Food Research International 53 (2013) 464–475

Contents lists available at SciVerse ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Association of selected viniviticultural factors with sensory and chemical characteristics of New Zealand Sauvignon blanc wines

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ARTICLE INFO

Article history:
Received 22 March 2013
Accepted 25 May 2013

Keywords:
3MH
3MHA
Grape harvesting
Sauvignon blanc
Sensory

ABSTRACT

The major aim of this study was to investigate associations between selected grape-growing and winemaking factors and sensory and chemical characterisation of Sauvignon blanc wines from New Zealand. Thirteen commercial Sauvignon blanc wines produced by the same wine-making team were assessed. The 13 wines included several produced under 'standard' Marlborough wine-production conditions from machine-harvested fruit, whilst other wines were produced from hand-harvested fruit, each exemplifying a particular viticultural (e.g., location) or oenological (use of oak) factor assumed to influence wine composition and sensory profile. The wines were evaluated organoleptically via several sensory methods (sorting; descriptive rating) by 28 New Zealand wine professionals. Varietal impact compounds, 3-mercaptohexan-1-ol (3MH), 3-mercaptohexyl acetate (3MHA), 4-mercapto-4-methylpentan-2-one (4MMP), and 3-isobutyl-2-methoxypyrazine (IBMP) were quantified in each wine. We show that machine-harvested-fruit wines had significantly elevated concentrations of 3MH and 3MHA, and were perceived overall as fruitier, less acidic, and as having better concentration, balance and persistence in mouth than the Sauvignon wines made from hand-harvested fruit. The Sauvignon blanc wine produced by indigenous fermentation in older oak was rated significantly higher in perceived intensity, length, palate weight, and balance than most of the other wines. The study demonstrated that vineyard location, row orientation, type of grape processing at harvest, and oenological manipulations provide means for influencing sensory profile and chemical composition of Sauvignon wines.

1. Introduction

Sauvignon blanc has been described as a relatively simple white wine (Masneuf-Pomarede, Mansour, Murat, Tominaga, & Dubourdieu, 2006), its characteristic varietal aroma due to relatively few volatile compounds. The sensory qualities and chemical compounds that contribute significantly to the perceived varietal character of Sauvignon blanc, *Vitis vinifera* L. var. Sauvignon blanc, have been the subject of much recent research (e.g., Benkwitz et al., 2012a,b; Capone & Jeffery, 2011; King et al., 2010; Marais & Swart, 1999; Parr, Green, & White, 2006; Parr, Green, White, & Sherlock, 2007, Parr, Valentin, Green, & Dacremont, 2010; Pena-Gallego, Hernandez-Orte, Cacho, & Ferreira, 2012; Tominaga, Baltenweck-Guyot, Peyrot des Gachons, & Dubourdieu, 2000; Tominaga, Furrer, Henry, & Dubourdieu, 1998).

Research quantifying the chemical compounds in Sauvignon wines that are considered to contribute the specific fruity and green characters reported as salient to varietal Sauvignon's flavour profile has focused on several thiol (e.g., Tominaga et al., 2000) and methoxypyrazine (e.g., Allen, Lacey, Harris, & Brown, 1991) compounds. Two thiol compounds in particular, 3-mercaptohexan-1-ol (3MH) and 3-mercaptohexyl acetate (3MHA), have been argued as important to the aroma profiles of Sauvignon blanc wine (Benkwitz, Tominaga, et al., 2012; Lund et al., 2009; Mateo-Vivaracho, Zapata, Cacho, & Ferreira, 2010; Tominaga et al., 2000). With respect to wine source-of-origin, Lund et al. (2009), Mateo-Vivaracho et al. (2010), and Green, Parr, Breitmeyer, Valentin, and Sherlock (2011) all reported high concentrations of these compounds in New Zealand Sauvignon wines relative to Sauvignons from other locations. Another thiol compound, 4-mercapto-4-methylpentan-2-one (4MMP), has also been reported as contributing boxwood and/or fruity notes to Sauvignon wines (Green et al., 2011). The methoxypyrazine compounds that are considered important in contributing perceived, green characteristics to wines, notably Sauvignon blanc and Cabernet Sauvignon, are 3-isobutyl-2-methoxypyrazine (IBMP) and 3-isopropyl-2-methoxypyrazine (IPMP). Green capsicum notes are regularly attributed to IBMP (e.g., Allen et al., 1991; Parr et al., 2007), while other vegetal characteristics (e.g., asparagus) are more

