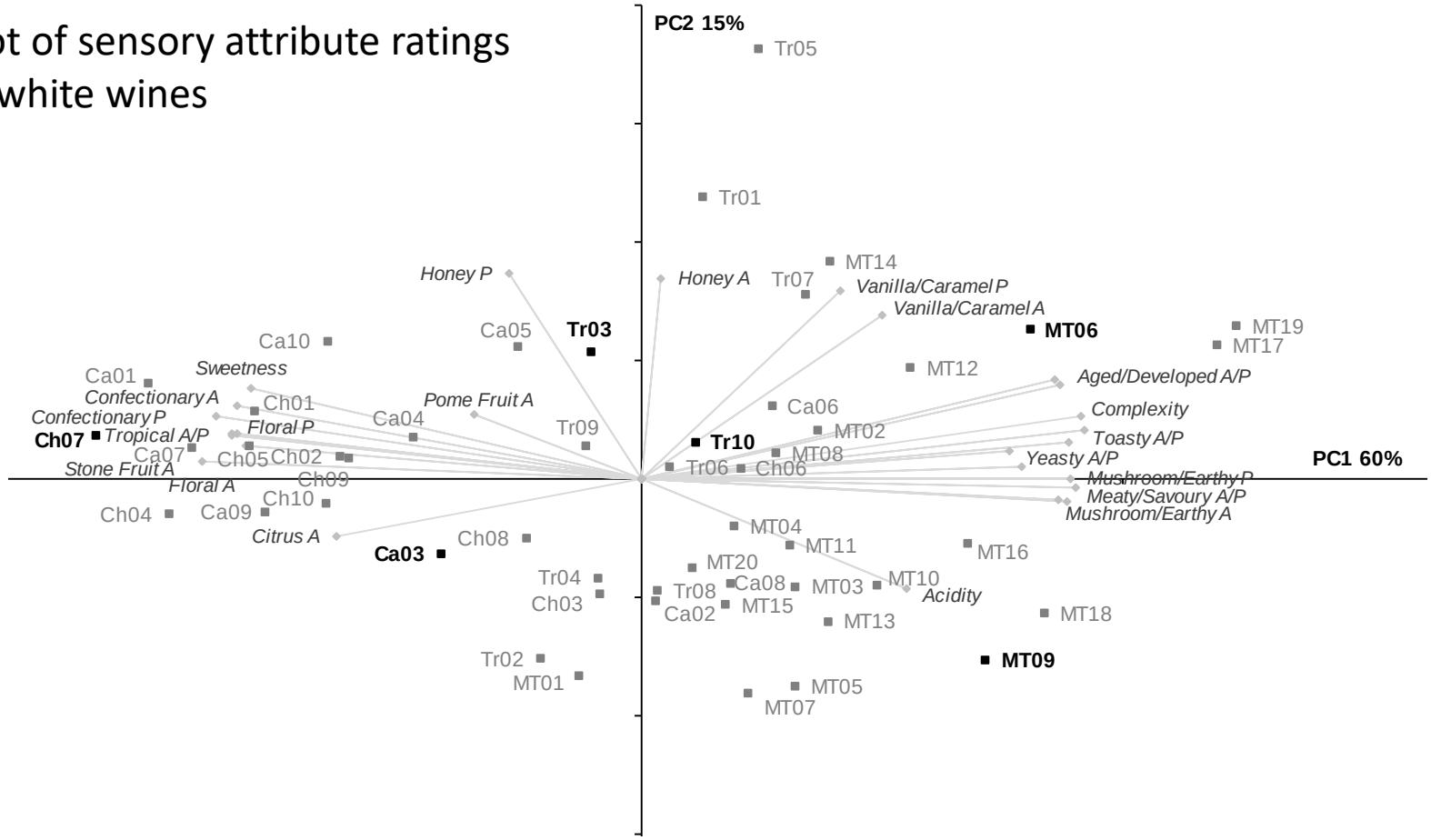
Sensory profiles and consumer acceptance of different sparkling white wines

PLSR plot of quality ratings against selected sensory attributes of sparkling white wines



