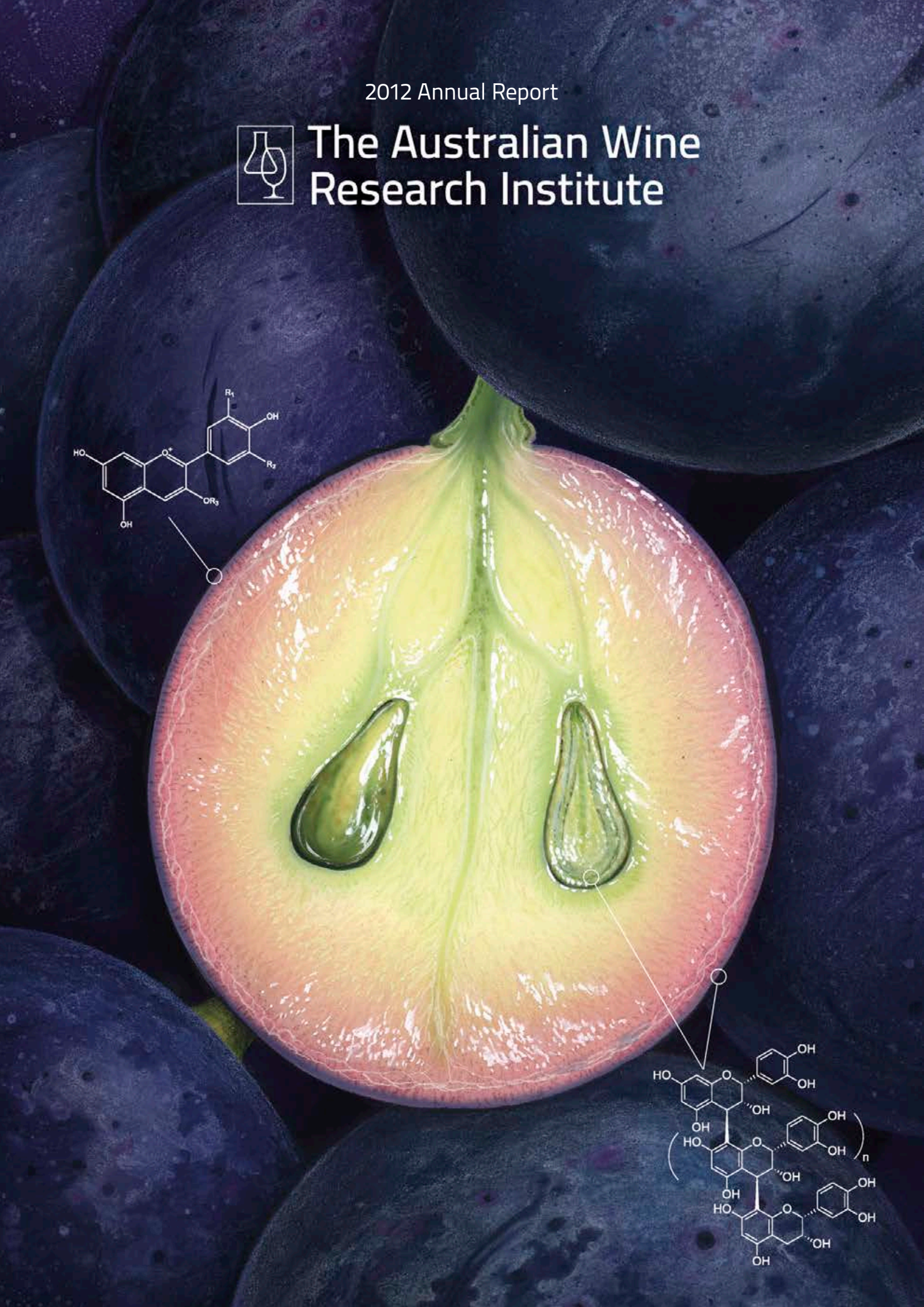
2012 Annual Report

# The Australian Wine Research Institute



**BOARD MEMBERS**

Mr P.J. Dawson, BSc, BAppSc(Wine Science)
Chairman–Elected a member under Clause 25.2(c) of the Constitution

Mr J.C. Angove, BSc
Elected a member under Clause 25.2(c) of the Constitution

Mr J.F. Brayne, BAppSc(Wine Science)
Elected a member under Clause 25.2(c) of the Constitution

Mr P.D. Conroy, LLB(Hons), BCom
Elected a member under Clause 25.2(b) of the Constitution

Dr J.S. Harvey, BSc(Hons), PhD, MBA, GAICD
Elected a member under Clause 25.2(c) of the Constitution (from 1 January 2012)

Dr D.L. Johnson, BSc(Hons), PhD, MBA, GAICD
*Ex officio* under Clause 25.2(a) of the Constitution as Managing Director of the AWRI
(from 1 December 2011)

Mr B.M. McKinnon, BAgSc (Oenology)(Hons)
Elected a member under Clause 25.2(c) of the Constitution

Mrs E.A. Riley, BAppSc (Wine)
Elected a member under Clause 25.2 (b) of the Constitution (from 1 January 2012)

Ms L.E. Rose, BAppSc, BSc
Elected as a member under Clause 25.2(c) of the Constitution

Mr M.R. Watson, BEc, MBA, ACA, IPAA
Elected a member under Clause 25.2(b) of the Constitution

Mr J.A. Lumbers, BSc(Microbiol); Lit B(Public Policy)
Elected a member under Clause 25.2(c) of the Constitution (until 31 December 2011)

Ms J.S. O'Connor, BEd (PE)
Elected a member under Clause 25.2 (b) of the Constitution (until 31 December 2011)

Professor I.S. Pretorius, BSc(Hons), MSc, PhD
*Ex officio* under Clause 25.2(a) of the Constitution as Managing Director of the AWRI
(until 30 November 2011)

**THE COMPANY**

The Australian Wine Research Institute Ltd was incorporated on 27 April 1955. It is a company limited by guarantee that does not have a share capital.

The Constitution of The Australian Wine Research Institute Ltd (AWRI) sets out in broad terms the aims of the AWRI. In 2006, the AWRI implemented its ten-year business plan *Towards 2015*, and stated its purpose, vision, mission and values:

*Purpose*
To contribute substantially in a measurable way to the ongoing success of the Australian grape and wine sector.

*Vision*
To deliver high value to the Australian grape and wine sector through world-class research and integrated solutions and to provide thought leadership to the research activities of the Australian wine sector.

*Mission*
To underpin our world-class research and integrated solutions with:

- a tenacious pursuit of understanding;
- the development of a unique, extensive and usable knowledge base; and
- a focus on contributing substantially to stakeholders achieving their needs.

AWRI's values provide guidance in how it will deliver on its mission. These *values* are:

- scientific integrity and excellence;
- a culture of delivering results;
- internally and externally collaborative;
- accountability and transparency; and
- focused on the Australian wine sector and industry driven.

The AWRI's laboratories and offices are housed in the Central Building of the Wine Innovation Cluster (WIC). The WIC is located within an internationally renowned research cluster on the Waite Precinct at Urrbrae in the Adelaide foothills, on land leased from The University of Adelaide. Collocated in the Wine Innovation Central Building with the AWRI are grape and wine scientists from The University of Adelaide. The WIC includes three buildings: WIC East, WIC Central and WIC West. WIC East is the Hickinbotham Roseworthy Wine Science Laboratory of the University of Adelaide and WIC West accommodates the other member of the WIC concept: CSIRO Plant Industry.

Along with the WIC parties mentioned, the AWRI is clustered on the Waite Precinct with the following research and teaching organisations: Australian Centre for Plant Functional Genomics (ACPFG), Australian Genome Research Facility (AGRF), Australian Grain Technologies (AGT), Australian Wheat Management, BiometricsSA, three divisions of CSIRO, Department of Water, Land and Biodiversity Conservation, Primary Industries and Resources South Australia (PIRSA), Membrane Transporter Expression Facility, VivoPharm and The University of Adelaide's *School of Science* (which includes the Schools of Agriculture and Wine, and Earth and Environmental Sciences).

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# Contents

# Chair's report


Peter Dawson

As the Australian grape and wine sector continues to grapple with challenging economic conditions, The Australian Wine Research Institute (AWRI) has remained focussed on adapting to the contemporary environment and delivering maximum value to the sector in the form of high quality research and development outcomes and effective extension.

Under the current investment agreement between the AWRI and the Grape and Wine Research Development Corporation (GWRDC), funding from industry levies and government has been static over the past three years and has declined in real terms. Fortunately, the AWRI has been able to leverage a strong foundation in capability to do more with less and the true value of the AWRI's outputs has never been higher.

When the Grape and Wine Research and Development Corporation (GWRDC) announced its intention to review the outcomes from its seven-year investment agreement partnership with the AWRI, the AWRI recognised an opportunity to investigate the value it brings to grape and wine producers. The investment agreement, which expires on 30 June 2013, concerns about 40% of the GWRDC's invested funds on an annual basis. It is essential that the AWRI is able to articulate the return on this investment – both quantitatively and qualitatively – to grape and wine levy payers. It is also essential that the assessment methods used stand up to rigorous external scrutiny.

The focus of the review was return on investment: the extent to which the AWRI has delivered value to grape and wine producers over the past seven years. The review also focused on capability and impact. It asked: do AWRI researchers demonstrate scientific and technical excellence? Is there evidence of impact, relevance and quality? Does industry use the AWRI's capability – in the form of research, expertise and technical advice – to make or save money? How effective have governance and financial arrangements been under the seven-year investment agreement?

In response, the AWRI pursued a multi-level, multi-methodology approach.

Firstly, the CRC (Cooperative Research Centre) Impact Tool was used to assess the inputs, activities, outputs, usages and impacts of the AWRI's 15 streams of activity outlined in its seven-year Research, Development and Extension Plan 2006-2103. The result was a benefit-to-cost ratio (BCR) in the order of 15:1. This compares very favourably with other institutions and research programs: a survey of economic assessments reports over the past decade suggests that BCRs of 8:1 are the 'norm'. A BCR of 15:1 is an outstanding result, demonstrating the AWRI's commitment to value delivery in tough economic times.

Secondly, an independent economic assessment was commissioned to evaluate the impact of AWRI's work in resolving and preventing selected taints and faults. This analysis revealed a substantial return of ~$264 million on an investment of ~$8.6 million across four project areas:

- *Brettanomyces* management and avoidance.
- Halophenol taint mitigation and avoidance.
- Smoke taint mitigation and avoidance.
- General help-desk services.

Thirdly, extensive documentation was prepared detailing the AWRI's research highlights, key publications and key collaborations; the value of its technical support and extension activities; and evidence of flexibility, responsiveness and adaptability in aligning its research programmes with industry priorities.

The documentation highlighted that, since July 2006, the AWRI has delivered:

- Responses to more than 30,000 information requests including technical problem solving. More than 7,000 problem samples have been investigated and confidential, expert advice provided to the companies concerned. These activities have made or saved Australia's grapegrowers and winemakers millions of dollars through improved products or averted problems.
- 2,066 presentations, workshops, seminars, lectures and other extension activities were delivered to an audience of more than 4,250 industry and academia. These activities are global in reach but focused on the value delivery to Australian grape and wine producers, providing advice and support in crises ranging from outbreaks of downy mildew to the devastating bushfires of Black Saturday in Victoria in 2009.

» A portfolio of 286 peer-reviewed and 240 industry publications on a range of technical topics, many of which are highly influential and referenced by third parties.

Finally, input was sought from stakeholders. 117 letters were received from external sources, including levy payers; suppliers of services and products (e.g. bottling companies, agrochemical suppliers and companies supplying yeast, tannin or closure products); industry associations; scientific bodies; state and Australian government; and media.

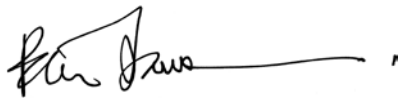
The feedback was overwhelmingly positive. In particular, stakeholders referred to the AWRI's: success in supporting their fight against 'Brett' and other spoilage organisms and taints; development of novel yeast strains; discovery of key aroma and flavour impact compounds; problem-solving capability; objective, confidential technical support services and dispute mediation on technical matters; extension platforms including AWRI Roadshows and ***Technical Review***; agrochemical 'dog' booklet; analytical service capability; Advanced Wine Assessment Courses; role played in conducting Australian Wine Industry Technical Conferences; depth of capability in a single institution; regional nodes; and overall flexibility, responsiveness and adaptability. The letters are a testament to the AWRI's efforts – in the past, present and future – to engage with industry and its stakeholders, delivering a 15:1 return on investment, in the process.

Completing this comprehensive and lengthy assessment in a short timeframe was an outstanding achievement, revealing new information about the economic value and importance of the AWRI's research to Australia's grape and wine producers. It is a credit to the AWRI's new Managing Director, Dr Dan Johnson, and the AWRI team.

There is evidence, therefore, that the GWRDC-AWRI Investment Agreement framework has been highly effective in striking a balance between accountability; strategic direction (both long and medium-term); financial and scientific oversight and operational flexibility. It has delivered outcomes that have reached every corner of the grape and wine sector. This would not have been achieved without the ongoing support and co-operation of the GWRDC Board and management and I would like to record my thanks to them as the AWRI looks forward to developing a new Investment Agreement.

I am proud of the AWRI's achievements over the past six years and embrace the review process as a significant milestone in demonstrating the AWRI's value proposition.

In closing, I would like to acknowledge the contribution of my fellow board members throughout this year, who have actively shared their wisdom and experience around the board table. I also wish to note the smooth transition of Dr Dan Johnson into the role of Managing Director. It has been a very busy and rewarding past six months for Dan in the new position, and I thank him for his tireless efforts this year.



Peter Dawson
Chair

# Managing Director's report


Dan Johnson

## Industry restructuring

The Australian wine sector continues to experience restructuring. From the vineyard to the boardroom, our sector has responded to challenging economic and trading conditions with commitment and determination.

At every level, and in every corner of our industry, we have had to take stock and find new ways to create sustainability and profitability. Very few vineyards, wineries or allied industries have been spared. Together, as a sector, we have restructured our operations and institutions to capture and create value.

Vineyards have been grubbed up to respond to economic and environmental pressures; wineries are working together to negotiate better deals on packaging; and industry bodies are rationalising their activities, changing service delivery models and, in the case of Wine Australia Corporation and the Grape and Wine Research and Development Corporation, actively exploring a merger to create efficiencies so that a higher proportion of levies can be allocated to on-the-ground initiatives, delivering more value back to industry.

The AWRI is playing its part in this restructuring process, continually seeking to maximise the impact of each and every dollar invested in research, development and extension activities. Levy investments in the AWRI have been essentially static for the past four years, not rising in line with inflation; as a result, the AWRI has yielded an efficiency dividend each year – delivering the same level of service, support and research despite rising costs. This has meant considerable restructuring at the AWRI, with cost-cutting and improved efficiency throughout the organisation, from the staffing of senior management positions to daily operations. It's all part of the AWRI's agenda to improve resource use across the organisation.

Innovation and responsiveness is embedded in the AWRI culture: the same drivers that find new ways to support growers through outbreaks of Botrytis and solve winemakers' 'Brett' problems leave the AWRI well-equipped to adapt quickly and reliably when the sector is under pressure – putting the needs of grape and wine producers first.

## The AWRI reviewed

This year's review of the AWRI's funding agreement with the GWRDC is a case in point. The review had an impact on every member of the AWRI team, requiring all staff to work together – to tight deadlines and during a busy vintage period – to evaluate the return on investment to industry of the AWRI's activities over the past six years.

By applying the same rigour that the AWRI brings to grape and wine research, development, extension and commercialisation, comprehensive data – in quantitative and qualitative formats – were generated to assess the returns to industry of the AWRI's activities.

The overarching benefit-to-cost ratio of 15:1 cited in the Chair's report is a significant achievement. Taken together with comprehensive feedback from levy payers and industry stakeholders across the value chain, and evidence of sustained engagement through extension and information activities, the AWRI has been able to demonstrate its ongoing commitment to value delivery aligned with industry priorities.

