Chardonnay 'hazelnut' aromas: Current research review

Alana Seabrook Laffort Australia Technical Manager alana.seabrook@laffort.com.au Virginie Moine BioLaffort Director of Research and Development <u>virginie.moine@laffort.com</u> Tertius van der Westhuizen Managing Director: Australia Laffort Australia

Introduction

Chardonnay is the second most planted white varietal in the world and is integral in the production of high quality wines from Margaret River, Adelaide Hills, Mornington Peninsula, Burgundy and Champagne. Despite the fact that it plays such a majestic role in both new and old world white wines, we know very little about its distinctive varietal aroma from a chemical perspective. Some of the finest Chardonnay wines from around the world present nuances of "hazelnut", "flint", "oatmeal", and "grilled bread". Despite the recurrent citation of hazelnut (fresh and roasted) descriptor in Chardonnay wines, there has been no specific investigation of it and still no chemical explanation for it. Several studies have identified non-varietal markers, but this is the first study to propose a set of sulphur-based volatile markers sharing a common structure associated with Chardonnay wine. The present work aimed at identifying the molecular determinants reminiscent of the characteristic hazelnut notes in Chardonnay wines through a sensory-guided approach. After having confirmed the relevance of the hazelnut attribute, various analytical techniques such as Gas Chromotography coupled with Olfactory analysis (GC-O) and multidimensional gas chromatography-mass spectrometry (MDGC-MS) were implemented to search for compounds exhibiting this aroma. Their sensory properties were also assessed. More detailed information on methods and analysis can be found at Gros et al (2017).

This work, initiated by Pr. Denis Dubourdieu and directed by Dr. Axel Marchal at Bordeaux University ISVV (Gros et al 2017), - financed by BIOLAFFORT[®] and SEGUIN-MOREAU, identified and quantified new molecules unknown in wine until today and responsible for the hazelnut aroma distinctive to Chardonnay wines.

Overview of Analysis and Sensory conducted

Five wine consultants having a good knowledge of the diversity and typicality of Chardonnay wines short listed 4 wines from the Burgundy region (St Aubin 1er Cru, CHSA5; Chassagne Montrachet, CHCM6, CHCM7; Pernand Vergelesses, CHPV2) of 31 as representative a single Chardonnay grape variety for sensory profiling (**Table 1**). A panel composed of 24 experienced tasters (researchers in wine science, teachers, and enologists) were then asked to provide the descriptors corresponding to the four Chardonnay wines. Once sensory analysis had been done, 35 descriptors were collected and listed in descending order of the number of citations (**Figure 1**). Besides the recurrent descriptors such as "butter", "creamy", "gunflint", and "yellow stone fruit", the terms "hazelnut", "almond", "bergamot", "jasmine", "honeysuckle", and "verbena" emerged as important descriptors. The olfactory detection threshold corresponds to the lowest concentration perceived by 50% of tasters.

Determination of important Odoferous Zones for Chardonnay

Vacuum distillation of 10 wines was carried out on four typical Chardonnay wines (already selected for the sensory profiling), two Chardonnay wines presenting low typicality, and four non-Chardonnay

wines (Sauvignon blanc, Semillon, Viognier, and Riesling wines). These were used to design a distillation diagram designed to give *three sensorally important fractions:*

- a. **Fraction 1** (70 mbar): described as imparting hazelnut, woody and verbena notes perceived primarily for Chardonnay wines of high tipicity (Not perceived in F1 from Non-Chardonnay and from Chardonnay of low typicity)
- b. **Fraction 2** (50 mbar): Butter-like notes and slight almond aroma, particularly for the typical wines.
- c. **Fraction 3** (30 mbar): Described as common white wine characters (dry apricot, brioche notes). Was not discriminative for Chardonnay and non-Chardonnay wines.

Fractions 1 and 2 were deemed to be the more important extracts for typical Chardonnay. Sensory analysis and Molecular determination (Gas Chromatography coupled with Olfactometry Analysis) of Fraction 1 and Fraction 2 in the 10 wines (Table 2), demonstrated that over 90% of key descriptors for 'typical' Chardonnay characters were found in Fraction 1. More detailed analysis with specific heart cuts was performed on the above fractions to determine compounds found at exact peaks (Figure 2). As a result, five compounds were determined as being responsible for the 'hazelnut' aroma in Chardonnay (Figure 3), and 4 of which were able to significantly discriminant for typical Chardonnay wine (Confidence interval 95%). To assess the role of these compounds on aroma, their individual detection thresholds were estimated in model wine and in a dry white wine (Table 3).

The findings from this study are that *pyrroles* (1-ethylpyrrole-2-carboxaldehyde; 1-methylpyrrole-2-carboxaldehyde; 2-acetyl-1H-pyrrole; 1H-pyrrole-2-carboxaldehyde in **Table 3** and **Figure 2**) are able to chemically discriminate Chardonnay and non-Chardonnay wines. Results from this study also suggest that the presence of pyrroles could be partly due to their release from oak wood, as well as the grape juice and wines. Specifically, the two thiopyrroles *which to date have never been identified in nature*, 1-methylpyrrole-2-methanethiol and 1-ethylpyrrole-2-methanethiol, are responsible for the hazelnut nuance in great Chardonnay wines. These thresholds are amongst the lowest in wine, at a similar level to TCA or 4-MSP.