Sensory profiles and consumer acceptance of different sparkling white wines

PCA score plot of sensory attribute ratings for sparkling white wines



Sensory profiles and consumer acceptance of different sparkling white wines

Composition, price and quality of the subset of sparkling white wines

	pH	TA (g/L)	Residual Sugar (g/L)	Alcohol (% abv)	Total Phenolics (au)	Price (AUD)	Quality Ratings (/20)
MT06	3.2	8.6	9.5	12.7	2.5	$70	16.6
MT09	3.3	8.5	5.5	12.0	0.3	$41	15.6
Tr03	3.2	7.6	10.5	13.1	0.9	$23	14.8
Tr10	3.2	7.9	13.3	12.7	2.4	$26	15.3
Ch07	3.3	7.8	17.3	11.9	2.0	$10	14.6
Ca03	3.4	8.4	11.6	11.1	4.1	$7	14.4

Sensory profiles and consumer acceptance of different sparkling white wines

Consumer liking scores and quality ratings for the subset of sparkling white wines

	Hedonic Ratings					Price (AUD)	Quality Ratings (/20)
	Total Sample (n=150)	**Cluster 1 (n=37)**	**Cluster 2 (n=34)**	**Cluster 3 (n=47)**	**Cluster 4 (n=32)**		
MT06	4.4 bc	5.2 a	2.0 c	5.4 a	4.8 bc	$70	16.6
MT09	4.1 c	2.9 c	3.3 b	3.9 d	6.5 a	$41	15.6
Tr03	4.4 bc	2.9 c	5.2 a	4.8 bc	4.5 bcd	$23	14.8
Tr10	4.5 b	5.9 a	4.8 a	2.8 e	5.2 b	$26	15.3
Ch07	5.1 a	5.5 a	5.0 a	5.6 a	4.2 cd	$10	14.6
Ca03	4.5 b	4.3 b	5.2 a	4.4 cd	3.9 d	$7	14.4

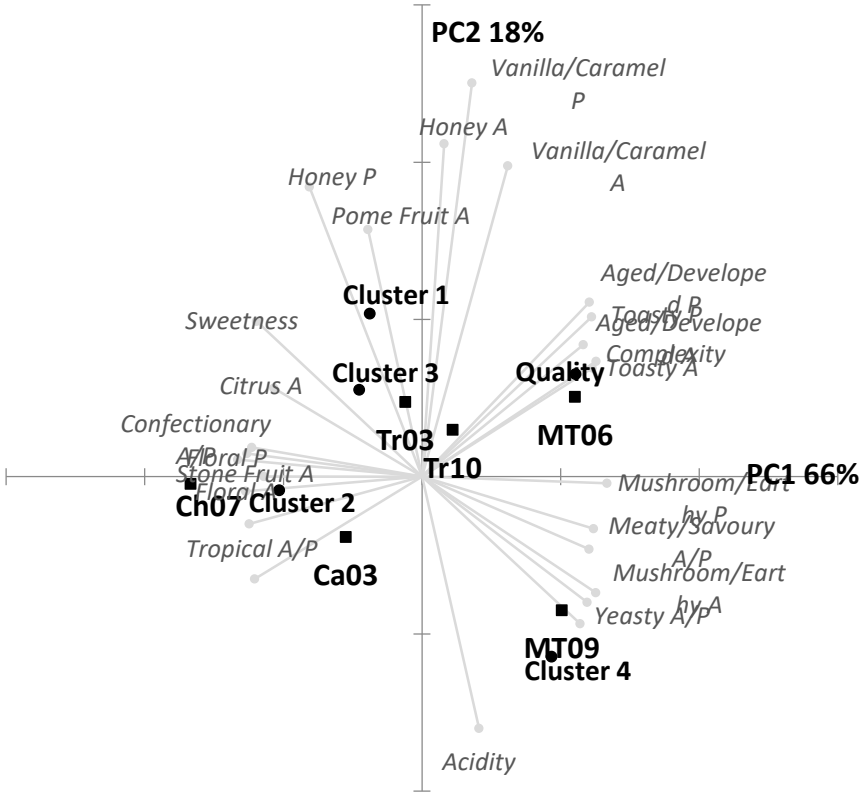
Means within a column followed by different letters are significantly different (P = 0.05, one-way ANOVA).