However, while stakeholder feedback was positive, there is no room for complacency. The AWRI will continue to listen carefully to stakeholder feedback and will integrate that feedback into the AWRI's forward planning and service delivery to industry.

## Highlights over the past six years

In addition to the highly valued extension services provided by the AWRI to industry on a daily basis, research highlights from the past six years articulated during the review process included:

- Insights into drivers of consumer preference in Australia and in key international markets such as China.
- New yeast strains developed and commercialised, giving winemakers more control over wine composition, creating style to achieve business objectives.
- World-first break-throughs in the genome sequencing and comparison of wine yeast, bacteria and wine spoilage microorganisms.

» Identification of the black pepper impact compound, rotundone, and improved winemaker control over impact compounds such as those responsible for fruity and/or minty characters.

» Improved management practices for 'Brett', a spoilage yeast whose influence is not preferred by the majority of consumers.

» Improved understanding of factors that influence fermentation performance, leading to risk minimisation strategies and savings due to fewer stuck or attenuated ferments.

» Practical applications of spectroscopy that inform consumer's choices, allow non-destructive monitoring of wine properties 'in bottle', and assist in rapid analysis of key juice and wine compositional parameters such as Yeast Assimilable Nitrogen (YAN).

L to R: Vince O'Brien, Shiralee Dodd, Annette Freeman, Dan Johnson

» New, rapid tools to measure key wine compositional trends that affect consumer preferences, such as tannins and pigments, leading to cost savings in analytical testing and improving turnaround times and decision-making.

» Improved oxygen management during bottling and storage through an ability to assess total package oxygen (TPO) and new closure trials for red wine and sparkling wine.

» Evaluation and commercial-scale trials of novel alternatives to bentonite, potentially leading to cost savings.

» Tools for improving economic and environmental sustainability by reducing electricity costs in the winery and understanding the carbon footprint across the value chain.

## Highlights for 2011/2012

In the current reporting period, FY 2011/2012, the AWRI has continued to work with collaborators in industry and research institutions to conduct a portfolio of programs which offer opportunities to add value to products and/or save money in production. Several noteworthy highlights are outlined below, and a complete list is provided elsewhere in this annual report.

Further progress has been made in the 'omics disciplines of genomics, metabolomics, bioinformatics and systems biology. With a critical mass of specialist staff and expertise in this emerging and internationally significant area, the AWRI has the potential to become a 'hub' for this important area of research, giving Australian grape and wine producers a 'head start' in an increasingly challenging and competitive global market. The AWRI's announcement of the genome sequence of the spoilage yeast 'Brett' provided further evidence of the potential of 'omics disciplines in guiding future management strategies for all organisms involved in the grape and wine value chain.

The AWRI has also contributed to raising the profile of Australian wine and Australian grape and wine science internationally this year, striking collaborations with key international universities and research centres that deliver benefits for Australian producers. For the first time, the AWRI has become involved in three European Union Framework Program projects, accessing a wealth of world-class expertise for the benefit of Australia's wine sector as a whole. The INNOVINE project will evaluate innovative vineyard management strategies and genetic diversity for sustainable viticulture. The STABIWINE project will investigate the use of biopolymers for sustainable stabilisation of quality wines. The FOODSNIFFER project will enable the AWRI to further its expertise and advisory work on agrochemicals detection tools. In each case, the AWRI will have access to the results quickly and be able to inform Australian grape and wine producers.

The AWRI has also commenced a new collaboration with the University of British Colombia to sequence the genome of a number of Chardonnay clones, a key varietal for Australia.

An additional regional node of the AWRI was launched in Victoria, the result of a four-way agreement between the Victorian Government, Victorian grape and wine producers, the GWRDC and the AWRI, providing support from government, industry and research bodies. Extension is the focus of the Victorian node, ensuring that producers are kept informed of key developments of direct relevance.

Important outcomes were generated at this new Victorian node and the other AWRI nodes. In partnership with Wine Tasmania and the Tasmanian Institute of Agriculture, the Tasmanian node hosted the International Cool Climate Symposium with a focus on Pinot Noir and sparkling wine production. The Griffith node made significant progress in the development of a break-through fermentation simulator in partnership with Riverina producers.

To support the Australian wine sector following the introduction of the Carbon Tax, the AWRI secured two Australian Government grants to investigate the impact of vineyard management systems on nitrous oxide emission levels and evaluate a potential new market for grape marc: preliminary evidence suggests that cows might emit less methane when fed a diet that includes grape marc supplements, and research is now underway to assess different varieties of grape marc and determine its potential value to growers.

Collaborative projects were undertaken with other industry peak bodies to eliminate barriers to trade for Australian wine, including work towards Maximum Residue Limits (MRLs) for phosphorous acid, and work towards approvals for additives such as ascorbic acid, malic acid and tartaric acid (and their salts), in key markets such as China and Canada.

Consumer preference projects related consumer experiences with closures. In one study, the AWRI determined that consumer liking scores were related to the degree of fruit freshness and oxidative flavour as a result of differing closure performance. This result came from a study which looked at a Barossa Shiraz wine bottled under seven different closures and determined consumer response after the wine had been in bottle for 18 months. The AWRI continues to be surprised at the strong response of consumers to fairly small differences in wine flavour.

All of the above highlights sit alongside the AWRI's ongoing extension and adoption activities – in 2011/2012 the AWRI received just over 4,000 requests for information and technical support, conducted about 200 help-desk investigations, provided online information through >337,000 page views on the AWRI website and a new webinar initiative, and staged 23 regional seminars and workshops.

## A productive start

It has been a highly productive year for the AWRI and my first in the position of Managing Director. It has been both rewarding and challenging to work as part of our industry in a period of transformation, change and adjustment. I believe there is now a cautious case for optimism, with a number of industry trends suggesting that we might soon emerge from this period at the bottom of the cycle. Whatever future economic conditions confront us, the Australian industry's long-standing focus on deriving competitive advantage through technical innovation will be a major factor in the industry's future success. I am proud of the AWRI's role as the industry's own research institute and the AWRI team, who pursue scientific excellence and industry impact every day. I look forward to building even closer partnerships with Australia's grape and wine producers and stakeholders in both industry and government now, and into the future.

I wish to thank the Chairman and the Board for their invaluable contribution and guidance this year. I would also like to acknowledge the GWRDC for their continued support and partnership, enabling such effective outcomes to be produced. Finally, my thanks to Team AWRI, who continue to work enthusiastically for the benefit of Australian grape and wine producers to make this great industry even greater.

Dan Johnson, Managing Director

L to R: John Harvey, Mark Watson, Jim Brayne, Peter Dawson (Chair), Liz Riley, Louisa Rose, Dan Johnson, John Angove, Brett McKinnon, Paul Conroy

# Board notes

**Chair**
Mr P.J. Dawson

**Alternate Directors of the Board**
Mr M.R. DeGaris (until 31 December 2011)
Mr N.A. McGuigan
Mr C.B. Ryan
Mr A.N. Sas

**Audit Sub-Committee**
Mr M.R. Watson (Chair)
Mr P.D. Conroy
Ms. L.E. Rose

**Remuneration and Nomination Sub-Committee**
Mr P.J. Dawson (Chair)
Mr B.M. McKinnon
Mr J.F. Brayne

**Meetings**

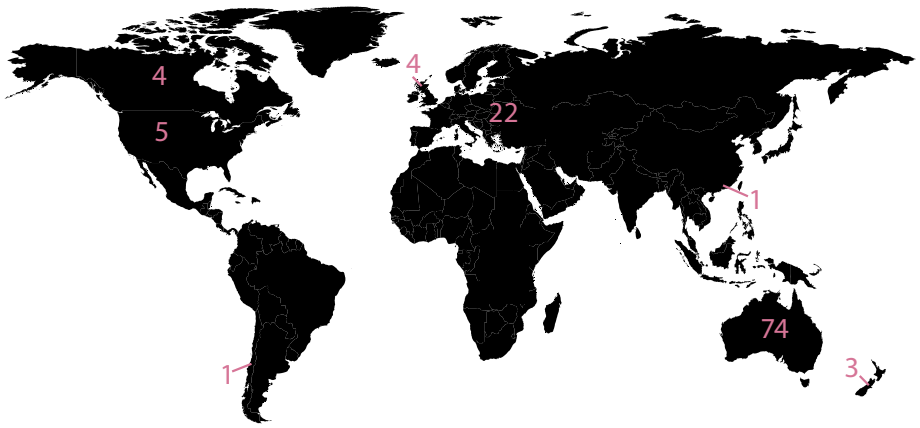
***Ordinary General Meeting***
The 57th Ordinary (Annual) General Meeting was held on 6 December 2011.

***Special General Meeting***
n/a

***Board***
The Board of the AWRI met on the following dates: 20 September 2011, 6 December 2011, 28 February 2012, 5 June 2012.

***Funding***
The Board of the AWRI acknowledges the continuing financial support of the Grape and Wine Research and Development Corporation, the Premier's Science and Research Fund, Government of South Australia, and Bioplatform Australia's EIF/Super Science program.

**Appreciation**
The activities at the AWRI benefit from collaborations from individuals and organisations from 13 different countries: Australia (Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia), Canada, Chile, China, Denmark, England, France, Germany, Italy, New Zealand, Scotland, Spain, and the USA. We gratefully acknowledge the assistance, cooperation and/or collaboration from our partners across the globe.




Number of collaborators in areas around the world

# Highlights of the year 2011/2012

## Market and consumer understanding

Highlights towards enabling market access include:

» **Phosphorous acid trial completed:** possible residue levels emanating from the use of phosphorous acid in Australian vineyards was elucidated. The study was undertaken in two parts and involved: a) the testing of domestic wines for phosphorous acid residue; and b) determination of the transfer of residue from grapes to wine after phosphorous acid fungicide applications, across a range of Australian regions. This work was primarily undertaken to inform those key export markets which are engaged in the process of setting an MRL for phosphorous acid.

» **Working towards approval of various winemaking additives:** in conjunction with the OIV and WFA, dossiers on ascorbic, malic, tartaric acid and their salts, which are additives not currently recognised for winemaking in China, were prepared for submission to the Chinese government for their consideration. This will facilitate closer alignment of regulations in China with those of other countries on allowable additives and processing aids in winemaking, to prevent a technical barrier to trade.

Highlights towards improving consumer understanding and acceptance include:

» **Consumer experiences with closures**, including work to assess ease of extraction and reinsertion of a wide range of closure types. A separate study looked at a Barossa Shiraz wine bottled under seven different closures and determined consumer response after the wine had been in bottle for 18 months. While there were only small differences in sensory properties across the closures at this time point, consumer liking scores were nevertheless related to the degree of fruit freshness and oxidative flavour due to differing closure performance. The AWRI continues to be surprised at the strong response of consumers to fairly small differences in wine flavour.

» **The AWRI now a member** of the European Union Framework Program (FP7) project FOODSNIFFER *Food safety at the point-of-need via monolithic spectroscopic chip identifying harmful substances in fresh produce*. The 10 core project partners in this recently approved €4 million project will seek the AWRI's input into the design of a new diagnostic platform for the rapid detection of agrochemicals. The AWRI's input will see agrochemicals of relevance to the Australian grape and wine sector used as a primary basis for proof of concept and scale-up work, potentially allowing a faster path to market in the Australian sector for a product resulting from this project.

» **Adoption of PinotG Style Spectrum grows:** 46 commercial wines were classified this year using the PinotG Style Spectrum. A number of these wines, now available through retail stores and through on-line distributors, use the unique labelling device to engage with and inform consumers on the style of wine they can expect when they open a bottle of Pinot Grigio or Pinot Gris.

» **Spectral fingerprinting shows promise for Chardonnay wine style:** the Chardonnay Style Spectrum has been developed, in conjunction with a number of leading wine producers, to translate the complex attributes of Chardonnay wines into a single linear scale that can be used to classify the style and correlates with the sensory characteristics of the wines. This is an extension of the PinotG Style Spectrum concept, which was developed as a labelling device for Pinot Grigio and Pinot Gris wines to inform consumers of the expected wine style at the point of sale. Further development and refinement of this tool is currently underway.

## Winemaking excellence

Highlights include:

» **Bound flavour and aroma compounds released in the mouth:** as part of the AWRI's studies into smoke taint, a non-volatile glycoside (sugar molecules joined to aroma compounds) fraction isolated from smoke-affected grapes was found to give smoky flavour when tasted. This shows that these compounds, which were previously regarded as flavourless, can be broken down during the short time of tasting to release flavour. This research has been extended to evaluate desirable flavours in wines and how it relates to both intensity and persistence of fruity flavour when wines are tasted.

» **White wine phenolics:** AWRI research has shown different phenolic composition can display different textures when tasted in the same wine background/environment (alcohol, pH, TA etc.). Alcohol concentration positively enhanced four major taste/textural attributes (astringency, viscosity, bitterness and hotness) in white wine, and phenolics and alcohol contributed in an additive way (that is, they combine their effects) to these attributes. Caftaric acid was shown to reduce the burning hotness from alcohol and grape reaction product was shown to increase oiliness. 'Astringency' ratings in white wines were found to be strongly negatively correlated with pH (i.e. lower pH gives higher astringency). This is one of several findings of significance which contradict the widely held assumption that phenolics are the main cause of astringency in white wines. 'Viscosity' ratings in white wines were found to be strongly positively correlated with pH (i.e. lower pH gives lower viscosity). This new discovery emphasises further the importance of pH in wine composition on the perception of mouth-feel in white wines. 'Bitterness' was generally shown to be positively associated with phenolics. However, the two major phenolics in Australian white wines (GRP and caftaric acid) don't contribute to bitterness. This means some other phenolic or phenolic class in white wine does contribute to bitterness, the identity of which remains to be established.

» **Aged Riesling flavour**: working with Henschke Wines, a study measured the levels of the bottle-aged-related flavour compound TDN in commercial Riesling wines and gave insight into TDN's development. Wine age, high mean January temperature of the growing season and screw-cap closures were all found to be important factors which resulted in higher levels of this key compound.

» **Alternative to bentonite a step closer—Proctase proof of performance tests completed:** physicochemical and sensory analysis on wines produced during pilot-scale trials on combined heat and protease treatment of juice were completed. Sensory testing conducted on Sauvignon Blanc wines showed that wines produced with Proctase were *not different* from those stabilised with conventional bentonite fining. Analysis confirmed that those proteins responsible for forming heat-unstable hazes (chitinases) were fully removed using the combined heat and protease treatment.

» **AWRI hybrid yeast preferred for Pinot Noir production:** a very successful workshop informing winemakers on how to produce alternative styles for Pinot Noir ('Taming the Pinot Noir terroir') was held during the 8th International Cool Climate Symposium in Tasmania, January 2012. Frogmore Wines winemaker Nick Glaetzer (2011 Jimmy Watson Trophy winner) showcased wines made by diverse winemaking processes, including maceration methods benchmarked by research at the AWRI Tasmanian Node and the use of unconventional yeasts developed at the AWRI. Along with sensorial differences, spectral analyses of wines identified tannin variations between individual processes and between different yeast. A large majority of the participants preferred wine made by the hybrid yeast AWRI Fusion to wine made by an industry standard Pinot Noir yeast.

» **The AWRI now a member** of European Union Framework Program (FP7) project STABIWINE *Use of biopolymers for sustainable stabilization of quality wines;* a project valued at >€2 million. The project partners (14 entities in total) successfully argued that the AWRI should be involved in this project. The AWRI's participation will allow the Australian wine sector to obtain first hand access to the results of the project and ensure that Australian wine entities obtain access to project results in a timely manner.

» **Fermentation support tool:** field testing of the AWRI fermentation simulation tool continues. The tool provides real-time predictions of ferment end-point and automated warning information on fermentations that are moving away from desired specifications, allowing problems with stuck or attenuated ferments to be reduced. The tool also provides guidance on energy demand profiles at a tank-farm level and scenario planning functionality that allows reduction of energy use and production costs.

## Sustainability

Highlights include:

» **Cleaner production opportunities:** knowledge of how in-winery practices influence wastewater quantities and quality has been generated along with opportunities for reduction initiatives. Studies included wine movements within wineries, cleaning chemical reuse, and cross-flow lees filtration.

