

The modulation of Sauvignon Blanc wine aroma through control of primary fermentation

Ellena S. King

A thesis submitted for the degree of Doctor of Philosophy

School of Agriculture, Food and Wine

The University of Adelaide

The Australian Wine Research Institute

July 2010



The Australian Wine Research Institute



Declaration

I declare that this thesis is a record of original work and contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference has been made in the text. The publications included in this thesis have not been previously submitted for the award of any degree at the University of Adelaide or other University.

I give consent to this copy of my thesis when deposited in the University library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

The author acknowledges that copyright of published work contained within this thesis (as listed in the Preface), resides with the copyright holders of those works.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue, the Australasian Digital Thesis Program (ADTP) and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Ellena King

Date:

Publications

With the exception of Chapters 1, 6 and 7, this thesis is a collection of manuscripts published in different journals. As such, the text and figures in these chapters are formatted differently, according to the requirements of the specified journals. Before each of these chapters is a Statement of Authorship, signed by all authors, listing individual contributions to the work.

The journals are ranked below in the order of impact factor in reference to their scientific significance (*Journal citation report 2009*, Thomson ISI).

Journal title	Impact factor	ERA rating
<i>Food Chemistry</i>	3.146	A*
<i>Journal of Agricultural and Food Chemistry</i>	2.469	A
<i>Australian Journal of Grape and Wine Research</i>	1.872	B
<i>American Journal of Enology and Viticulture</i>	1.171	B

The thesis is based on the following papers.

- Chapter 2.** King, E.S., Swiegers, J.H., Travis, B., Francis, I.L., Bastian, S.E.P. and Pretorius, I.S. (2008) Coinoculated fermentations using *Saccharomyces* yeasts affect the volatile composition and sensory properties of *Vitis vinifera* L. cv. Sauvignon Blanc wines. *Journal of Agricultural and Food Chemistry* 56, 10829-10837.
- Chapter 3.** King, E.S., Kievit, R.L., Curtin, C., Swiegers, J.H., Pretorius, I.S., Bastian, S.E.P. and Francis, I.L. (2010) The effect of multiple yeasts co-inoculations on Sauvignon Blanc wine aroma composition, sensory properties and consumer preference. *Food Chemistry* 122, 618-626.
- Chapter 4.** King, E., Francis, I.L., Swiegers, J.H. and Curtin, C. (*in press*) Yeast stain-derived sensory differences are retained in Sauvignon Blanc wines after extended bottle storage. *American Journal of Enology and Viticulture*.
- Chapter 5.** King, E.S., Osidacz, P., Curtin, C., Bastian, S.E.P. and Francis, I.L. (*in press*) Assessing desirable levels of sensory properties in Sauvignon Blanc wines – consumer preferences and contribution of key aroma compounds. *Australian Journal of Grape and Wine Research*.

Panel of supervisors

Dr Sue Bastian

School of Agriculture, Food and Wine
The University of Adelaide

Dr Leigh Francis

Australian Wine Research Institute
Affiliate of the University of Adelaide

Prof Sakkie Pretorius

Australian Wine Research Institute
Affiliate of the University of Adelaide

Dr Chris Curtin

Australian Wine Research Institute

Dr Hentie Swiegers

Australian Wine Research Institute
Present employer: Chr Hansen, Denmark

Acknowledgements

Thank you to my extensive supervisory team for their support and encouragement. I would particularly like to acknowledge Dr Leigh Francis and Dr Chris Curtin for their relentless efforts in making me the researcher that I am today.

An honorary supervisor to this project was my mother, Professor Karen Grimmer-Somers. Her advice and emotional support sustained me throughout, and was essential to my swift completion. I would also like to thank my father, my sister and brother-in-law, my step-father, my step-siblings, Sam and my beloved grandparents for their love and support.

Places and people in the wild must be named as supportive environments for this thesis: Ballerwindi vineyard in Mornington Peninsula, and the many winemakers who gave me the chance to get away from my studies and remember why I enjoy winemaking. To my dearest Pete, Jeune and Bob for their constant affections and for teaching me the joys of having my own family.

I also thank the staff and students at the Australian Wine Research Institute for their on-going support and encouragement; in particular, Robyn Kievit, Gal Winter and the AWRI Bioscience team, and Patricia Osidacz and the AWRI sensory team. From the University of Adelaide, I would like to acknowledge the emotional guidance of Kieren Arthur, Luke Johnston and Dr Chris Ford. Thank you also to Trent Johnson for giving up so much of his time for me.