Sensory profiles and consumer acceptance of different sparkling white wines

PCA score plot of sensory attribute ratings liking scores and quality ratings for subset of sparkling white wines

Cluster 2: tended to be younger, female consumers, but high wine involvement

Cluster 4: tended to be older, higher proportion of male consumers, less educated, but higher household income and high wine involvement



Chemical profiles of different sparkling white wines

Analysed for:

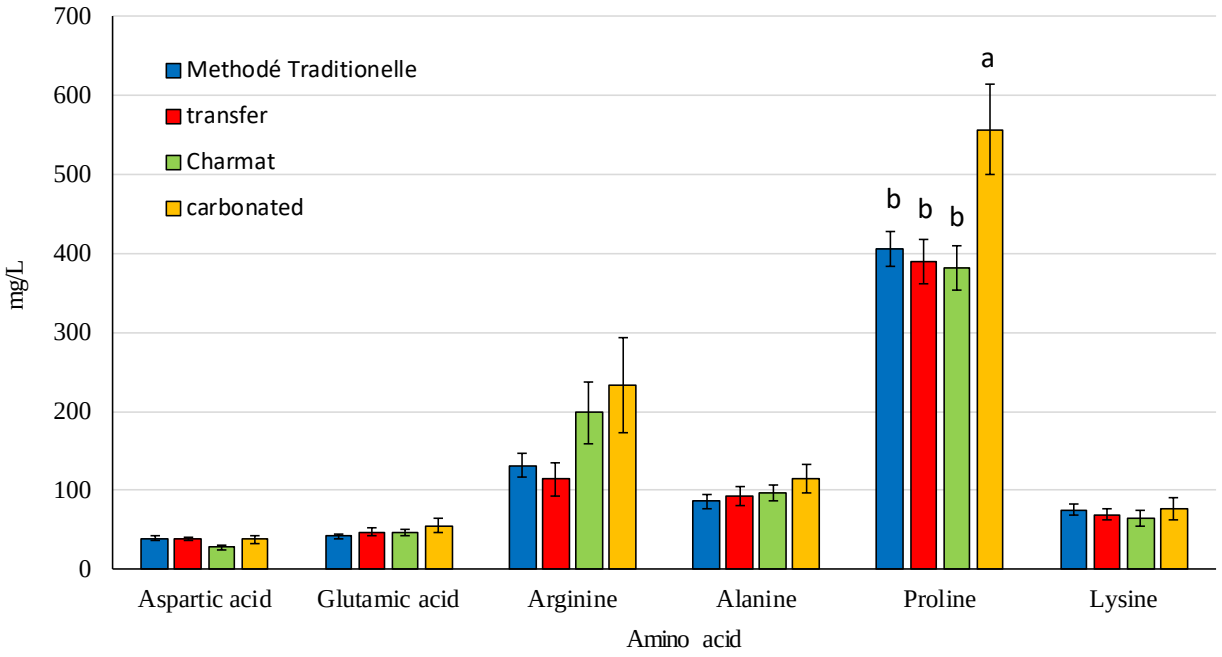
- Basic (pH, TA, sugar, % alcohol, phenolics)
- Amino acids
- Proteins
- Polysaccharides
- Volatiles

Physical analysis:

- Foaming properties

Chemical profiles of different sparkling white wines: amino acids

Production Method	Total amino acids (mg/L)
Méthode Traditionelle	460-1542 (949) b
Transfer	602-1168 (931) b
Charmat	665-1254 (976) b
Carbonation	465-1924 (1274) a