» **Improving refrigeration efficiency:** case studies analysing the practicalities and savings associated with different refrigeration improvement opportunities were performed, including the use of warmer brine temperatures and the increased use of off-peak electricity.

» **Sensory threshold data have been obtained from sodium and potassium chloride:** results show that sodium chloride in white wine is detected at much lower levels than in red wine (difference threshold of 455 mg/L in white compared to 1156 mg/L in red), while there is a wide variation in sensitivity to potassium chloride, which also tastes salty. These sensory studies augment the evaluation of salt excluding properties of rootstocks in a collaborative project which is led by CSIRO Plant Industry.

» **Winery wastewater management:** a Research to Practice (RtP) training manual and workshop seeking to mitigate the effects of climate change, drought and water shortage was developed. The AWRI prepared this module on Winery wastewater management to help overcome what are real and immediate threats for the Australian grape and wine sector. Key strategies for sustainable production including efficient water use, wastewater management, water reuse and recycling were presented in the Hunter Valley.

» **The AWRI now a member** of European Union Framework Program (FP7) project INNOVINE *Combining innovation in vineyard management and genetic diversity for a sustainable European viticulture*. The AWRI will act as a member of the project scientific advisory panel.

## Smart science/practical solutions

Highlights include:

» **Clonal variation in Chardonnay grapevines:** the AWRI, in collaboration with the University of British Columbia's Wine Science Center and Bioplatforms Australia, has embarked on a study of genetic variation among Chardonnay clones. Through a combination of whole genome sequencing and clonal winemaking trials the project will identify genetic determinants that shape wine-relevant traits. This will enable the development of diagnostic tools for authenticating Chardonnay clones and will enhance our understanding of Chardonnay clone performance in an Australian context.

## Extension and educational activities

Highlights include:

» **Crush 2011**: the AWRI staff played a major role in organising and supporting the *Crush 2011* symposium including program development activities, chairing sessions and delivery of presentations.

» **The 8th ICCS successfully completed:** the 8th International Cool Climate Symposium was held in Hobart 1-4 February. The AWRI's contribution to this event included eight workshops and resourcing of the conference secretariat role. Content focussed on Tasmanian wine styles featuring sparkling and Pinot Noir.

» **AWRI Victoria node established:** an agreement was signed between DPI Victoria, GWRDC, Wine Victoria and the AWRI for the formation of a node to service the regions of 'greater Victoria'. The aim of this partnership is to enhance the uptake of the latest technologies, best management practices and climate change adaptation practices.

» **New information made available to producers:** 28 new fact sheets of AWRI activities were produced; new technical literature from around the world was abstracted in six issues of *Technical Review*; producers were alerted to topical issues in 28 eBulletins; updates of AWRI activities were produced in six issues of *eNews*; and industry was informed of newsworthy updates from the AWRI in eight media releases.

» **Seminars, workshops and webinars:** this year, 23 seminars and workshops were staged (32 different wine regions are visited over a two-year cycle). A webinar program was commenced to allow industry members to participate in seminars without leaving their workplace. Nine webinars were presented in the first series and an expanded program is planned for 2012/2013. Two courses of the Advanced Wine Assessment Course were staged in addition to a number of other themed tasting events.

» **Eight Research to Practice training courses** were organised with 137 wine sector stakeholders in attendance. Training in 'Alternative Varieties: emerging options for a changing environment' was by far the most popular of the courses offered by the AWRI. The other course presented was 'Winery wastewater management and recycling', held in Hunter Valley.

» **Throughout the year, the AWRI staff gave 399 presentations and 28 media interviews;** conducted 26 workshops; presented 23 posters; presented 39 lectures to undergraduate students (plus coordinated a 50 hour subject); and supervised/co-supervised 22 students.

## Technical support

Highlights include:

» **Technical advice**: AWRI staff responded to ~1,000 technical queries during the 2011/2012 period. The majority of these queries were received from winemakers or associated winery production staff. The type and nature of the queries were consistent with historical trends. The top 10 keywords were: taints and contaminations, haze and deposits, microbiological, fermentation advice, regulation, smoke, analysis methods, moulds, sulfur dioxide and 'other' types of queries.

» **Helpdesk investigations:** the AWRI performed ~200 small-scale winemaking research projects (investigations), with the results and remedial advice reported to winemakers in a variety of formats. Investigations were performed for wineries located in various regions and zones throughout Australia with recurrent themes including:

- Botrytis and laccase.
- Hydrocarbon taints and paint contaminations.
- Musty taints.
- Reductive issues.
- Wine damaged during transport.
- Copper related instabilities.

» **Bulk shipping taints:** during the year, there were four bulk shipping taint investigations involving a total of 14 different wines, eight of which were found to be tainted with petroleum-derived aromatic hydrocarbons. All of these cases involved wine which had been shipped in flexible bladders, generally referred to as 'flexitanks'. Whilst the AWRI has investigated similar cases over the past 20 years, there has been an increase in the number of such cases over the past few years, with that increase generally following the increasing volume of bulk wine exported.

» **Non-invasive spectroscopic screening provides a new approach to assessing damaged wines:** the BevScan™ (an analytical instrument used to identify spectral differences among wines in-bottle) was used at Angove Family Winemakers to screen samples of a commercial red wine that were exhibiting random patterns of oxidation during storage. Bottles were identified that had acceptable development characteristics, allowing the mobilisation of stock for overseas markets.

» **Response to requests for information:** the AWRI responded to **4412 recorded requests for information** during the 2011/2012 year. To put the statistics into perspective, 18 people contacted the AWRI seeking information on every working day of the year. This figure does not include the amount of problem solving samples investigated (816) or the number of Commercial Services analyses undertaken during the year. Of the total number, **979 requests were for technical information and winemaking-related enquiries**. The AWRI viticulture staff members responded to **327 requests for viticulture assistance**. The majority (189) were 'agrochemical-related'. The remaining 138 calls related to various general viticulture enquiries. **61 information health and nutrition requests and 81 independent regulatory, science and technical-related information requests** were managed by the Health and Regulatory Information Manager. The Information Services team managed **2964 requests for information**.

## Reference sites

Highlights include:

» **New website supporting national extension objectives developed:** the AWRI proposed, developed and manages an events-based website on behalf of the National Wine Extension and Innovation Network (NWEIN). This initiative enables grape and wine producers to access information on extension events which are scheduled in their region, state or national, addressing a wide range of interests. It also supports extension providers in effective programming of events by avoiding date clashes, event topic 'fatigue' and highlighting opportunity gaps.

» **AWRI website upgrade:** the website is a key communication and support platform attracting more than 52,000 unique visitors during 2011/202. Re-developed using a web content management system, the website comprises self-help sections including FAQs on winemaking, viticulture and health, library database and online article ordering system and fact sheets. The suite of on-line tools encompasses winemaking calculators, Total Package Oxygen calculator, search tools for agrochemicals and permitted additives and processing aids. During this financial year, visitors to the website viewed over 337,000 pages.

Readers are strongly encouraged to read the annual report in detail rather than relying on the brief details above for information.

**Acknowledgements**
Edited by Rae Blair and Dan Johnson

Compilation assistance from Shiralee Dodd, Heather Donnell, Virginia Phillips, Annette Freeman and Alfons Cuijvers

Design by Geoffrey Reed Communications

Photography by Jacqui Way Photography

# Staff

The actual number of AWRI staff employed in a full-time, part-time and casual capacity as at 30 June 2012 was 125 (100.7 full-time equivalents). When the number of AWRI-based students (both from Australia and overseas) and visiting researchers are added to our complement, the number increases to 143. Of this number of people working on outcomes for Australian grape and wine producers, around two-thirds (67%) are funded by the GWRDC.

## Office of the Managing Director

**Daniel Luke Johnson,** BSc (Hons), PhD *Flinders*, GAICD, MBA *UAdel*, Managing Director

**Isak Stephanus Pretorius,** BSc (Ag) (Hons), MSc (Ag), PhD *Orange Free State Uni*, Managing Director (concluded 30 November 2011)

**Vincent Thomas O'Brien,** BE (Chem) (Hons) *UAdel*, PhD *UniQLD*, Business Development Manager

**Raelene Joan Blair,** CertAppMgt (Mkting) *AIM*, GAICD, Communication Manager

**Shiralee Joy Dodd,** BA, LLB (Hons), *UAdel*, GDLP, *Law Society of SA,* Executive Officer

**Alfons Cuijvers,** M. Law *UniAntwerp*, Project Officer Business Development

**Amy Rose Hill,** Personal Assistant to the Managing Director

**Kathryn Sarah Beames,** AWITC Conference Manager

**Andrea Robyn Francis,** BSc *UniWA*, GradDip (EnvSc) *MurdochUni,* AWITC Conference Secretariat (commenced 13 February 2012)

## Corporate Services

**Hans Engelbert Muhlack,** BEc *UAdel*, CPA, Group Manager – Corporate Services

**Mark Raymond Braybrook,** CertIV (EngMechTrade) *TAFE*, Operations Manager

**Christopher John Day,** BAgSc (Oen) (Hons), MBA *UAdel*, GradChartAccountFound *DeakinUni*, CA, Finance Manager

**Adam Leigh Holland,** Cert IV IT *NTUni*, IT Coordinator

**Linda Joy Halse,** BA, PostGradDip (IndRel) *UniNatal*, HR Manager

**Catherine Louise Borneman,** BBus (Acc) *RMIT*, CA, Accountant

**Anne Hazel Haworth,** Finance Officer (concluded 2 September 2011)

**Fang Tang,** Undergrad (ForeignEcon) *RenminUniChina*, GradDip (FinMgmt), M. Comm *UniNewEngland*, Finance Officer (commenced 19 September 2011)

**Alfons Cuijvers,** M. Law *UniAntwerp*, Project Officer HR, OHS

**Pauline Jorgensen,** Cert III (BusAdmin) *TAFE SA*, Administration Officer

**Janice Margaret O'Donnell,** Receptionist

**Deborah Joy Thornton-Wakeford,** Receptionist

**Jeanette Fay Tooley,** Administration Support

## Research

**Markus Johannes Herderich,** staatlich geprüfter Lebensmittelchemiker (CertFoodChem), PhD *UniWürzburg*, GAICD, Group Manager – Research

**Anthony Richard Borneman,** BSc (Hons), PhD *UMelb*, Principal Research Scientist – Molecular Biology

**Paul Joseph Chambers,** BSc (Hons), PhD *UniHertfordshire*, Research Manager – Biosciences

**Christopher Daniel Curtin,** BSc (Hons), PhD *Flinders*, Research Manager – Biosciences

**Ian Leigh Francis,** BSc (Hons) *Monash*, PhD *UAdel*, Research Manager – Sensory and Flavour

**Yoji Hayasaka,** Dip Eng (IndChem) *Tokyo IT*, MPharmSc *Monash*, PhD *YamanashiUni*, Senior Research Scientist – Mass Spectrometry Facility

**Paul Anthony Henschke,** BSc (Hons), PhD *UAdel*, Principal Research Scientist – Microbiology

**Paul Alexander Smith,** BSc (Hons), PhD *Flinders*, Research Manager – Chemistry

**Eveline Jutta Bartowsky,** BSc (Hons), PhD (Microbiol) *UAdel*, Senior Research Scientist – Microbiology

**Cristian Andres Varela,** BSc (Biochem), MSc (Biochem), PhD (ChemEngBioproc) *CatholicUniChile*, Senior Research Scientist

**Cory Alan Black,** BSc (Hons), PhD (Chem) *UOtago*, Research Scientist

**Dimitra Liacopoulos Capone,** AssDip (Chem), BAppSc (Chem) *UniSA*, PhD *UAdel* Research Scientist

**Peter James Costello,** BSc (Hons), MSc *UniNSW*, PhD *UAdel*, Research Scientist

**Martin Peter Day,** BSc (Hons) *USussex*, PhD *UNantes*, M. Oen *UAdel*, Research Scientist

**Richard Gawel,** DipEd, BSc, GradDip (Oen) *UAdel*, Research Scientist

**Helen Elizabeth Holt,** BAgSc (Hons), PhD *LaTrobe*, Research Scientist

**Keren Bindon,** BSc (Biol) (Hons) *UniNatal*, MSc (Plant Biotech) *UniStellenbosch*, PhD *UAdel*, Research Scientist

**Simon Anthony Schmidt,** BSc (Hons), PhD *Flinders*, Research Scientist

**Mark Edward Smith,** BSc (Hons), PhD *UAdel*, Research Scientist

**Antonio Felipe Garcia Cordente,** BSc (Chem), BSc (Biochem), PhD *UniBarcelona*, Research Scientist

**Matteo Marangon,** BSc (Hons), PhD *UniPadua*, Research Scientist

**Jacqui Marie McRae,** BSc (EnvMgmt) *VicUni*, BSc (Biotech) (Hons), PhD *SwinburneUni*, Research Scientist

**Christine Marianne Mayr,** State Exam (Pharm) *LMUMunich*, PhD, Post Doctoral Research Fellow

**Dariusz Roman Kutyna,** MSc *AgUniPoland*, PhD *VicUni*, Post Doctoral Research Fellow

**Marlize Zaretha Viviers,** BSc (IndustChem) (Hons), M. Chem, PhD *Stellenbosch Uni*, Post Doctoral Research Fellow

**Tracey Ellen Siebert,** ScTechCert (Chem) *SAIT*, BSc *UAdel*, Senior Scientist

**Patricia Osidacz Williamson,** BSc (FoodEng) *StateUniCampinas*, MSc *Unilllinois*, Senior Sensory Scientist

**Jennifer Rose Bellon,** BSc (BiochemGenetics) *UAdel*, Scientist

**Alexander Schulkin,** BSc, Bar-Ilan, GradDip (Oen) *UAdel*, Scientist

**Tangerine Parker,** BSc (Chem) *Flinders*, Scientist

**Stella Kassara,** BSc (Hons) *UAdel*, Scientist

**Caroline Elisabeth Abrahamse,** BSc (Biotech) (Hons) *UAdel*, Technical Officer

**Sheridan Renee Barter,** BTech (ForensAnalChem), BSc (Hons) *Flinders*, Technical Officer (commenced 31 October 2011)

**Belinda Ruth Bramley,** ScTechCert (Biol) *SAIT*, BSc *UAdel*, Technical Officer (concluded 14 October 2011)

**Angus Henderson Forgan,** BSc (Hons) *Flinders*, Research Laboratory Manager

**Robyn Louise Kievit,** BSc *UniSA*, BSc (Hons) *UAdel*, Technical Officer (concluded 3 February 2012)

**Radka Kolouchova,** AssDip *TechCollFoodTech*, Technical Officer

**Jane Melissa McCarthy,** Cert (Anim Hand), Cert (VetNurs) *TAFE SA*, AdvCert (MedLabSc) *UniSA*, Technical Officer

**Kevin Herbert Pardon,** AssDip (AppChem) *SAIT*, Technical Officer

**Wesley Peter Pearson,** BSc (WineBiochem.) *UniBritish Columbia*, Technical Officer – Sensory (commenced 26 October 2011)

**Samantha Ellen Anderson,** BSc (ForensAnalytChem) *Flinders*, Laboratory Technician (commenced 6 July 2011)

**Russell Bond Gardiner,** Winery Assistant

**Jelena Jovanovic,** Purchasing Officer

**Heather Margaret Donnell,** Administrator

**Jennifer O'Mahony,** Laboratory Assistant

**June Robinson,** Research Laboratory Support

### *Microbial Metabolomics Facility*

**Meagan Diane Mercurio,** BSc (Hons), BTech (ForensAnalChem) *Flinders,* MBA *UniSA*, Manager – Metabolomics Facility (concluded 3 April 2012)

**Philip Mercurio,** BSc *UniNthArizona*, BSc (Hons), MSc *JamesCookUni*, Scientist (concluded 30 November 2011)

**Mark Roger Solomon,** BSc (Chem) (Hons), BSc (MedChem) *Flinders*, Scientist

**Natoiya Dee Rayette Lloyd,** BSc (MedChem) (Hons) *Flinders*, Post Doctoral Research Fellow (commenced 5 December 2011)