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0963-9969/$ – see front matter
http://dx.doi.org/10.1016/j.foodres.2013.05.028

often attributed to IPMP (Allen et al., 1991; Parr et al., 2007). However, these compounds occur in wine in trace concentrations, have extremely low detection thresholds (Allen & Lacey, 1999; Allen et al., 1991) and are difficult to measure accurately. In the present study we measured concentrations of IBMP only as IPMP concentrations are often too low for valid comparisons between wines to be made.

Other researchers have focused on the sensory characteristics of Sauvignon blanc wines, providing data that show both northern hemisphere and southern hemisphere Sauvignon wines' varietal character to be dominated by fruity notes and 'green' (green capsicum; grassy; vegetal) characters. The exact perceived flavour notes and chemical composition of the wines studied appears to be influenced by wine source-of-origin (Green et al., 2011; Mateo-Vivaracho et al., 2010). The fruity characters most often reported include passionfruit, grapefruit/citrus notes, gooseberry, stone-fruits (e.g., peach; nectarine), and tropical fruits (e.g., guava; pineapple). As well as fruity notes, 'green' characteristics appear essential to Sauvignon wines judged as typical of some locations. These include green capsicum characters in high-typicality New Zealand Sauvignon (Green et al., 2011; Parr et al., 2007), grassy notes in Sauvignons from Sancerre, France (Parr et al., 2010), and herbaceous notes in Sauvignons from Saint Bris in Burgundy, France (Parr et al., 2010).

The sensory profile and chemical composition of a wine can be altered by both viticultural (i.e., grape-growing) and oenological (i.e., wine-making) manipulations (e.g., Jones, Gawel, Francis, & Waters, 2008). Grape and wine processing operations have been shown to influence chemical composition of wines, including Sauvignon blanc (Baiano et al., 2012; Capone & Jeffery, 2011; Murat, Tominaga, & Dubourdieu, 2001). The literature is less clear however as to the way(s) in which grape and wine processing operations influence the sensory profile of Sauvignon wines. In the current study, several viticultural and oenological factors relevant to production of New Zealand Sauvignon blanc wines were associated statistically with sensory qualities and impact chemical compounds. Selection of the vitivinicultural factors to include in the present study had its basis in both current practices in Marlborough wine production and from results of a recent study (Parr, Mouret, Blackmore, Pelquest-Hunt, & Urdapilleta, 2011) that was aimed at understanding the nature of complexity in wine. Results demonstrated that wine professionals' conceptualisations of complexity in wine were dominated by reference to oenological processing operations (e.g., use of oak barrels; type of yeast used to ferment the juice), and viticultural factors (e.g., vineyard site; fruit ripeness) several of which were investigated in the current study.

Sauvignon blanc wine in Marlborough, New Zealand is most often produced in a style considered fruit-driven and relatively free from winemaker influence. That is, Marlborough Sauvignon wine is typically produced in the following way: grapes are grown on vines planted in north–south oriented rows to encourage even ripening of fruit on both sides of the row; the grapes are machine harvested and then processed relatively reductively (i.e., little opportunity for contact with oxygen during crushing and pressing operations); the musts are inoculated with commercial yeasts and fermented in stainless steel vats at temperatures between 12 °C and 18 °C. On the contrary, hand-harvesting of fruit, use of older oak barrels for fermentation or maturation of Sauvignon musts and wines, and other oenological manipulations aimed at increasing complexity or aging ability in the finished wines (e.g., use of indigenous yeasts; batonnage or lees stirring) are practised by a small number of producers only.