Chemical profiles of different sparkling white wines: proteins

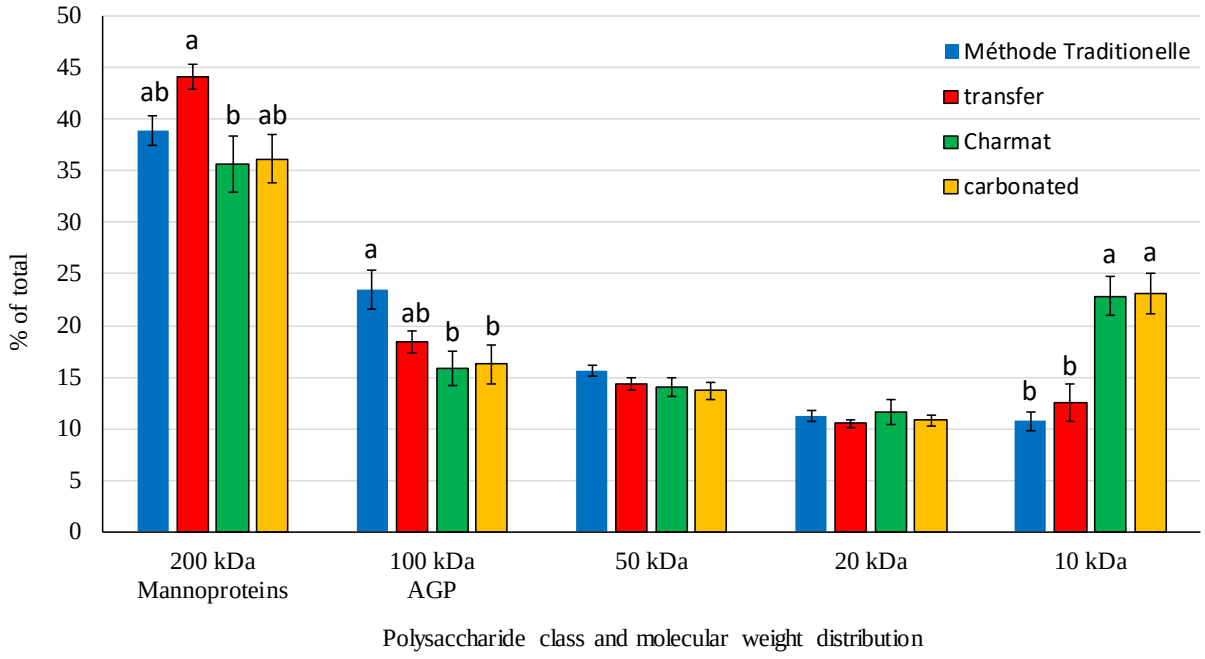
Production Method	Proteins (mg/L)
Méthode Traditionelle	6.9–161.3 (66.9) a
Transfer	5.6-78.9 (29.7) b
Charmat	7.6-71.1 (34.9) b
Carbonation	9.1-88.8 (34.6) b

Proteins influence wine foam

Wine foam influences quality

Chemical profiles of different sparkling white wines: polysaccharides

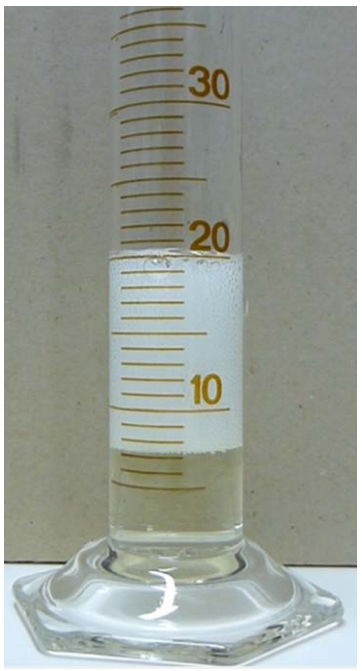
Production Method	Total Polysaccharides (mg/L)
Méthode Traditionelle	239–1285 (723)
Transfer	393-792 (622)
Charmat	341-801 (660)
Carbonation	443-975 (736)

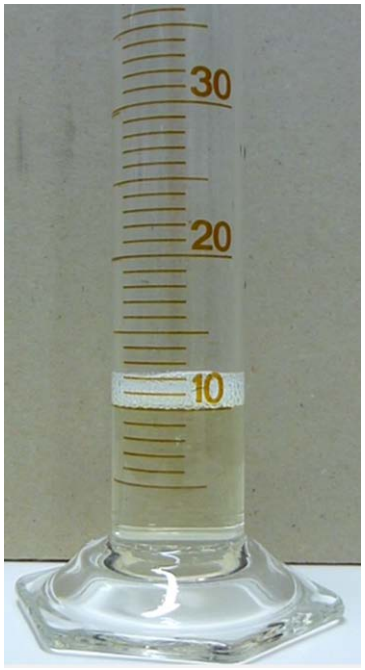


Foaming properties of different sparkling white wines

Looked at:

- Amount of foam generated (per mL of wine poured)
- Rate of foam collapse (mL/s)
- Foam collar (mL)



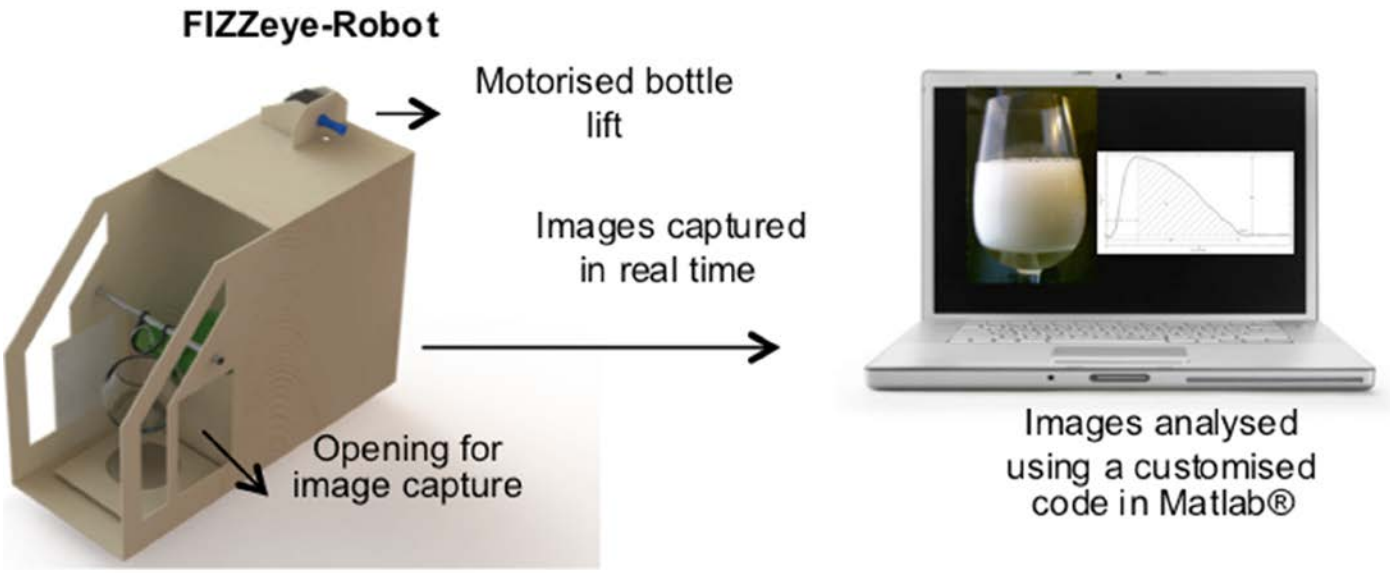


Foaming properties of different sparkling white wines

Production Method	Foam volume (mL) per mL of wine poured	Foam Collapse (mL/s)	Foam Collar (mL)
Méthode Traditionelle	1.2–3.7 (**2.4**) a	0.33-1.26 (**0.86**)	1.5–8.0 (**3.1**) a
Transfer	0.2–3.0 (1.7) b	0.94-1.55 (0.94)	0.0–4.0 (1.9) ab
Charmat	1.3–2.8 (2.0) ab	0.68-1.75 (1.11)	0.0–3.0 (1.2) b
Carbonation	0.9–2.6 (2.0) ab	0.23-1.45 (0.89)	0.0–6.0 (1.6) ab