**Esther Kristianto,** BSc (AppChem) *UniTech Sydney*, Technical Officer-Metabolomics (commenced 5 December 2011)

### *Bioinformatics*

**Wade Michael Hines,** BA (BioChemMolecBiol) *UCSanta Barbara*, PhD *UCSanFrancisco*, Manager AWRI/BPA Bioinformatics Node

**Nathan Spencer Watson-Haigh,** M. Pharmacol. (Hons) *UBath*, PhD (Biology) *UYork*, Senior Bioinformatician

**Jeremy Crispin Hack,** Bioinformatician

### *Casual Sensory Panel*

Lynn Alabaster, Peter Baldwinson, Brian Beggs, Jaqueline Gould, Philippa Hall, Felicity Harding, Sonya Henderson, Gurinder Khera, Lynette Lee, Mary Likos, Catherine Milne, Ralph Osborne, Vivianne Rees, Heather Smith, Mark Werner, Fiona Woodcock

## Industry Development and Support

**Con Arthur Simos,** BAppSc (Oen) *UAdel*, MBA *UniSA*, Group Manager – Industry Development and Support

**Peter Ronald Dry,** BAgSc, MAgSc, PhD *UAdel*, Viticulture Consultant

**Linda Maree Bevin,** BBus (InfoMgt), GradDip (LibInfoStud) *QUT*, Information and Knowledge Manager

**Adrian Dermott Coulter,** BSc *Flinders*, GradDip (Oen) *UAdel*, Senior Oenologist

**Geoffrey David Cowey,** BAppSc (WineSc) *CSU*, BSc (Hons) *UAdel*, Senior Oenologist

**Marcel Essling,** BBus *UniVic*, BAgSc *UAdel*, Senior Viticulturist

**Matthew Grant Holdstock,** BSc *Flinders*, GradDip (Oen) *UAdel*, Senior Oenologist

**Mark Krstic,** BAgSc (Hons), PhD *UniTasmania*, MBA *MelbBusSch*, Extension Services Manager Victoria (commenced 30 January 2012)

**Creina Standish Stockley,** BSc (Hons) *UAdel*, MSc *Flinders*, MBA *UniSA*, Health and Regulatory Information Manager

**Mardi Longbottom,** BAgSc (Vit Sci), M. Vit, PhD *UAdel*, Viticulturist

**Gemma Ashe West,** BAgSc (Oen), *UAdel,* MBA *UniSA*, Winemaker

**Gayle Ann Baldock,** BSc (Hons) *UniGuelph*, Scientist

**Emma Louise Kennedy,** BSc (CompMod) *Flinders*, Technical Officer

**Francesca Blefari,** BBus, *UEdithCowan,* Events and Projects Coordinator

**Anne Dorothy Lord,** GradDip (InfoStud) *UniSA*, Librarian

**Michael Lansel Downie,** GradDip (LibInfoMgmt) *UniSA*, Library and Information Services Officer (commenced 12 December 2011)

**Sean Mathew Boden,** BA *UAdel*, GradDip (InfoStud) *UniSA*, Systems Librarian (concluded 28 October 2011)

**Virginia Frances Phillips,** Administrator

## Industry Applications

**Peter William Godden,** BAppSc (WineSc) *UAdel*, Group Manager – Industry Applications

**Neil Scrimgeour,** BSc (AppChem) (Hons) *Wolverhampton*, Research Manager – Industry Applications

**Daniel Cozzolino,** AgricEng *Uruguay*, PhD *UniAberdeen*, Senior Research Scientist (concluded 28 November 2011)

**Robert George Dambergs,** BSc (Hons) *UAdel*, PhD *UniQLD*, Senior Research Scientist

**Wieslawa Cynkar,** BSc, PhD *Wroclaw*, Research Scientist

**Richard Anthony Muhlack,** BE (Chem) (Hons), PhD *UAdel*, Process/Environmental Engineer

**Ella Margaret Clare Robinson,** BA, BSc (Hons) *UAdel*, Project Manager

## Commercial Services

**Eric Wilkes,** BSc (Chem) (Hons), PhD *Uni Newcastle*, Group Manager – Commercial Services (commenced 4 July 2011)

**Leanne Michele Hoxey,** BSc *UAdel*, Quality Systems and Laboratory Manager

**Randell Leith Taylor,** BSc (Hons) *UAdel*, Manager Trace Laboratory

**Warren Keith Roget,** BEng (Mechatronic) (Hons) *UAdel*, Technical Manager

**Karl Kevin Forsyth,** BEng (Chem) (Hons), BEc *UAdel*, Senior Engineer

**Simon Nordestgaard,** BE (Chem) (Hons), BEc, PhD *UAdel*, Senior Engineer

**Tina Thi My Tien Tran,** BSc (Microbiol/Biotech), BSc (AppBiol) (Hons), PhD *VicUni*, Project Officer

**Bryan Newell,** BAppSc (Chem&ChemProcTech), BAppSc (AppPhys) *UniSA*, Laboratory Technician

**Kerry Anita Pinchbeck,** BSc (MedChem) *Flinders*, PhD *UAdel*, Laboratory Technician

**Tadro Jonathan Abbott,** BChemEng (Hons) *UAdel*, Project Engineer (commenced 16 January 2012)

**Matthew James Cream,** Customer Relations Manager (commenced 19 December 2011)

**Melissa Nutt,** BTourHospMgmt, GradCert (HRMgmt) *UniSA*,Customer Service & Marketing Coordinator (concluded 18 November 2011)

**Robyn Monica Gleeson,** Laboratory Support

**Alana Spears,** CertII (HospOp) *TAFE SA*, CertIV (JapaneseLang) *VLLC*, Customer Service Officer

**Heather Mandy Tosen,** BSc *UAdel*, Scientist

**Slavko Matthew Bekavac,** BAppSc (Chem&Chem ProcTech) *UniSA*, Senior Laboratory Technician

**Daniel Scott Tynan,** DipAppSc (ChemTech) *UniSA*, Laboratory Technician

**Pamela Solomon,** BTech (ForensAnalChem), BInnEnt (ScTech) *Flinders*, Technical Officer

**Timothy James Gordon Reilly,** BSc (Nanotech) (Hons) *Flinders*, Laboratory Technician

## Students

**Andrea Anesi,** M. Biotech *UniVerona*, PhD Student (7/2/2011-30/09/2011)

**Ines Botscher,** (FoodChem) *UniBonn,* Honours Student (07/11/11 – 31/12/12)

**Raul Guerrero,** PhD (Oen) *UniCadiz*, PhD Student (18/03/2011-27/04/2012)

**Michael Hanscho,** DipEng *UniGraz* (31/10/2011-04/04/2012)

**Claudio Hidalgo,** M. Oen *UniRovira/Virgili*, PhD Student (27/04/2011-31/10/2011)

**Jingyuan Li,** Doctor *China Agricultural Uni,* PhD Student (31/10/11-31/10/2012)

**Christina Linke,** (FoodEng) *UniBonn* (18/01/2012-25/05/2012)

**Alessandro Moncalvo,** AssProfFoodEng&Oen *UniCattolica Piacenza Italy*, PhD Student (05/09/2011-07/03/2012)

**Corine Ting,** *UAdel*, Hons & PhD Student (01/02/2010-31/08/2011)

**Gal Winter,** BSc, M. Sc (Biochem&FoodSc) *HebUniJerusalem*, PhD Student (27/06/2010-31/03/2012)

## Visiting Researchers

**Juami Canals Bosch,** PhD (Chem) Assoc Prof *UniRovira/Virgili*, Visiting Researcher (31/5/2011 – 30/5/2012)

**Chiara Bozzini,** M. AgSc *UniPadua*, Visiting Scientist (10/10/2011-30/03/2012)

**Angela Contreras,** PhD *UniSantiago,* Visiting Researcher (17/04/2012-16/10/2012)

**Estibaliz Mateo,** PhD (BiolSc) *UniRovira/Virgili*, Visiting Researcher (27/04/2011-31/10/2011)

**Ignacio Nevares Dominguez,** PhD (AgEng) *UniValladolid*, Visiting Researcher (15/08/2010-15/09/2011)

**Simona Campolongo,** PhD (WineMicrobiol) *UniTorino,* Visiting Scientist (12/01/12-04/04/2012)

# Staff activities

**Dan Johnson** is Chair of the Australian Wine Industry Technical Conference Inc.; a Member of International Scientific Board of l'Institut des Sciences de la Vigne et du Vin (ISVV) Bordeaux, France; Winemakers' Federation of Australia Innovation Policy Committee; Winemakers' Federation of Australia Wine Industry Technical Advisory Committee; National Wine Foundation; Wine Innovation Cluster Leadership Group, Waite Strategic Leadership Group; *Australian Journal of Grape and Wine Research* Advisory Committee and Chair, WineHealth 2013 Organising Committee. Dan was also a member of the 8th International Cool Climate Symposium Planning Committee.

**Markus Herderich** is a Director of the Australian Wine Industry Technical Conference Inc., member of the Metabolomics Australia Executive Management Group, and Wine Innovation Cluster Research Group. He is also an Affiliate Associate Professor of The University of Adelaide and a member of the Advisory Board of the *Journal of Agricultural and Food Chemistry*. Markus is a delegate and expert for the Organisation International de la Vigne et du Vin (OIV), and a member of the 15th Australian Wine Industry Technical Conference Planning Committee and the Program sub-committee.

**Eveline Bartowsky** serves on the Joint Editorial Board of the *Journal of Applied Microbiology* and *Letters in Applied Microbiology,* serves on the Editorial Review Board of the *Journal International des Sciences de la Vigne et du Vin*, *Acetic Acid Bacteria*, and *Frontiers in MicroBioTechnology* journals. She was also a member of the international Scientific committee of the 3rd International Conference on Acetic Acid Bacteria, Vinegar and other Products (Cordoba, Spain 17-20 April 2012), a member of the 15th Australian Wine Industry Technical Conference Planning committee and Poster coordinator, and is an Affiliate Lecturer at The University of Adelaide.

**Paul Chambers** is coordinator of a national Bioplatforms Australia/AWRI, Wine Yeast Systems Biology project, and is coordinator of the Australasian Yeast Group (through its homepage at http://www.ayeastgroup.org/).

**Peter Costello** is an External Advisor to Aaron Hayes, PhD student at the University of Adelaide. Aaron's PhD title is: 'Microbiological and chemical characterisation of indigenous versus inoculated fermentations: the role of bacteria'.

**Bob Dambergs** is a member of the Wine Industry Tasmania Technical Committee and the National Wine Research Network (NWRN), Secretary and Board member of the ASVO, member of the 8th ICCS Planning Committee, Chair of the 8th ICCS Program Committee and an Honorary Associate of the University of Tasmania.

**Leigh Francis** is an Associate Editor of the *Australian Journal of Grape Wine Research*, a member of the Editorial Board of the *Journal of the Science of Food and Agriculture*, and is also an Affiliate Lecturer at The University of Adelaide.

**Jeremy Hack** is a member of the Metabolomics Australia Analytical, Laboratory Information Management System (LIMS) and Informatics working groups.

**Paul Henschke** is an Associate Editor of the *Australian Journal of Grape and Wine Research,* is a member of the Editorial Review Boards of *Food Microbiology* and *Mitteilungen Klosterneuburg*, and was a member of the local organising committee for the 8th International Cool Climate Symposium held in Hobart in February 2012. He is a guest lecturer at The University of Adelaide and Flinders University.

**Simon Schmidt** is a member of the Australian Society of Biochemistry and Molecular Biology (ASBMB) and ASBMB liaison officer for the Adelaide Protein Group (APG) Organising Committee.

**Peter Godden** is a member of the 15th Australian Wine Industry Technical Conference Planning Committee and the Program sub-committee, participated as a judge at the Royal Adelaide Wine Show, and is a member of the Royal Adelaide Wine Show Wine Committee.

**Con Simos** is a member of the National Wine Extension and Innovators Network(NWEIN), the 15th Australian Wine Industry Technical Conference Program sub-committee and Program Convenor for the 15th AWITC Workshop program.

**Peter Dry** is an Adjunct Associate Professor, University of Adelaide, and Associate Editor of the *Wine and Viticulture Journal*.

**Mark Krstic** is the Deputy Chair of the National Wine Extension and Innovation Network (NWEIN); current Board member and past President of the Australian Society of Viticulture and Oenology (ASVO); member of the 15th Australian Wine Industry Technical Conference Planning Committee and the Program sub-committee; and Wine and *Viticulture Journal* editorial advisory panel member.

**Creina Stockley** is an Affiliate Senior Lecturer at The University of Adelaide and is the Coordinator of the Wine Science Course entitled *Grape Industry Practice, Policy and Communication* for the School of Agriculture and Wine. She is a member of the National Alcohol Knowledgebase Expert Working Group, the Winemakers' Federation of Australia (WFA) Wine Industry Technical Advisory Committee, WFA Wine industry National Environment Committee and the WFA Wine and Social Responsibility Committee. She is also the DAFF nominated Australian delegate for the Organisation International de la Vigne et du Vin (OIV) Safety and Health Commission (IV), is currently the President of the Food Safety Expert Group and was elected on 22 June 2012 as President, Commission IV Safety and Health. She is also a member of the honorary editorial board of the *International Journal of Wine Research*, as well as a charter member of the International Scientific Forum on Alcohol Research and a member of the Scientific Board of the (European) Wine Information Council. In addition, Creina is a member of the Planning Committee and Chair of the Scientific Committee for WineHealth 2013 International Wine and Health Conference (to be held in Australia). She was also Guest Editor of the Special Issue: Wine and Health of the *Journal of Wine Research*.

**Vince O'Brien** is a member of the Winery Engineering Association Conference Planning Committee, and Wine Industry Suppliers Association Innovation Committee.

**Leanne Hoxey** is a member of the IWAG (Inter Winery Analysis Group) committee.

**Chris Day** is the Treasurer of the Australian Wine Industry Technical Conference Inc. and a member of the Planning Committee of the 15th Australian Wine Industry Technical Conference.

# Progress reports

## Information and knowledge transfer

### Transfer of knowledge relating to winemaking

**Staff**

Con Simos, Geoff Cowey, Adrian Coulter, Matt Holdstock, Emma Kennedy, Virginia Phillips, Francesca Blefari, Ella Robinson

L to R: Mark Krstic, Con Simos and Creina Stockley

Australian winemakers were supported through the year by the AWRI's Winemaking and Extension Service team. Winemaker queries were addressed and advice and assistance were offered by a small group of qualified winemakers through this problem solving service. The team monitors each month the type and nature of queries and investigations conducted against industry trends observed over the last 20 years. This allows the team to observe, to react to and communicate any current sector issues to Australia's grape-growers and winemakers; to enact any required emergency response; conduct small-scale applied winemaking trials or communicate internally any additional research that may be needed to be conducted by the AWRI research team. Any required industry educational tools are then produced and made available through development of workshops or seminars to aid in the prevention of future similar issues or make available information for future occurrences.

The team communicates with industry through the AWRI's *Technical Review*, *eBulletins*, *eNews*, *The_AWRI* twitter account, Facebook and wine industry magazines and journals, and through educational services such as: the national road-show seminar and workshop program; AWRI Webinars, AWITC workshop program; the Advanced Wine Assessment Course; Research to Practice®; web-based resources; and tailored workshops or seminars on request by sector associations. The team also provides presentations for external seminars and conferences; produces educational material and resources for winemaking in the 'Resources for wineries' section of the AWRI website and also provides 8 hours of lectures to Oenology students at the University of Adelaide (see the Appendices for further details).