The present study involved sensory and chemical characterisation of thirteen Sauvignon blanc wines. All wines were produced in Marlborough in commercial quantities by the same commercial wine producer and were made by the same winemaking team. Three of the wines were produced in the 'standard' way described above, whilst ten wines exemplified a specific viticultural and/or oenological factor of interest. These ten wines were each produced by selecting and controlling a range of viticultural and oenological factors considered as possible sources of enhanced complexity in Sauvignon wines. The factors are summarised in Table 1.

Viticultural factors included (i) harvesting all fruit, or just the shaded fruit (south side of a vineyard row), from vines planted in east–west oriented rows; (ii) fruit from 'old' vines (27 years); and (iii) all fruit from the Awatere Valley, a sub-region of Marlborough known for producing Sauvignon wines with relatively high levels of IBMP (Parr et al., 2007) and a distinctive sensory profile (Trought et al., 2010). Finally, a fourth viticultural manipulation considered was hand-harvesting of fruit (9 wines) versus machine-harvesting (4 wines). This type of processing operation, along with skin contact time and must temperature, recently has been shown to influence chemical composition of Sauvignon blanc grape musts (Capone & Jeffery, 2011). Capone and Jeffery investigated concentration of thiol precursors in Sauvignon blanc grapes that were hand- versus machine-harvested and reported approximately 70% less precursor 3-S-glutathionylhexan-1-ol and 65% less 3-S-cysteinylhexan-1-ol in the hand-harvested fruit compared to machine-harvested fruit. The authors suggested increased berry damage from the latter type of harvesting relative to hand-harvesting as the likely source of the result. In the present study we extended this recent work on the influence of grape processing operations by investigating sensorial as well as chemical aspects of the wines.

Oenological factors considered in the study included (i) natural fermentation of the must in a 3-year-old, 228-litre, oak barrique; (ii) 4.5% of the wine subjected to French oak (228-L barrels) for 150 days; (iii) inoculation of the must with a specific, commercial

Table 1
Sauvignon wines employed in the study. All wines were Marlborough, New Zealand, Sauvignon wines from the 2009 vintage. TA = total acidity expressed as g/L tartaric acid equivalent; RS = residual sugars; SO_2 = sulphur dioxide.

Wines ID	Description	Ethanol % v/v	TA g/L	pH	RS	Dry extract g/L	Free SO_2 mg/L	Total SO_2 mg/L
WF3yob	Hand harvested fruit; wild ferment in 3 year old, 228-L Vicard barrel, Awatere Valley fruit	13.7	9.56	3.16	5.5	24.5	28	146
X5Yst	Hand harvested fruit; yeast X5	14.8	8.48	3.18	4	19.8	24	109
AwatereF	Hand harvested fruit; Awatere Valley fruit	14.1	7.89	3.19	1.5	15.7	27	128
Oldvines	Hand harvested fruit; old vines (planted 1982)	12.3	10.63	3.07	5.5	23.5	21	129
LgWoodFe	Hand harvested fruit; large wooden ferment: Vicard cuve	14	10.29	3.13	2.3	20.1	23	124
StainLSt	Hand harvested fruit; stainless steel tank	14.3	9.71	3.12	3.5	20.1	22	133
ShadEWV	Hand harvested fruit; shaded-side fruit of east–west vine	14.7	8.38	3.19	2.7	18.3	24	106
EWVCoqP	Hand harvested fruit; all fruit east–west vines, Coquard press	14.5	9.81	3.07	3.3	20.1	27	127
PichiYst	Hand harvested fruit; *Pichia kluyveri* yeast	14.6	8.24	3.16	5.8	20.3	22	118
MES	Machine harvested fruit; 4.5% in French oak for 150 days	13.9	7.43	3.3	3.1	17.2	18	106
MVS	Machine harvested fruit; standard wine production	12.8	7.1	3.39	4.2	18.3	21	109
MRS	Machine harvested fruit; standard wine production	13.6	6.97	3.35	2.8	18.3	23	118
STS	Machine harvested fruit; standard wine production	13.2	7.32	3.36	3.4	16.7	23	125