Foaming properties of different sparkling white wines

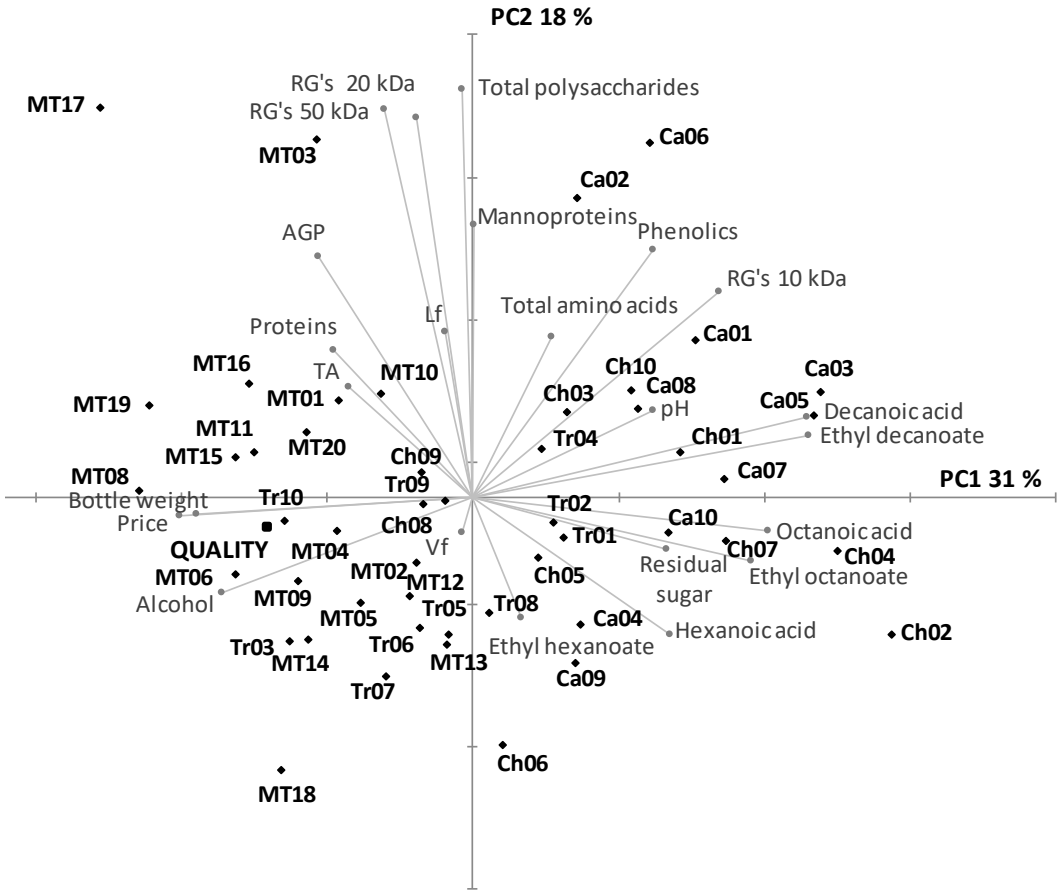
University of Melbourne



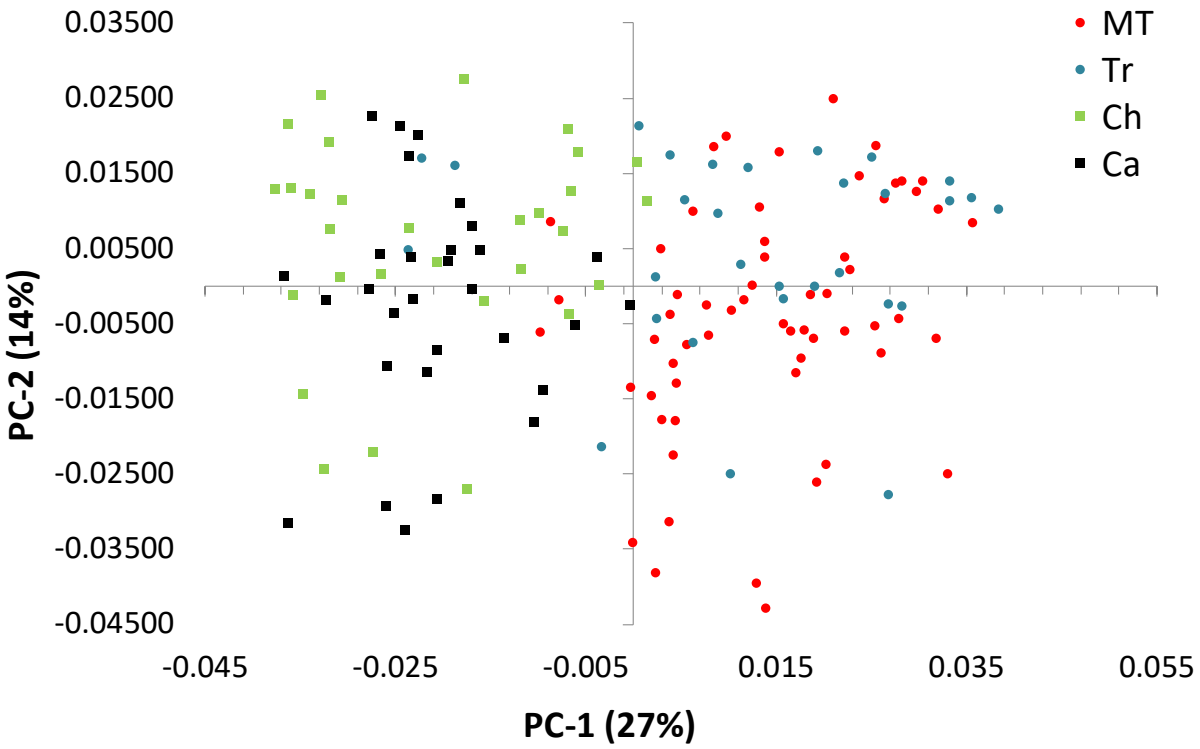
Foaming properties of different sparkling white wines

Production Method	Foam volume (mL) per mL of wine poured	Foam Collapse (mL/s)	Foam Collar (mL)	Max. foam volume V*f* (mL)	Foam Stability L*f* (s)
Méthode Traditionelle	1.2–3.7 (**2.4**) a	0.33-1.26 (**0.86**)	1.5–8.0 (**3.1**) a	53–147 (**91**)	4.0–19.8 (**10.2**) a
Transfer	0.2–3.0 (1.7) b	0.94-1.55 (0.94)	0.0–4.0 (1.9) ab	52–132 (89)	1.8–9.8 (6.5) ab
Charmat	1.3–2.8 (2.0) ab	0.68-1.75 (1.11)	0.0–3.0 (1.2) b	54–111 (81)	1.5–14.5 (5.7) b
Carbonation	0.9–2.6 (2.0) ab	0.23-1.45 (0.89)	0.0–6.0 (1.6) ab	71–106 (84)	4.0–32.9 (11.2) ab

Chemical profiles of different sparkling white wines:



Volatile compounds – PCA score plot



Volatile compounds of statistical significance