An *eBulletin* and *eNews* article were prepared and distributed in advance of the chemical buying period to alert wineries to review their contractual arrangements with suppliers to ensure the wineries have appropriate legal recourse.This was in response to an issue in 2007, where the AWRI advised industry of a taint derived from tartaric acid. The investigation identified a compound exhibiting a 'plastic/chemical/beachball-like' taint. This case went to court in 2010 and involved the manufacturer and supplier of the contaminated tartaric acid, and a number of wineries that had wine tainted as a function of using the acid in the winemaking process. In handing down its decision, the court ruled in favour of the supplier; the finding was based on the terms and conditions of sale which were included in a credit application signed by the wineries prior to purchase of the tartaric acid from the supplier. While it was accepted that the 'contaminated' tartaric acid provided by the supplier was not reasonably fit for use by the winery as an additive in the making of wines for human consumption for itself or for others, and that the tartaric acid delivered by the supplier to the winery was not of merchantable quality, the supplier's terms and conditions included clauses which absolved the supplier of any responsibility.

The team also released several *eBulletins* launching the *Wines of France* and AWAC tasting events, and announcing the establishment of the AWRI's new Victorian node.

The team offers more informal information through AWRI's *eNews*. Five *eNews* articles were also produced this year in response to trends observed throughout the year:

» 'Don't get contaminated this vintage!' was released just prior to 2011 vintage to highlight that vintage is the riskiest period where wines can be tainted or contaminated. The article detailed how to keep wines taint free during vintage by taking simple preventative measures and precautions.

» 'Didn't see that coming – how did that get there?' alerted the industry that the AWRI's winemaking team had observed a number of wines from the 2011 vintage with high calcium levels. A potential cause of this trend was through the use of calcium additives such as calcium carbonate, used to deacidify the very acidic wines produced by some regions in this cooler year.

» 'A question on tartaric acid use' was issued to highlight changes to the interpretation of the specifications for additives in the Australian and New Zealand Food Standards Code. It now suggests that winemakers can use L-tartaric acid, D-tartaric acid or a racemate or enantiomer mixture for winemaking in Australia. The AWRI advised winemakers to continue to use L-tartaric acid for acid adjustments in winemaking in order to avoid the formation of unpredictable calcium DL-tartrate crystalline deposits that are more likely to occur when using D- or the racemic (DL-) tartaric acid.

» 'On the wood' highlighted issues regarding use of oak alternatives in Australia. Acacia particularly cannot be used for wine barrels and FSANZ should be consulted before using any timber other than oak.

» 'Avoid costly miscalculations' was prompted in response to an unfortunate measurement error when adding winemaking additives; wineries were encouraged to reference the Winemaking Calculators resource available on the AWRI website.

The Winemaking team, in conjunction with the AWRI's Viticulture team, now offers a monthly column in the *Australian and New Zealand Grapegrower and Winemaker* called *Ask the AWRI*. This column also addresses monthly trends observed by the AWRI. Five columns were prepared during the year:

» 'Botrytis – Implications in wine development' answered pertinent questions regarding how 2011 Botrytis and laccase-affected fruit should be treated post-fermentation and during wine ageing.

» 'Start preparing now for vintage 2012' suggested winemakers do a pre-vintage stocktake of their chemicals and additives, highlighting expiry dates and appropriate storage conditions for different materials.

» 'The burning question on smoke taint' summarised the basics of what contributes to smoke taint flavour in grapes and wines.

» 'Rules and regulations on the move' highlighted a myriad of regulatory changes occurring at the start of 2012, such as allergen labelling requirements for exporting wine to Canada and the EU from July 2012, along with comments on the newly allowed use of CMC in Australia, and a change to the minimum alcohol content for wine, reducing from 8% to 4.5%.

» 'How to and why identify Matter Other than Grapes' addressed quality issues that might be experienced in wines due to different kinds of MOG, including taints from millipedes and other insects observed during the wet 2011 and 2012 vintages.

The AWRI website has had a major overhaul this year and information and resources for winemakers, grapegrowers, wine exporters and consumers are now easier to find and use. The new *Resources for Wineries* section allows users to rapidly access from the AWRI home page: all AWRI Winemaking & Support Services; On-line tools and databases; Winemaking Calculators; Frequently Asked Questions; Fermentation, Sensory and Laboratory methods; and Packaging information and Regulatory information.

Two articles were published regarding laccase and Botrytis issues faced by Australian winemakers during 2011 and 2012 vintages entitled 'Laccase and rot: Is it there or is it not?' in the *Australian and New Zealand Grapegrower and Winemaker* and 'The rotten facts about laccase', in the AWRI's *Technical Review*. An article entitled 'Post-bottling spoilage – who invited Brett?', was published in the *Practical Winery & Vineyard* journal.

Further comments on Botrytis management strategies were delivered to the Australian Society for Viticulture and Oenology (ASVO) seminar in a talk entitled 'Making the best out of difficult vintages: managing sub-optimal fruit in the winery' and 'Winemaking management strategies for Botrytis and Powdery Mildew' to the Interwinery Analysis Group (IWAG) Seminar, both held in November 2011.

The National Roadshow seminar and workshop program is delivered on a rotating basis to locations covering Australia's winemaking zones and regions. The seminar program attends all locations once every two years. The workshop program is presented to all locations over a three-year period. The Roadshow schedule is available on the AWRI website and the Australian grape and wine events calendar website, as well as advertised through the national wine press, various publications and through the local wine association websites.

During the year, 22 days of roadshow seminars and workshops were held throughout Australian winemaking zones and regions including: Barossa Valley, Bendigo, Canberra, Coonawarra, Clare Valley, Geelong, Gippsland, Griffith, Hobart, Hunter Valley, Launceston, McLaren Vale, Orange, Pyrenees, Renmark, Rutherglen and Stanthorpe.

Roadshows seminars are organised in conjunction with winemakers' and growers' regional associations and presented by subject experts. These associations select the presentations to be made from a range of research topics, in order that the seminars are closely tailored to the interests and needs of the audience. 'Which AWRI technologies can add value to your business' was the most requested seminar topic this year. Many industry members are requesting more information on topics broadly relating to climate change; including information on alternative grape varieties for a changing environment, winery cost saving strategies, sustainability, carbon neutrality, renewable energy and wastewater management.

Roadshow workshops are presented by subject experts, and are tailored to deliver practical winemaking advice to the wine sector to address current industry concerns, technical issues or challenges. The workshops are interactive in nature and involve tastings, diagnostic tests and practical exercises. The current workshop 'A guide to troublefree packaging for winemakers' has now been delivered 20 times throughout Australia, and will conclude this year. The workshop provides practical information regarding preparing wine for bottling, controlling microbiological activity, both through filtration and chemical measures, packaging operations, closure and package choice and wine storage and transport. The workshop was developed on industry request due to a gap in knowledge or available information resources regarding best practice packaging. Feedback from the workshops has been overwhelming positive; "one of the best workshops I have attended", "terrific workshop", "excellent", "extremely informative", "easily understood and readily relevant to our current winemaking needs", "pitched right with summary of basics and explanation of more complex topics".

During delivery of this workshop feedback from industry has led to a number of areas where more research and information is required, particularly in relation to the effect of storage temperature on wine development. Work will continue in this area in the future.

There has been a large amount of interest during these workshops in wine transport in general, particularly transporting wine in bulk for bottling offshore both for quality and sustainability reasons. This coincides with an increase in transport-related queries received by the AWRI's Winemaking team, particularly regarding taints arising from wines transported in flexibags—not only from compounds in the bags themselves, but potentially also by adsorbing taints from containers or the shipping environment. Further research will be conducted in this area.

Workshop attendees across Australia over the last two years have been asked what workshop they would like to see next. In line with comments noted above during the seminar series, a general topic covering climate change is in high demand. This ranges from winemaking management strategies during both hot dry years (heatwaves, stuck fermentations, salinity) and conversely wet years (disease, botrytis management, the impact of floods), in addition to topics regarding sustainability and the environment. To cover these broad areas, the AWRI Viticulture team will join the AWRI Winemaking team to deliver a climate change-related workshop for the next three years, covering impacts and strategies from the vineyard to the winery. The workshop will be launched in McLaren Vale next year.

A Research to Practice (RtP) Winery Wastewater workshop was launched by Karl Forsyth in the Hunter Valley in December 2011. Additionally, a concise seminar presentation has been prepared for the Roadshow seminar series. Wastewater management has been a key focus in industry during the last three years.

The AWRI completed the development of a national events website on behalf of the National Wine Extension and Innovation Network (NWEIN). The website (www.grapeandwineevents.com.au) was developed to help coordinate and communicate national, state and regional grape and wine industry extension and adoption events. The AWRI, on behalf of the NWEIN, developed and manages the independent, collaborative website. Event information can now be entered by each user and searched. The expected benefits of this website include:

» Extension members or event providers are informed of scheduled events by other members, and new events can be planned to fill gaps in topic presentation, location and frequency.

» A wider cross promotion of all extension activities in addition to the existing communication channels used by NWEIN network members.

» Users of the website can easily search for upcoming events in their region or across Australia.

Invitations have been issued to state and regional associations, in addition to various industry stakeholders, encouraging them to use and promote their events on this website.

The AWRI webinar program, a new initiative launched in September 2011, augments the existing AWRI roadshow seminar program. The AWRI webinar program enables Australia's grapegrowers and winemakers to attend AWRI seminars via their computers. A range of winemaking, winery management and viticulture topics were presented. Each webinar consisted of a presentation followed by an interactive Q&A session. A different topic was presented every week, for a period of eight weeks. The webinars proved popular and a new series has been prepared for release later in 2012.

The delivery of the Advanced Wine Assessment Course (AWAC) continues to be an important career development opportunity for those who wish to strengthen their knowledge in wine show judging and improve their sensory skills. This year, the AWAC was held at the Adelaide Showground. The Showground is home to the Royal Adelaide Wine Show and is thus a fitting venue receiving positive reviews from participants. Since the first course in 1992, and in response to feedback from previous participants, the course has been subject to a process of continuous improvement and refinement. The current program is offered in a four day format with more than 40 hours of content. As part of the intensive program, participants have the opportunity to evaluate a diverse range of more than 300 wines under simulated wine show conditions. Lectures are also presented by AWRI staff, and leading wine show judges, journalists and winemakers participate throughout the course.

Feedback from AWAC graduates suggests that it is very difficult to obtain judging positions at Australia's premier wine show events. In order to fast-track opportunities, and to facilitate the development of talented professionals, the top performing participant from each course now has the opportunity to participate as an associate judge at a national wine show level. Han Tao Lau, winemaker from Long Gully Estate (Dux for AWAC 30) and Toby Barlow, winemaker from St Hallett Wines (Dux for AWAC 31) were both offered a judging place at future Royal Adelaide Wine Shows.

Over many years the AWRI has solicited and received considerable feedback from graduates of the Advanced Wine Assessment Course. Graduates continue to seek education programs that provide exposure to the styles and wines in other countries which will enable them to stay abreast of new developments in world wine styles. On the basis of this feedback the AWRI developed a series of one day international-themed events; the first being 'Wines of France'.

Due to high demand, this event was delivered twice on consecutive days in December 2011. Outstanding feedback was provided as to the content and delivery of the event and a strong desire was expressed to see similarly structured tastings on other countries to be delivered. The AWRI is now in the process of developing an event on international sparkling wine styles for the second half of 2012.

The AWRI and the Institute of Masters of Wine (IMW) completed the third year of its cooperation agreement. As part of the arrangement, the AWRI hosts the Institute of Masters of Wine each year for the Australasian education program and additionally contributes to the IMW's education program. As a part of this collaboration, two AWRI presentations were delivered to the IMW Australasian seminar: 'Bulk shipping of wine' and 'Botrytis – what we heard, what we saw…… how we responded' and two presentations were delivered to the IMW Americas seminar (Napa Valley): 'A taste of flavour research', and 'A simulated tainted/faulty wine tasting'. The AWRI and the IMW have both seen positive outcomes from this relationship and intend to continue the collaboration in the future.

The portfolio of education themed wine tasting and evaluation events continues to be expanded. Tastings include general wine sensory evaluation, wine aromas, flavours, faults and taints tastings, an Australian Wine Show Judging exercise and a 'Wine in Society' presentation. A one-day abridged session of the Advanced Wine Assessment Course was also held in the Hunter Valley in August 2011.Simulated flavours, faults, taints and mouth-feel tastings are also delivered upon request to regions around Australia, such as to the Limestone Coast Wine Industry Association in February 2012, and to companies such as Premium Wine Brands.

The 8th International Cool Climate Symposium was held in Hobart in February 2012. The AWRI was involved in providing secretarial, financial, technical and logistics support for the ICCS program, along with Wine Tasmania and the Tasmanian Institute of Agriculture. Eight workshops were delivered: five involved tastings and three were seminars. The workshop topics showcased Tasmanian content on sparkling wine styles and Pinot Noir. Other topics included Riesling, Biodiversity, Botrytis and Hybrid grape cultivars.

**Database development**

This year, an integrated database has been developed to capture all queries received by all of AWRI's industry support teams: Winemaking, Viticulture, Health, Regulation, and Information Services. The database has also been integrated to include all queries and problem solving investigative projects conducted by the teams, including historical upload of data from 1990. Streamlining the AWRI's Support Services in one management database will improve efficiency and enable the team to more effectively identify future trends. The database also enables the identification of cost savings achieved by companies using this AWRI service, customer service measures including response and resolution times, time duration invested per case, and a comprehensive company contacts list of users of the service from 1990.

In addition, a number of automated reports can now be generated, including summaries of queries received and investigations conducted by month, quarter, year, and by state and wine region compared to historical figures from 1990. This enables prediction of early trends occurring during the season, and also comparison of trends to similar vintage conditions that have occurred in the past; for example in cooler years the AWRI can review and predict the number and type of queries to expect for Botrytis and laccase management at different points during the year, and disseminate targeted management strategies during these times. Industry trends can be mapped using key words such as 'stuck fermentations', '*Brettanomyces* issues' and 'taint occurrences'.

This information will be instructive for the AWRI's research teams who are able to observe and adjust any applicable research or information delivered to regions based on real-time information being observed in the wine industry.

## Transfer of knowledge relating to viticulture

**Staff**

Dr Peter Dry, Marcel Essling, Dr Mardi Longbottom

**Collaborators**

AHA Viticulture (Jim Campbell-Clause), Braemore Wines (Ken Bray), National Measurement Institute (Roselle Mailvaganam), Perth Region Natural Resource Management (Keith Pekin), SARDI (Peter Hayman), Treasury Wine Estates (Amy Richards), Wine Grape Growers Australia (Lawrie Stanford), The Yalumba Wine Company (Robin Nettlebeck).

During the year, the Viticulture team responded to 327 viticulture-related enquiries. The majority (189) were 'agrochemical-related'. The remaining calls related to various general viticulture enquiries including fungal and insect pest control. Marcel Essling, Peter Dry and Mardi Longbottom fielded 76%, 11% and 10% of the enquiries respectively. The remaining 3% were handled by the AWRI Commercial Services staff.

Marcel Essling issued nine *eBulletins* or agrochemical updates, predominantly focused on providing information to the grape sector related to agrochemical issues. The challenging weather conditions experienced during the previous season had growers on 'high alert' for another wet year with many fearful of further chemical shortfalls. Interest in the use of phosphorous acid prompted the processing of samples gathered for the purpose of understanding the relationship between vineyard applications, subsequent grape residue levels and wine residue levels post-fermentation. The report from the trial supported the restriction on use of the chemical on grapes to be used in making wine for export. The potential for residue 'carry-over' into the following season was confirmed. Concerns about residues from 2,4-D drift and the use of chlorine dioxide products prompted the collection of fruit samples for investigations, which will continue over the next 12 months.

To facilitate the trade of table grapes and protect Australia's reputation as a 'clean and green' primary producer, guidelines similar to that used in the AWRI booklet 'Agrochemicals for use in Australian viticulture' (aka the 'dogbook') were developed for table grape growers as well as an on-line search facility under an agreement with Horticulture Australia Limited.

A 34-page guide to wine grape quality in the vineyard was compiled on behalf of the Riverina Wine Grapes Marketing Board.

The Viticulture support team members were active in disseminating relevant information for grape and wine producers at roadshow events, conferences and symposia, journal articles and books, and undergraduate courses.