This project was financially supported by Australia's grapegrowers and winemakers through their investment body the Grape and Wine Research and Development Corporation. Further support was provided by the Australian Postgraduate Award and the CJ Everard scholarship.

Thesis summary

There are a number of aroma compounds that are fundamental to the sensory properties of Sauvignon Blanc wines. Two such classes of compounds are volatile thiols and esters, both of which are modulated by yeast during alcoholic fermentation. Therefore, controlling fermentation using appropriate inoculated wine yeast is likely to be an effective means of enhancing wine aroma.

In an initial study, Sauvignon Blanc wines were made using different commercial *Saccharomyces* yeast strains, with two- and three-yeast co-inoculations, as well as single-strains, and equal blends of the single-strain wines after fermentation. The wines were analysed for volatile aroma compounds, and sensory descriptive analyses were performed approximately six months post-bottling. Differences in the chemical composition and sensory profiles were observed (which confirmed and elaborated on previous research). The co-inoculated yeast treatments generally had higher concentrations of volatile thiols and higher levels of esters, with higher ratings for ‘tropical’ and ‘fruity’ attributes, than their single-strain components and the blends of the single-strain components. The co-inoculated treatments generally fermented faster and issues with an ‘acetic’ flavour for one strain were eliminated when included in co-inoculation.

Some of the wines were stored, under screw cap closures, at 15°C for three years, and the chemical and sensory analyses were repeated. The results showed that some of the yeast-derived flavour differences in young Sauvignon Blanc wines were retained after extended bottle storage.

A subset of wines showing large sensory differences was subjected to consumer acceptance testing approximately six months after bottling. Differences in liking for the different yeast treatments were observed, with the largest group of consumers preferring the two-yeast co-inoculation with an intermediate sensory profile, while another group favoured the wine made using the three-yeast co-inoculation with highest ratings for the ‘estery’ and ‘floral’ aromas and highest concentrations of volatile thiols.

To further investigate this result, a study was conducted to identify which sensory attributes drive consumer preferences for Sauvignon Blanc wines, and furthermore, the volatile compounds and their levels responsible for these sensory attributes. Volatile thiols, esters and

methoxypyrazines were added to a neutral white wine at realistic levels to mimic those found in Sauvignon Blanc wines. A sensory descriptive analysis was conducted, and a subset of samples was evaluated by consumers for liking. All three classes of compounds were responsible for influencing consumer liking, with ‘confectionary’, ‘cat urine/sweaty’, ‘cooked green vegetal’ and ‘fresh green’ aromas identified as the strongest drivers of liking for different groups of consumers identified. Demographic information, and wine usage and attitudes of these white wine consumers were also used in a segmentation exercise to gain insights into consumer behaviour.

The results of this study demonstrate that the choice of yeast inoculum, using single or multiple yeasts, affects wine aroma composition and sensory properties even after an extended period of bottle age, and that there are sufficiently large differences to influence consumer preference. This study has also shown, for the first time, clear linking of Sauvignon Blanc aroma compounds, their associated sensory attributes and interactions, and effects on consumer preference. These findings highlight the importance of yeast strain selection, and give wine producers a clearer direction for tailoring white wine styles that can be targeted to specific consumer groups.

Table of contents

Declaration	i
Publications	ii
Panel of supervisors	iii
Acknowledgements	iv
Thesis summary	v
Chapter 1.	1
Review of the literature	
Chapter 2.	45
Coinoculated fermentations using <i>Saccharomyces</i> yeasts affect the volatile composition and sensory properties of <i>Vitis vinifera</i> L. cv. Sauvignon Blanc wines	
Chapter 3.	59
The effect of multiple yeasts co-inoculations on Sauvignon Blanc wine aroma composition, sensory properties and consumer preference	
Chapter 4.	77
Yeast strain-derived sensory differences are retained in Sauvignon Blanc wines after extended bottle storage	
Chapter 5.	95
Assessing desirable levels of sensory properties in Sauvignon Blanc wines – consumer preferences and contribution of key aroma compounds	
Chapter 6.	127
Characterisation of Sauvignon Blanc wine consumers in South Australia – their wine usage and attitudes	
Chapter 7.	149
Concluding remarks and future perspectives	