This work and the discovery of this new family of molecules shed new light to aroma in Chardonnay wines and could explain the 'hazelnut' aromas present in older bottles of Champagne. Research is ongoing and new results are under way, which will have oenological consequences, as large and game changing as the discovery of Sauvignon blanc thiols had a few decades ago.

BIOLAFFORT[®] is the R&D subsidiary of the LAFFORT[®] group, worldwide leader in enology. Since 1991, 20 PhDs have been financed around the world, over a 100 publications, 18 patents and today 25 employees working to develop innovative products sustainable, knowledge based enology.

Gros, J., Lavigne, V., Thibaud, F., Gammacurta, M., Moine, V., Dubourdieu, D., Darriet, P. and Marchal, A., 2017. Toward a Molecular Understanding of the Typicality of Chardonnay Wines: Identification of Powerful Aromatic Compounds Reminiscent of Hazelnut. Journal of agricultural and food chemistry, 65(5), pp.1058-1069.

no.	grape variety	identifier	origin	vintage
1	Chardonnay	CHPV1	Pernand Vergelesses 1er cru, France	2007
2	Chardonnay	CHPV2	Pernand Vergelesses 1er cru, France	2011
3	Chardonnay	CHPV3	Pernand Vergelesses, France	2011
4	Chardonnay	CHCM4	Chassagne Montrachet, France	2010
5	Chardonnay	CHSA5	St Aubin 1er Cru, France	2011
6	Chardonnay	CHCM6	Chassagne Montrachet, France	2008
7	Chardonnay	CHCM7	Chassagne Montrachet, France	2011
8	Chardonnay	CHAUS8	Margaret River, Australia	2012
9	Chardonnay	CHAUS9	Victoria, Australia	2007
10	Chardonnay	CHCHAB10	Chablis, France	2009
11	Chardonnay	CHCHAB11	Chablis, France	2007
12	Chardonnay	CHCHAB12	Chablis, France	2011
13	Chardonnay	CHMEUR13	Meursault, France	2011
14	Chardonnay	CHPUL14	Puligny Montrachet, France	2010
15	Chardonnay	CHPUL15	Puligny Montrachet, France	1997
16	Chardonnay	CHBEA16	Beaune 1er Cru, France	1996
17	Riesling	RIES17	Alsace, France	2009
18	Sauvignon Blc	SB18	Pessac-Léognan, France	2009
19	Sauvignon Blc	SB19	Pays d'Oc, France	2013
20	Sauvignon Blc	SB20	Sancerre, France	2012
21	Sauv.Blc.Sem	SBS21	Bordeaux, France	2012
22	Sauv.Blc.Sem	SBS22	Bordeaux, France	2010
23	Aligoté	Ali23	Bourgogne, France	1998
24	Aligoté	Ali24	Bouzeron, France	2007
25	Viognier	VIOA25	Tumbarumba, Australia	2013
26	Viognier	VIOA26	Trentham, Australia	2010
27	Viognier	VIOR27	Collines Rhodaniennes, France	2010
28	Cab.Sauv.Mer	MCB28	Graves, France	2013
29	Cab.Sauv.Mer	MCB29	Saint Julien, Medoc, France	2010
30	Grenache	GRE30	Vallée du Rhône, France	2013
31	Melon B	MUS31	Muscadet Sèvre-etMaine, France	2013

Table 1. Grape Variety, Identification, Origin, and Vintage of Wine Samples



Figure 1. The most quoted descriptors from ensory analysis of four 'typical' Chardonnay wines

Odorant	Descriptor	Fraction 1	Fraction 2
zone			
Α	Almond, sweet	-	+
В	Fresh hazelnut	+	-
C	Dry hazelnut	+	+
D	Grilled toasted	+	-
E	Almond, sweet hazelnut	+	-
F	Roasted hazelnut	+	-
G	Hazelnut	+	-
Н	Hazelnut	+	-
I	Almond, flowery	+	-
J	Roasted almond	-	+
К	Grilled hazelnut	+	+
L	Raw hazelnut	+	+
М	Smoked hazelnut, sweet	+	-
N	Hazelnut, coffee	+	-
0	Hazelnut, praline	+	+
Р	Hazelnut, almond, nugat	+	-

Table 2. HazeInut-like Odoriferous Zones evidenced by Gas Chromotography coupled with Olfactory analysis



Figure 2. Multidimensional Gas Chromatography Coupled with Olfactometry and Mass Spectrometry to determine key molecules



Figure 3. Quantitation of 1-ethylpyrrole-2-carboxaldehyde, 1-methylpyrrole-2-carboxaldehyde, 2-acetyl-1H-pyrrole, 1H-pyrrole-2-carboxaldehyde, and in Chardonnay and non-Chardonnay wines

	Threshold (mg/L)	
Compound	Model wine	White wine
1H-pyrrole (5)	21.3	26.1
1-ethylpyrrole-2-carboxaldehyde (1)	0.7	1.2
1-methylpyrrole-2carboxaldehyde (2)	13.6	19.6
2-acetyl-1H-pyrrole (3)	94.1	126
1H-pyrrole-2-carboxaldehyde (4)	3.2	7.9
1		

Table 3. Analytical and Sensory Characteristics of Pyrroles Identified in ThisStudy