A grant application to the 'Action on the ground' program, administered by the Department of Agriculture Fisheries and Forestry, was successful. As a result, the AWRI will be managing a project entitled 'Greenhouse gas abatement in viticulture' from June 2012-May 2015. Nitrous oxide ($N_2O$) emissions and soil carbon storage will be measured under varying undervine and midrow management regimes in commercial vineyards across five Australian grape growing regions (Margaret River, Hunter Valley, Murray Darling, Barossa and McLaren Vale) over two seasons. The aim of this work is to establish baseline $N_2O$ emission data for those regions and to identify and recommend practices which have potential to reduce $N_2O$ emissions and increase carbon storage in vineyards. The findings will be extended through an RtP workshop.

Mardi Longbottom and Marcel Essling

In an endeavour to understand the challenges wine grape growers experienced in the 2010/2011 season and how they dealt with them, a survey was developed and distributed entitled 'Pest and Disease Review – 2011', and the results were collated. This information was used in the GWRDC roadshows that went to Adelaide, Melbourne, Renmark, Griffith and Mildura. The AWRI also developed fact sheets for grapevine management in extreme heat events in collaboration with South Australian Research and Development Institute and independently on Queensland Fruit Fly control. A total of eight RtP workshops were conducted across several regions (Clare, Adelaide Hills, Langhorne Creek, McLaren Vale, Canberra and Hunter Valley) and at the AWRI's Wine Innovation Cluster Central building in Adelaide. A winegrape quality survey was also developed and distributed on behalf of the Winegrape Quality Measures Committee. Over 350 responses were collected from across most regions representing an even spread of grape purchasers and buyers. The results of this survey were presented to the WGGA Board and will form the basis for future research and extension activities.

## Winemaking and Extension Services – Technical problem solving and consulting

**Staff**

Adrian Coulter, Matt Holdstock, Geoff Cowey, Gayle Baldock, Emma Kennedy, Con Simos and Dr Yoji Hayasaka

The Winemaking and Extension Services team provides a range of services to the Australian wine sector, including a range of advisory, problem solving, extension and information services. In addition to its extension and information transfer activities, which are discussed elsewhere in this report, the Winemaking and Extension Services team provides a technical problem solving and analysis service to levy-payers within the Australian wine sector. The primary aim of the service is not only to provide diagnoses of industry problems, but to offer preventative and remedial advice based on the cumulative problem solving and practical winemaking experience of the AWRI staff.

The technical problem solving and analysis service represents a significant proportion of the team's workload and is provided according to strict terms and conditions. Client confidentiality is an important aspect of the provision of the services. This facilitates a frank exchange of information between the AWRI and its clients, which in turn allows the maximisation of the knowledge gained from the provision of these services. If a particular problem is considered to be of interest to the wider wine sector, the results of investigative work are made available through forums such as *eNews* and *eBulletins*.

The number of enquiries received from wineries continues to be significant and indicates that a large number of Australian wine producers regard the AWRI as a trusted, reliable, and an important source for quality technical information and problem solving solutions. The nature of the queries continues to be varied and these are tracked through the Winemaking and Extension Services database where queries are assigned to keywords, allowing trends and spikes to be monitored, and appropriate responses coordinated and executed. Compared with the previous year, the figures for 2011/2012 (Table 1) show a 9% decrease in the total number of enquiries received, most likely a result of the good 2012 vintage in South Australia and Victoria relative to the challenges of the 2011 vintage.

A proportion of the investigations conducted by the team relate to disputes arising between levy-payers or between levy-payers and suppliers of either materials or contract services. Consequently, and with great sensitivity, staff often find themselves in a mediation role in these disputes, and spend a considerable amount of time providing technical information to legal professionals representing grapegrowers and wine companies. Fortunately, however, the majority of disputes are settled before formal court proceedings are instigated, which is of great benefit to clients.

Full reports, containing technical information relating to the problems investigated, are prepared for clients when investigations are likely to result in litigation and or insurance claims. Otherwise, clients are provided with summaries which seek to explain the underlying causes of the problems encountered, and often include links which direct the client to relevant sections within the AWRI's website. Advice on how to prevent the re-occurrence of such problems is provided to clients and technical references relating to the area of investigation are also often supplied.

A summary of the number and type of investigations conducted by the Winemaking and Extension team over the past three financial years is presented in Table 2.

*Table 1. Enquiries received by Winemaking and Extension Services advisory staff in the period 2009/2010 to 2011/2012.*

| | 2009/ 2010 | 2010/ 2011 | 2011/ 2012 |
|---|---|---|---|
| Wineries | 829 | 897 | 808 |
| Government organisations | 19 | 26 | 13 |
| Other | 149 | 132 | 138 |
| Students | 4 | 7 | 20 |
| Total | 1001 | 1062 | 979 |

*Table 3. Summary of the number of investigations from the different states within Australia during the past two years.*

| Number of investigations conducted | | |
|---|---|---|
| **State** | **2010/2011** | **2011/2012** |
| SA | 95 | 65 |
| VIC | 42 | 50 |
| NSW | 36 | 44 |
| WA | 21 | 11 |
| ACT | 2 | 0 |
| TAS | 5 | 20 |
| QLD | 9 | 7 |

*Table 2. Summary of the number and type of problem solving investigations conducted, and numbers of samples analysed by the Winemaking and Extension team during the past three years.*

| Type of investigation | Investigations conducted and samples analysed | | |
|---|---|---|---|
| | 2009/ 2010 | 2010/ 2011 | 2011/ 2012 |
| Identification of hazes and deposits | 84 | 77 | 75 |
| Microbiological investigations | 23 | 15 | 20 |
| Sensory assessments | 70 | 50 | 29 |
| Taint problems | 23 | 28 | 18 |
| Other investigative analyses | 40 | 37 | 53 |
| Closure-related investigations | 1 | 2 | 2 |
| Total number of investigations | 241 | 210 | 197 |
| Total number of samples analysed | 1000 | 1197 | 816 |

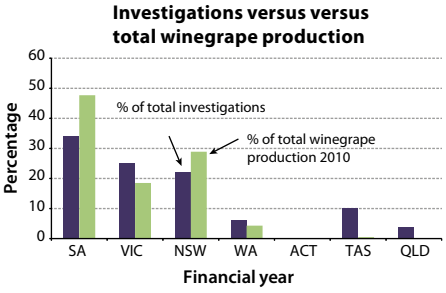



*Figure 1. The number of investigations conducted by the Winemaking and Extension Services team for a particular state, presented as a % of the total, versus the % of the total wine grape production for that particular state in the year 2010.*

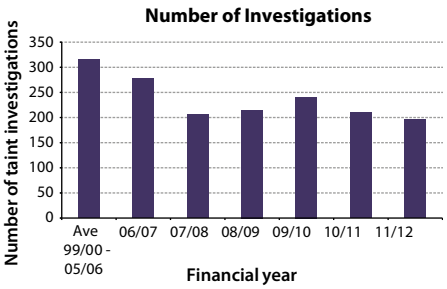



*Figure 2. The number of investigations conducted by the Winemaking and Extension Services team during the period 2006/2007 to 2011/2012 and the average number of these types of investigations for the period 1999/2000 to 2005/2006.*

The figure for the number of investigations conducted during 2011/2012 is 7% lower than the figure for the previous year. Interestingly, the actual number of investigations for the past three years appears to be relatively steady (Table 2). Victoria, New South Wales and Tasmania all recorded higher numbers this year compared to the previous year, with South Australia, Western Australia, Queensland and the ACT having lower numbers of investigations than the previous year (Table 3). The number of investigations conducted per state as a percentage of the total and plotted against the percentage of the state production of winegrapes as a percentage of the total winegrape production data (source 2012 *The Australian and New Zealand Wine Industry Directory*) is presented in Figure 1.

The total number of investigations conducted into wines affected by hazes and deposits has again slightly decreased in numbers from the previous year and continues to follow a three year decreasing trend in this category. This is discussed further later in this report. These types of problems continue to represent a considerable percentage (35% for 2009/2010 and 37% for the 2010/2011 and 38% for 2011/2012) of the total number of investigations performed. Consequently, issues related to such instability problems are continually being addressed during AWRI's Roadshow workshops and via other AWRI communication forums such as the AWRI website, *eNews* and *eBulletins*.

The number (20) of investigations conducted into microbiological instabilities increased slightly this year. The investigations were varied and included problems such as increasing volatile acidity (VA), refermentation, Brett-related spoilage, stuck fermentations and post-bottling yeast growth. This increase is most likely a carry-over from the difficult 2011 vintage where moulds and botrytis infections were widespread. Awareness around how to avoid these issues continues to be addressed at regional workshops, as bottling issues have represented a large proportion of the queries received by the Winemaking and Extension Services team in recent years.

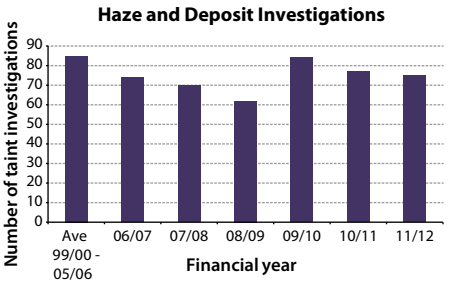



*Figure 3. The number of haze and deposit investigations conducted by the Winemaking and Extension Services team during the period 2006/2007 to 2011/2012 and the average number of these types of investigations for the period 1999/2000 to 2005/2006.*

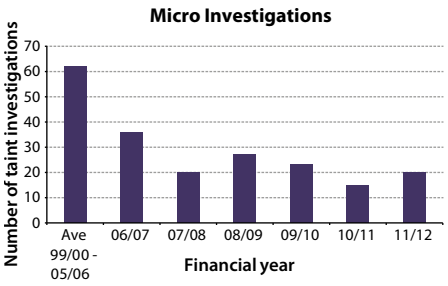



*Figure 4. The number of microbiological investigations conducted by the Winemaking and Extension Services team during the period 2006/2007 to 2011/2012 and the average number of these types of investigations for the period 1999/2000 to 2005/2006.*

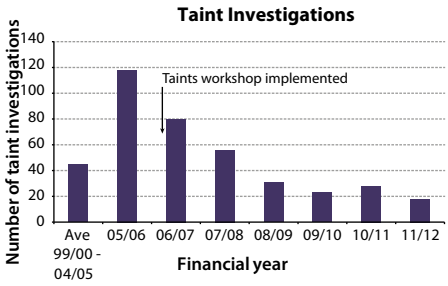



*Figure 5. The number of investigations conducted into wines affected by taints during the period 2005/2006 to 2011/2012 and the average number of these types of investigations for the period 1999/2000 to 2004/2005.*

Investigations conducted under the category 'Sensory assessments' during the previous financial year decreased from 50 to 29. Although this is a large decrease, the number of investigations conducted under the category 'Sensory assessments' is still considered significant. The types of investigations carried out under the 'Sensory assessments' category vary from year to year, winery to winery, and this year was no different with relatively even numbers of wines being submitted exhibiting 'reductive' characters; wines reported to be affected by 'unknown' or 'unusual' sensory characters; wines showing 'deterioration' or bottle to bottle 'variability' after packaging; or wines that might have been the subject of a 'customer complaint' with TCA and 'other' types of taints. Sensory evaluation is an important analytical and research tool, and is also commonly used in problem solving investigations classified under other categories, such as 'Microbiological investigations', 'Taint problems' and 'Other'.

The number (18) of taints investigated in the past 12 months was lower than the previous year (28), and is well below the average figure (45); this is the lowest number of taints ever recorded in a 12 month period (Figure 5). These data might indicate that, at least in part, the strategies for avoiding taints and contaminations advocated in the workshop 'The avoidance of taints and chemical instabilities during winemaking', which was delivered as part of the AWRI's Roadshows from 2006 to 2009, are still continuing to being adopted by the Australian wine sector. Interestingly, in the past 12 months, there were four investigations where wines had been tainted during transport in flexi-tank. It is possible that more of these types of taints will be seen with the increasing use of flexi-tanks to transport wine overseas for bottling.

Sources of some of the taints observed during the year were varied and included TCA and TBA, naphthalene and hydrocarbon taints from transport environments, chemical like taints from winery hoses and mousiness from microbiological spoilage. It is encouraging that the number of post-bottling cork-type taint investigations are low for the second year in a row, suggesting that the incidence of this type of problem might be decreasing. This could be related to the increasing number of wines bottled under screw-cap closures, however, TCA-type contaminations are still occurring from mechanisms unrelated to cork.

An interesting taint-related investigation, which was carried out during the year, involved a batch of fruit that had become tainted with hydrocarbons sometime between harvesting and crushing. The winemaker contacted the AWRI indicating that he had rejected a batch of fruit due to a strong petrochemical-like aroma, which he thought had come from the picking bins. The fruit had been hand harvested, placed into picking bins, and then transported to the winery for crushing. Unbeknown to the winemaker, the bins (which had been painted early that vintage) had been sitting in the sun (on an extremely hot day) for quite some time before collecting the fruit, which has most likely led to volatile compounds being released from the paint and then into the fruit. The juice from this batch of fruit was tested and confirmed as containing a variety of C2-, C3- and C4-alkylbenzenes. Previous investigations conducted at the AWRI have shown that aromatic hydrocarbons are typically derived from contact of juice or wine with products derived from petroleum, such as various oils and greases, epoxy-coated and other painted surfaces, paint thinners and exhaust fumes. The winemaker was later informed that these picking bins had actually been used previously without any taint pickup, indicating that the long exposure in the hot sun might have caused the paint to become soft and volatile.

The Winemaking and Extension Services team is in a unique position to investigate unusual problems or problems that the average winery or winemaker may only encounter once or twice in a lifetime of winemaking. This year, the team identified quercetin dihydrate in wine six times, which is double the number for the previous year. Quercetin dihydrate appears as a slimy yellow/green coloured crystalline deposit, typically in red wines. Quercetin dihydrate is one of the flavonol compounds which are natural components of grape skins and leaves. Flavonol deposits in wine are relatively rare, but some modern viticultural practices such as increased sun exposure of fruit and machine harvesting can contribute to elevated levels of these compounds in wine (Ziemelis 1982). Quercetin glycosides are extracted from the grape skins during fermentation. The quercetin glycosides then hydrolyse in the acidic wine conditions to release the free quercetin. The quercetin might then crystallise, incorporating some water molecules in the process and form a deposit. The deposit is harmless, however it is unsightly in a glass. The AWRI is currently unaware of any predictive tests. Further research is required for a complete understanding of why these deposits occur and if there is anything that can be done, including analysis, to prevent deposits from forming post-bottling.

As mentioned above, there were four flexi-bag taint investigations during the past 12 months, involving a total of eight wines. In one taint investigation, seven products were submitted for taint assessment after becoming 'tainted' during transit. The seven wines had been exported in bulk, transported in flexi-tanks, and bottled at an overseas bottling facility. Each wine sample was analysed using a technicque that was developed at the AWRI (AWRI publication #766) for screening wines for petroleum-derived aromatic hydrocarbons. Out of the seven wines screened, five of these were determined to contain various aromatic hydrocarbons, including C2-, C3- and C4-alkylbenzenes, naphthalene and C1-alkylnaphthalenes. The scope of the investigation did not extend to determine how or when these wines became tainted; further understanding in this area is required for preventative measures to be implemented, as there is no remedial cure or fix for wines that have been contaminated with aromatic hydrocarbons.

## Development of an alternative method for laccase

Weather conditions during the 2011 growing season were conducive for the growth of the mould *Botrytis cinerea* in many of the winemaking regions. Not surprisingly, many queries were taken by the AWRI's Winemaking and Extension Services team were in some way related to the presence of Botrytis and, in particular, laccase, the oxidative enzyme it produces. Apart from seeking advice on processing botrytis-infected fruit and winemaking strategies to reduce the negative effects of laccase, many of the queries related to methods of testing laccase activity and interpretation of test results for red wines and red juices.