Compounds significantly higher in Charmat and carbonated wines

Peak	Compound	Confirmation
28	1-Pentanol	Poor match
42	(Z)-3-Hexen-1-ol	Poor match
47	Ethyl octanoate	Std
63	Unidentified	n/a
72	Ethyl decanoate	Std
78	Phenethyl acetate	Std
97	Octanoic acid	Std
114	n-Decanoic acid	Std

Volatile compounds of statistical significance

Compounds significantly higher in MT and transfer wines

Peak	Compound	Confirmation
34	4-methyl 1- pentanol	Poor match
35	3-Methyl 1-pentanol	Std
37	Ethyl 3-ethoxypropionate	Poor match
48	Unidentified	n/a
55	Unidentified	n/a
56	Furfural	Std
57	Unidentified	n/a
58	2-ethyl 1-hexanol	Std
64	2-Hexanol	Poor match
65	Pentanoic acid, 2-hydroxy-4-methyl-, ethyl ester	Database

Peak	Compound	Confirmation
69	2-Furancarboxylic acid, ethyl ester	Std
82	Unidentified	n/a
99	Unidentified	n/a
102	Unidentified	n/a
104	Succinoic acid, 2-hydroxy-3-methyl, diethyl ester	Database
109	Unidentified	n/a
115	Unidentified	n/a
116	Unidentified	n/a