## Laccase test kits and some problems encountered

The commercial test kits currently available for testing laccase activity are based on the oxidation of the phenolic substrate syringaldazine, which produces a pink/purple-coloured oxidation product. During 2011, many people found the interpretation of laccase activity in deeply coloured Shiraz was difficult, given the two laccase test kits commonly available rely on the substrate syringaldazine and therefore the ability to detect the pink/purple colour change. If not effectively decolourised, red juice or wine samples might begin with a slight pink tinge and this can be misread as a 'positive' laccase result. Alternatively, the presence of a slight pink tinge at the start of the analysis can make it difficult to detect a small change in pink/purple colour due to a low level of laccase activity, leading to a 'negative' laccase result.

Another problem encountered was how to interpret and compare results from different laccase test kits, as one of the test kits (the 'Dolmar' kit) uses a laccase activity scale which ranges from 0.2 to 1.5 laccase units, whereas another test kit (the 'Botrytest' kit) reports laccase levels from 0 to 20 laccase units per mL.

Additionally, there were concerns that laccase test kits might have underestimated the laccase activity in juice. In some cases, test results for wines where either no, or low activity was detected at the juice stage, gave higher results when tested at the wine stage. All of these situations were associated with red wines and juices.

## Development of an alternative laccase method

Given the problems encountered with laccase testing during the 2011 vintage, the AWRI began investigating an alternative to the syringaldazine method, with the initial aim of reducing the incidence of 'false negative' and 'false positive' results. Given the issues regarding interpretation of the different laccase test kit results, it was planned that a comparison of the different methods should be conducted once a new method was developed. Additionally, other issues, such as the possible underestimation of laccase activity in juice compared to the corresponding wines, would also be investigated.

During 2012, a method was developed using an alternative substrate to syringaldazine and a simple, effective, cartridge-type decolourising system.

Once the initial development was completed, red juices and red wines were then spiked with laccase enzyme from *Trametes versicolour* and the laccase activity measured. The results were compared to those obtained using two available commercial laccase test kits ('Botrytest' and 'Dolmar' kits).

It became evident that the term 'apparent laccase activity' is one that better reflects the results obtained for any of the test kits, as none were able to quantitatively determine laccase activity. However, the newly developed method gave the highest and most consistent assessment of laccase, especially at low laccase concentrations.

## Next stage

During vintage 2012, various samples of grapes affected by *Botrytis* were collected and forwarded to the AWRI, so that the new method could be trialled using laccase excreted by *Botryits cinerea*. The AWRI gratefully acknowledges all industry personnel who collected and submitted grapes for this trial. A total of 44 batches of grapes were collected and the crushing and fermenting of these samples is underway. The laccase activity in both the juice and wine will be tested using the newly developed method and also using the 'Botrytest' and 'Dolmar' kits. Additionally, the samples will be tested for the concentration of glycerol and gluconic acid, which may be indicators of the degree of *Botrytis* infection, and the juice samples will be tested using 'Quickstix', which provides qualitative or semi-quantitative results for the presence of *Botrytis*.

The results of this trial should help provide some answers to the questions raised during the 2011 vintage and deliver some information regarding various predictors or indicators of the presence of *Botrytis*.

L to R: Matt Holdstock, Gemma West, Geoff Cowey

## Applications of mass spectrometry to ensure the quality and integrity of Australian wine

**Staff**

Dr Yoji Hayasaka, Gayle Baldock, Mango Parker

The members of the Mass Spectrometry team work collaboratively across the AWRI and also with external researchers. Their collaborative activities are included elsewhere within this report, however, the highlights from the year 2011/2012 are shown here.

### Investigations into smoke-affected grapes and wine

The AWRI continues to play a proactive role in the understanding and management of smoke taint, communicating outcomes and assisting regions affected by fires in providing technical support and educational activities. Smoke taint was an issue in Western Australia and Tasmania this year.

**Collaborators**

The Department of Primary Industries Victoria (Dr Mark Downey); University of Adelaide (Dr Kerry Wilkinson); the Department of Agriculture and Food Western Australia (Glynn Ward); and Industry partners.

Bushfire risk in the vicinity of grape-growing regions has increased significantly with major fire events in 2003, 2007 and 2009. Unfortunately, Australia is likely to experience even more bushfires in the future. Wine made from grapes exposed to smoke in vineyards was often characterised by objectionable 'smoky', 'burnt', 'ash', 'ashtray' and 'smoked salmon' aromas, together with having 'an excessively drying' back-palate and a retronasal 'ash' character (2003 AWRI annual report, AWRI publication #1358). Such negative sensory characteristics can result in significant reductions in the market value or even render a wine not fit for sale.

In response to the increasing incidence of bushfires in proximity to wine grape growing regions, the AWRI has been investigating the effect of smoke exposure on grapes and wine (2003, 2009, 2010 and 2011 AWRI annual reports). The key research objectives are to develop assays (smoke diagnostic assays) for measurement of smoke exposure in grapes prior to winemaking, and to characterise composition and sensory properties of wine made from smoke-affected grapes. In particular, the development of reliable and robust smoke diagnostic assays is important to the industry to reduce or minimise the potential of producing smoke-affected wine made from smoke-exposed grapes.

### Establishment of phenolic glycoside analysis as a diagnostic tool

As reported in the previous Annual report (2011), two new diagnostic assays were developed to assess the level of smoke exposure in grapes and wine. These diagnostic assays are based on measurement of i) volatile phenols, in addition to guaiacol and methylguaiacol, that are present in significant abundance in bushfire smoke (GC-MS analysis), and ii) numerous bound forms of the volatile phenols (phenolic glycosides) that are formed in grapes following smoke exposure (HPLC-MS/MS analysis).

Of the two assays, the phenolic glycoside analysis is considered a core tool for reliable diagnostic strategies to assess the impact of smoke exposure in grapes and wine according to the following observations: i) when a grapevine is exposed to smoke, the amount of the volatile phenols taken up by grapes can be related to the intensity and duration of smoke exposure (AWRI publication #1165); ii) once taken up by grapes, the volatile phenols are rapidly metabolised into their more stable and non-volatile glycosidic forms (AWRI publications #1267 and 1270); iii) the smoke-induced glycosides persist and accumulate in grapes until the time of harvest (AWRI publication #1267), so the amount of the grape phenol glycosides can be correlated to the intensity of smoke exposure; iv) unlike free guaiacol, the concentrations of the phenolic glycosides are very low or absent in non-smoked grapes (AWRI publications #1179, 1183, 1267, 1270) and in oak (unpublished data); and v) the phenolic glycosides are easily extracted into wine and act as a pool of precursors which release volatile phenols during fermentations, ageing, and storage (AWRI publication #1267, 1270).

An analytical method for the quantification of phenolic glycosides in grapes and wine was thoroughly validated and established. The method was confirmed to be able to quantify phenolic glycosides as low as 0.5 µg/kg for grape extracts and 0.25 µg/L for wine and was sufficiently reliable (in terms of reproducibility and recovery) for routine analysis of a range of phenolic glycosides. Importantly, the method can be applied to the analysis of phenolic glycosides regardless of different sample matrices such as red and white grape or wine samples.

To confirm the concept that these glycosidic grape metabolites can be used as diagnostic markers to detect smoke exposure, the AWRI compared results from the analysis of the commonly used marker, free guaiacol (2003 AWRI Annual Report), with concentrations of phenolic glycosides in a broad range of smoked and non-smoked grape and wine samples. As a result, the phenolic glycosides were significantly better marker compounds to indicate smoke exposure than the guaiacol, as judged by the ability to distinguish between smoke-affected and non-smoked samples.

### Baseline study

In collaboration with industry partners, a comprehensive survey of the baseline concentrations of volatile phenols and phenolic glycosides in control grape samples (no history of smoke exposure) was conducted. This study is essential to improve the reliability of diagnostic strategies to identify smoke-affected grapes, and estimate an extent of smoke exposure relative to their baseline levels.

Over the 2010 and 2011 vintages, more than 200 grape samples representing five varieties (Cabernet Sauvignon, Chardonnay, Pinot Noir, Riesling and Shiraz) collected from a wide range of grape-growing regions across Western Australia, South Australia, Victoria, New South Wales and Tasmania were analysed. Volatile phenols and phenolic glycosides were quantitatively measured.

Most Shiraz grape samples contained guaiacol at concentrations varying from 1 to 9 µg/kg, therefore the presence of guaiacol could not be used as a reliable indicator of smoke exposure in Shiraz grapes, particularly for marginal cases (Figure 6).

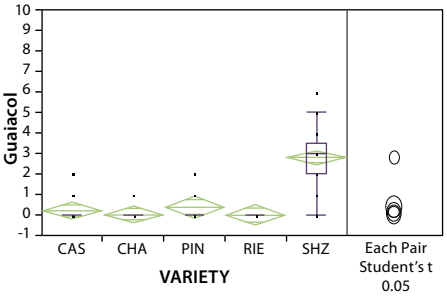



*Figure 6. Guaiacol concentrations (µg/kg ) in control grapes from the 2011 vintage by variety, showing the variation in guaiacol baseline concentrations of CAS (Cabernet Sauvignon), CHA (Chardonnay), PIN (Pinot Noir), RIE (Riesling) and SHZ (Shiraz).*

While the presence of volatile phenols in the grapes could be an indicator of smoke exposure when results are interpreted carefully considering the variety and its natural baseline levels, the phenolic glycosides provide a much more sensitive and reliable assay for smoke exposure.

### Volatile phenols and glycosides have sensory impact

Volatile phenols and their glycosides are also important to the sensory aspect of smoke-affected wines, contributing to smoky and medicinal aromas and flavours. This was recently confirmed by two sensory studies. In the first, wines sourced from industry partners suspected of being affected by smoke events in 2007 and 2009 were assessed by quantitative descriptive analysis. Wines from the 2007 event were strongly smoke-affected, and this was reflected in the concentration of free volatiles and the sensory

scores; whereas the 2009 wines were moderately smoke-affected. Relationships between the volatile phenols and smoke-related sensory attributes were consistent with previous AWRI research, indicating guaiacol and the cresol isomers are major contributors to smoky sensory attributes.

In a second study, it was confirmed that smoke flavour was strongest when a non-volatile glycoside fraction—that had been isolated from a smoke-affected wine—was included in a mixture with several volatile phenols. Glycosides (sugar molecules joined to aroma compounds) have previously been considered as only a reserve of flavour to be released during fermentation or ageing but not flavour-active themselves. It was of great interest to find that the addition of a glycoside fraction isolated from smoke-affected grapes gave a smoky/ashy flavour when tasted, and a combination of the glycoside fraction with volatile phenols gave a realistic level of smoke taint flavour, higher than when the volatile phenols alone were assessed by a sensory panel. It has also been determined that measurable amounts of the volatile phenols are released in the presence of saliva, and influences on flavour-release of acid, alcohol and other variables have been studied.

### Smoke taint collaboration with the Department of Agriculture and Food WA

A collaboration has been undertaken with Dr Glynn Ward at the Department of Agriculture and Food WA (DAFWA) to investigate the effect of smoke density from and duration of a natural fire event on the composition of grapes and wine. During February 2012, a large fire near Northcliffe WA resulted in persistent, dense smoke and a number of vineyards in the Pemberton and Manjimup wine regions were exposed to smoke from the fire. The DAFWA has smoke detecting units established in these regions which recorded the density of the smoke during these events, providing an opportunity to investigate the relationship between smoke density and duration and the levels of smoke taint compounds in grapes and resulting wines.

Three replicate grape samples were collected by DAFWA from the sites of the smoke detecting units and also from a number of other vineyards varying in distance (2–50 km) from the Northcliffe fire. Samples of five different grape varieties were collected from eight different vineyards. A portion of each of the grape samples was kept for analysis and fermentations were conducted with the remainder of the grapes from each sample.

The grape and wine samples were analysed at the AWRI for the concentration of a range of volatile phenol compounds associated with smoke taint and also their non-volatile precursor compounds. The results of chemical analysis will be compared to the results of the physical smoke density and duration data. It is envisaged that the results of the comparisons might provide an insight into the relationship between smoke density and duration and the levels of smoke taint compounds resulting in grapes and wine.

A significant fire event occurred at a vineyard located in the Derwent region of Tasmania in early 2012. The AWRI provided technical assistance and samples were collected for research purposes. One of the education outcomes was to schedule events in Launceston and Hobart (15 and 16 March). The format followed a Q&A interactive session and both were well attended; notably there was a high percentage of participants representing legal, forestry management and government organisations.

Mark Krstic organised the 2012 Smoke Taint Symposium, held in Melbourne in June 2012. This symposium featured 13 presentations on the day from 12 different presenters, including presenters from DAFWA, University of Adelaide Wine Industry Tasmania and the Department of Primary Industries Victoria. The day was attended by 105 people mostly from the wine sector, but also with representatives from the media and the Department of Sustainability and Environment.

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## Regulatory, technical and trade issues impacting on the Australian wine sector

**Staff**
Creina Stockley

The AWRI provides regulatory and technical advice and assistance to the Australian wine sector, through the Managing Director, the Health and Regulatory Information Manager and the Industry Development and Support group. During the year, 81 independent regulatory, science and technical-related information requests were received by Creina Stockley from the wine sector, the general public and government.

During the year, support to the wine sector has been provided through Creina Stockley's membership of numerous international and domestic government and industry committees. This year, Creina continued as a Department of Agriculture, Forestry and Fisheries-nominated Australian delegate for Organisation International de la Vigne et du Vin (OIV) Expert Group and Commission meetings and became the President of Safety and Health Commission IV. Together with members of Wine Industry Technical Advisory Committee, she revised and updated the 'Code of Good Manufacturing Practice for the Grape and Wine Industry': this 21-page second edition is available on the AWRI website.

**Technical and regulatory issues**

Technical and regulatory support to the Australian wine sector is ongoing as issues are regularly raised by industry or government, both in Australia and internationally, and often span several years. During 2011/2012, technical and regulatory information and/or issues that have been reviewed, and/or required the preparation of materials includes: copper and other heavy metals limits for wine and wine products; sulfur dioxide as a sanitiser for wine barrels; use of succinic acid to remove acetaldehyde from finished wine; sodium chloride concentration and limits for wine in Australia and Brazil; winery sanitation and risk of contamination from flood waters; commercially available analyses for casein, egg albumin and isinglass; airborne sulfur dioxide exposure and asthma; vineyard and winery workplace asthma triggers; paraffinic oil and its use in wine destined for the EU; production of low histamine containing wine and wine products; ginger based additive potentially used to remove protein from wine; health and safety regulations for home brewing and winemaking; possible nitrate poisoning from wine consumption; restrictions on use of synthetic tartaric acid; mean and maximum arsenic concentration of Australian wine; copper chromate alkaline-treated pine stumps used in Australian and New Zealand vineyards and residual arsenic risks involved; Ochratoxin A seasonal variation; gamma-hydroxybutyric acid concentrations (GHB) of wine; legality of non-*Vitis vinifera* tannin colour powder in export markets; and legality of, and regulations pertaining to, wines made from grapes of hybrids of *Vitis vinifera* such as Rubired and other grape species in export markets; synthetic tartaric acid analysis; use of acacia wine barrels in Australia; polyaromatic hydrocarbons (PAHs) in bushfire and other smoke sources; natural background levels and sources of cobalt in grapes and wine; polysaccharide-based fining agents; sources of lead in grapes and wine; the regulations surrounding the use of a fining agent BioArom (yeast bi-product containing glutathione); legality of a tannin-derived colour powder containing both *Vitis Vinifera* and *Vitis Rupestris;* legality of Proctase as an additive for winemaking; legality of inclusion of resveratrol on US wine labels; alcohol absorption during wine tasting; and histamine concentration in ageing red wine.