Factors that correlate with quality scores

Parameter	Coefficient (*r*)	*p* value
Price	**0.715**	**<0.0001**
Bottle weight	**0.534**	**<0.0001**
pH	-0.166	0.249
TA	0.177	0.220
Sugar	**-0.441**	**0.001**
Alcohol	**0.479**	**<0.001**
Total phenolics	**-0.279**	**0.050**
Total free amino acids	-0.020	0.891
Aspartic acid	**0.346**	**0.014**
Proteins	**0.466**	**0.001**
Total polysacharides	-0.046	0.751
RG-I & RG-II (10 kDa)	**-0.396**	**0.004**
Max. foam volume (**V***f*)	-0.005	0.971
Foam stability (**L***f*)	0.166	0.255

Volatiles that positively correlate with quality scores

Parameter	Coefficient (*r*)	*p* value
Peak 109	**0.553**	**<0.001**
Peak 120	**0.543**	**<0.001**
Peak 82	**0.523**	**<0.001**
Peak 107	**0.514**	**<0.001**
Propanoic acid, 3-ethoxy, ethyl ester	**0.505**	**<0.001**
Pentanedioic, diethyl ester	**0.496**	**<0.001**
Butanoic acid, 3-methyl, ethyl ester	**0.472**	**0.001**
Furfural	**0.453**	**0.001**
Peak 85	**0.452**	**0.001**
Diethyl succinate	**0.446**	**0.001**
Butanoic acid, 2-methyl, ethyl ester	**0.442**	**0.001**
Peak 101	**0.401**	**0.004**
Succinoic acid, 2-hydroxy-3-methyl, diethyl ester	**0.393**	**0.005**
Peak 16	**0.388**	**0.005**

Volatiles that negatively correlate with quality scores

Parameter	Coefficient (*r*)	*p* value
n-Decanoic acid	**-0.531**	**<0.001**
Phenethyl acetate	**-0.484**	**<0.001**
Ethyl decanoate	**-0.482**	**<0.001**
Isoamyl actetate	**-0.444**	**0.001**
(Z)-Hexen-1-ol	**-0.428**	**0.002**
Octanoic acid	**-0.426**	**0.002**
Isobutyl acetate	**-0.406**	**0.003**
3-Hexen-1-ol	**-0.378**	**0.007**
1-Pentanol	**-0.376**	**0.007**
Peak 63	**-0.374**	**0.008**
Hexyl acetate	**-0.340**	**0.016**
1-Hexanol	**-0.294**	**0.039**

Correlations between volatiles and sensory attributes

Volatile compounds correlated with fruity, confection and floral characters:

- Isoamyl acetate
- Phenethyl acetate
- Isobutyl acetate
- Hexyl acetate
- Decanoic acid
- Ethyl decanoate
- Octanoic acid
- Ethyl octanoate

Correlations between volatiles and sensory attributes

Volatile compounds correlated with toasty, yeasty, earthy, caramel, aged characters :

- Diethyl succinate
- Furfural
- Butanoic acid, 3-methyl, ethyl ester
- Pentanedioic, diethyl ester
- Butanoic acid, 2-methyl, ethyl ester
- Butanedioic acid, hydroxyl-, diethyl ester, (+ and -)
- 2-Furancarboxylic acid, ethyl ester
- Propanoic acid, ethyl ester
- Succinoic acid, 2-hydroxy-3-methyl, diethyl ester
- 2-Furancarboxylic acid, ethyl ester
- Other unidentified compounds

Conclusions:

- Diversity amongst style, quality and composition of Australian sparkling white wines largely driven by production method
- Transfer and Méthode Traditionelle sparkling wines rated of highest quality
- Consumer acceptance not linked to quality
  on average, Charmat sparkling wine liked most
- Different market segments exist with distinct preferences for different sparkling wine styles
- Production and marketing strategies should account for consumer diversity

Country of origin, occasion and value strongly influence purchasing/consumption decisions

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Industry partners and reference group

Wine Australia