Creina Stockley continued as a member of three OIV working groups — 'Taskforce on additives and processing aids in China', 'Protocol for the evaluation of the risks related to food safety for new oenological treatments' and 'Taskforce on allergens'. The former working group is preparing scientific and technical dossiers on the additives and processing aids not currently permitted for winemaking in China and hence not permitted to be present in Australian wine exported to China. The AWRI has provided dossiers on ascorbic acid and its salts, malic acid, and tartaric acid and its salts. The dossiers will be submitted to the Chinese government in order to vary Chinese Standard GB 2760. The aim of the latter working group has been to coordinate analytical and clinical research into the potential for residual protein in protein-fined wine and its significance for human health, which has been undertaken by Australia, France, Germany and Italy. The European Union intends to implement the requirement to label for the presence of milk and egg products from 1 July 2012 but has included a caveat to the clause, which defers to the detection limits of 'Resolution OIV-OENO 427-2010 for the methods of quantification of potentially allergenic residues of fining agent proteins in wine'. If milk or egg products and the wine has tested negative for the presence of residues using a technique with a detection limit of 0.25 mg/L then the presence of residues does not need to be indicated. From recent research results, including results from the analysis of commercially-available Australian wine, new appropriate analytical limits were established for both egg and milk allergens by the Taskforce (limit of detection ≤ 0.25 mg/L and limit of quantification ≤ 0.5 mg/L for both egg and milk). Commercially-available ELISA kits can meet the modified limits, including that utilised by the AWRI Commercial Services.

Furthermore, the information in the AWRI databases 'Analytical specifications for the export of Australian wine' and 'Approved additives and processing aids for winemaking in Australia and internationally' have been updated (in particular for the markets of Australia, China, EU, India, Japan, The Philippines and Vietnam), simplified and streamlined, and made available on the AWRI website. The former database now contains specifications for 38 markets and the latter for 15 markets.

The Health and Regulatory Information Manager also coordinates Course 3005WT 'Grape industry practice, policy and communication' for the School of Agriculture, Food and Wine at The University of Adelaide. In its sixteenth year, 22 students enrolled in the Course, which exposes students to organisational, commercial, environmental, political, societal and technical issues relating to the wine sector's operating environment.

L to R: Cory Black, Tracey Siebert, Marlize Viviers and Christine Mayr

# Grape and wine composition

## Defining and controlling important volatile compounds and their impact on wine aroma and flavour

**Staff**

Dr Leigh Francis, Dr Cory Black, Dr Dimitra Capone, Dr Christine Mayr, Tracey Siebert, Samantha Anderson, Sheridan Barter, Mark Solomon, Kevin Pardon.

**Collaborators**

Bests Wines (Adam Wadewitz); Casella Wines (Steve Warne); Copenhagen University/Adelaide University (Dr Damian Drew); Craggy Range Vineyards (NZ); CSIRO Land and Water (Dr Rob Bramley); Henschke Wines (Prue Henschke); Institut Français de la Vigne et du Vin Pôle Sud-Ouest (Olivier Geffroy); Orlando Wines (Nick Bruer); Mt Langi Ghiran (Nathan Scarlett, Damien Sheehan); Mt Majura Vineyard (Frank van de Loo); Shaw and Smith Winery (Darryl Catlin, Ray Guerin); Treasury Wine Estates (Paul Petrie, Roger Schmidt); University of Bonn (Ines Botscher, Prof. Matthias Wust); University of Adelaide (Dr Chris Ford, Professor Dennis Taylor, Dr Mark Sefton, Dr David Jeffery); University of Auckland (Gerard Logan, Assoc. Prof. Paul Kilmartin); University of Melbourne (Pangzhen Zhang, Dr Kate Howell, Prof. Snow Barlow).

Much of the flavour of wines arises from volatile compounds detected by the sense of smell. In wines there are hundreds of aroma-active compounds derived from different sources. The analytical challenges to quantify these compounds are considerable. Understanding the origin of the most important compounds and giving wine producers the ability to control their levels in wines is a major endeavor of the AWRI flavour chemistry team. Skills in quantitative analytical chemistry and synthetic organic chemistry mean that an extensive array of key compounds can be measured and studied, and the application of analyses to numerous projects across the research areas of the AWRI, as well as to wine companies, has been of continuing importance over the last 12 months.

Varietal thiols are important impact odorants in Sauvignon Blanc wines, and are major contributors to the tropical flavour of other varieties such as Chardonnay and Riesling. Of the three main thiols, 3-mercaptohexan-1-ol (3-MH) is of particular importance, as it has a very low aroma detection threshold and is found in grape juice and must in non-volatile bound forms (3-MH precursors). The bound forms act as a pool of flavour that can be released by the action of yeast or enzymes during fermentation to give rise to the volatile flavour compound. The known bound forms of 3-MH, which have been found in Sauvignon Blanc juice, are derived from cysteine (Cys-3MH) and glutathione (Glut-3-MH). Recent AWRI research has led to the identification of the precursor compound 3-S-cysteinylglycinehexan-1-ol (Cysgly-3-MH) and the tentative identification of another precursor compound, the aldehyde Glut-3-MHAl, in Sauvignon Blanc juice for the first time.

The last AWRI Annual Report noted that transportation of machine harvested must has a very large effect on levels of 3-MH precursors. Further investigations were carried out to determine whether the same effect could be observed for harvested fruit stored for prolonged periods prior to crushing and pressing, and to assess in more detail changes over time. In addition to measuring the 3-MH precursors, a range of 'grassy' $C_6$ compounds, glutathione (GSH) and the compound 2-S-glutathionylcaftaric acid (also known as grape reaction product [GRP]) were also studied, with pure standards obtained through synthesis or isolation techniques. The bound forms of 3-MH (Cys-3-MH, Glut-3-MH, Cysgly-3-MH) were found to have peaked at around 14 hours of storage post-harvest. While the bound forms of 3-MH increased over time, together with levels of GRP and $C_6$ alcohols, the AWRI found that levels of (*E*)-2-hexenal (a 'grassy' aroma compound) and GSH decreased. These studies are helping researchers to understand the complex chemistry that occurs in crushed grapes to give rise to tropical fruit flavour in white wines, and information obtained allows producers to adjust levels of 3-MH precursors available for release during fermentation. This work has been described in two publications: Capone, D.L., Pardon, K.H., Cordente, A.G., Jeffery D.W. (2011) Identification and quantitation of 3-*S*-cysteinylglycinehexan-1-ol (cysgly-3-MH) in Sauvignon Blanc grape juice by HPLC-MS/MS. *J. Agric. Food Chem. 59*: 11204-11210; and Capone, D.L., Black, C.A., Jeffery D.W. (2012) Effects of 3-mercaptohexan-1-ol precursor concentrations from prolonged storage of Sauvignon Blanc grapes prior to crushing and pressing. *J. Agric. Food Chem*., *60*: 3515-3523.

The potent compound rotundone, which was first identified as a wine flavour compound by the AWRI, gives a black pepper/spicy aroma. While it is grape-derived, being of a class of compounds called sesquiterpenes, there is little known about what factors influence its concentration in wines, except that it is more evident in wines from cool climates. Studies have continued in collaboration with the University of Auckland to understand more of the various viticultural and winemaking effects on rotundone levels. This work was the subject of a presentation at the viticulture conference, GiESCO 2011 in Asti, Italy, which received the Italo Eynard Award for best paper. Work has also continued with longstanding collaborator Mt Langi Ghiran winery to map rotundone levels across the vineyard and relate this to temperature data. Changes in other sesquiterpenes in Shiraz grapes have also been investigated. In a separate study on Shiraz grapes fermented in the presence of a small quantity of grapevine leaves and stems, it was found that the presence of grape leaves or stems can have a large effect on the pepper compound rotundone in the wine (Figure 7). This may be a means of adjusting the levels of this compound in wine. In addition, while extraction from skins during fermentation results in an increase in rotundone, the compound is relatively easily extracted early in fermentation on skins, so the total rotundone in grapes is a more important effect than time on skins. A study to assess the effect of fermentation on rotundone showed conclusively that *Saccharomyces cerevisiae* yeast play no role in degrading this compound during fermentation.

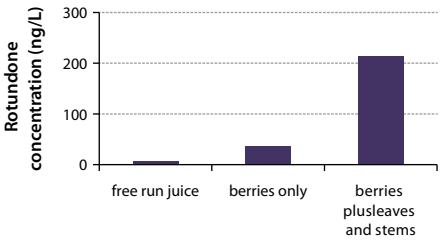


*Figure 7. Concentration of the black pepper compound rotundone in Shiraz wine made with no skin contact, with grape berries only and with berries with the addition of grape leaves and stalks.*

Gas chromatography 'olfactometry' studies have also been conducted to investigate whether any additional compounds are responsible for 'minty' aromas in red wines, apart from the well known eucalyptol. Research from the AWRI shows that eucalyptus leaves in grape harvest bins play the largest role in giving minty/eucalypt flavour to wine. The AWRI found that if a small quantity of eucalyptus leaves or bark were included in a ferment, a ten-fold increase in eucalyptol levels was found in the wine compared to grape berries alone. The AWRI also found that grape leaves or stems (from vines grown in close proximity to eucalyptus trees) in the tank can give rise to substantial amounts of eucalyptol. The study was done in a cool climate Shiraz vineyard close to eucalyptus trees that frequently produces wines with high eucalyptol levels. The results show that management of non-grape material in harvested fruit will allow good control of this flavour in wines. This work was described in: Capone, D.L., Jeffery, D.W., Sefton, M.A. (2012) Vineyard and fermentation studies to elucidate the origin of 1,8-cineole in Australian red wine. *J. Agric. Food Chem*., *60*: 2281-2287.

A collaboration with the scientific instrument company Agilent Technologies has been initiated, with the company providing to the AWRI a state-of-the-art two-dimensional gas chromatograph with a sophisticated tandem mass spectrometer detector. A separate new GC/MS system has also been purchased and installed. The new instruments will be highly valuable to assist in research on important trace aroma compounds that previously have been impossible to quantify.

The aroma compound TDN (1,1,6-trimethyl-1,2-dihydronaphthalene) contributes to aged flavours in Riesling wines. At high levels it can give a 'kerosene-like' aroma. A survey of 116 Riesling wines from various locations and vintages throughout Australia and abroad was conducted to assess levels of this compound in commercial wines. TDN was quantified in each of the wines and a statistical analysis was carried out investigating the relationship of TDN levels with vintage, closure and Mean January Temperature (MJT). Each of these parameters was found to be important to varying degrees, although wine age was the most significant factor; older wines under screwcap generally had higher levels of TDN.

## Phenolics and their contribution to wine composition and sensory properties

### Staff and students

Dr Paul Smith, Dr Keren Bindon, Dr Yoji Hayasaka, Dr Jacqui McRae, Dr Raul Guerrero (Visiting post-doctoral fellow), Assoc. Prof. Joan Miquel Canals Bosch (Visiting scientist), Dr Martin Day, Richard Gawel, Alex Schulkin, Stella Kassara

### Collaborators

Accolade Wines (Chris Bevin); The Australian Synchrotron (Dr Nigel Kirby); Flinders University (Dr Ingo Köper); Orlando Wines (Kate Lattey); SARDI (Dr Michael McCarthy); The University of Adelaide (Dr Sue Bastian, Dr Chris Ford), University of Melbourne (Professor Tony Bacic); and the staff, students and collaborators of the *Tasmania node* projects at the Tasmanian Institute of Agriculture / the University of Tasmania.

This suite of projects aims to determine the function of phenolic compounds in grapes and wine. Of specific interest is the identification of phenolic compounds that influence wine colour, mouth-feel, and taste. Also of interest is an improved understanding of grape and wine phenolic attributes related to consumer wine preference. The desired outcome the ability to effectively manage these components in the vineyard and winery to achieve a targeted wine composition, or style. The verification of the potential of, and the risks associated with, novel practices and new technologies are considered critical aspects to the success of these projects.

### Astringency: The impact of tannin structure

The phenolic composition of red wine impacts upon the color and mouth-feel, and thus quality, of wine. Both of these characteristics differ depending on the age of a wine, with the purple colour of young wines changing to brick red colour in older wines, a change associated with a softening of aggressive astringency or 'puckering'. To better understand the phenolic compositional changes over time, an extensive study was conducted into the colour, tannin concentration and tannin composition of a 50 year series of Cabernet Sauvignon wines as well as a 30 year series of Cabernet Sauvignon and Shiraz wines.

The results showed a dramatic decline in anthocyanins in wine over the first few years post-bottling although the concentration of pigmented tannins remained comparatively steady. These results support previous observations that pigmented tannins, which are resistant to bleaching by sulfur dioxide (i.e. non-bleachable pigments), play a much larger role in long-term wine color than anthocyanins. No age-related trend was observed for tannin concentration (Figure 8), suggesting that the astringency changes characteristic of older red wines are not necessarily related to a decrease in the amount of tannin, but potentially are a consequence of structural changes to the tannin. Wine tannins from older wines were generally larger than tannins from younger wines and showed structural changes consistent with oxidation.

Red wine astringency generally reduces in intensity with ageing, yet the reasons for this remain unclear since many older wines have similar tannin concentrations to younger wines. By understanding how this comes about, it may be possible to craft wines that have the mouth-feel of an aged wine, but at a much younger age. To explore this concept, the impact of wine tannin structure on sensory perception was investigated to determine if the changes in red wine tannin structure that occur with wine ageing influence the perception of wine mouth-feel. Previous research had shown (AWRI publication #1058) that tannin could be isolated from wine and separated into two fractions that differed in size and solubility. To obtain enough of the tannin fractions for a full descriptive sensory analysis, a separation method using liquid-liquid fractionation was developed which consistently produced two structurally distinct fractions: a 'water-soluble' fraction and an 'organic-soluble' fraction. This new method allowed isolation on a much larger scale than previous methods and tannin fractions were isolated from Cabernet Sauvignon wine from 2004 and 2008 on a scale large enough to permit sensory analysis. Analysis of the samples from each fraction showed that the 'water-soluble' fractions from each vintage were larger than the 'organic-soluble' fractions, which were smaller, less water soluble and more highly coloured. The 'organic-soluble' fractions also appeared to contain more oxidised structures than the aqueous fractions and so looked more like aged wine tannins.

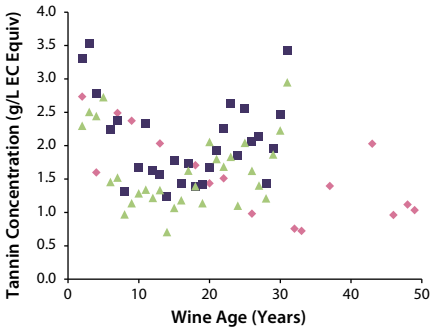


*Figure 8. Tannin concentration (g/L epicatechin equivalents) of the 50CAS (pink), 30CAS (purple) and 30SHZ (green) wines, clearly indicating that aged wines do not necessarily have less tannin than younger wines.*

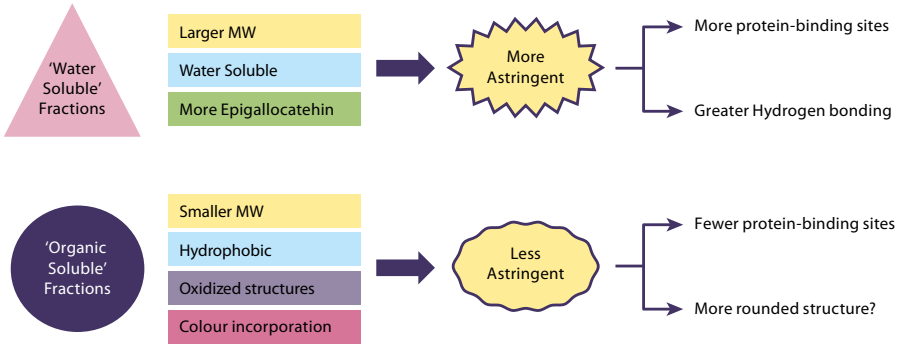


*Figure 9. General structure-function relationships for wine tannins.*

L to R: Alex Schulkin, Martin Day and Richard Gawel

Sensory analysis to describe the taste and texture of each wine tannin fraction was performed using a trained AWRI panel. Tannin samples were prepared in model wine made up to the same molar concentration (that is, the same number of tannins were present in each sample, but not the same gravimetric weight). The results indicated that the 'water-soluble' wine tannin fractions from each vintage were more astringent than the 'organic-soluble' fractions, which were perceived as hotter and more bitter. This indicated that astringency of red wine depends on the type of tannin (i.e. composition) as well as the amount (i.e. concentration). Structure/function analysis of the tannin fractions indicated that those with larger molecular size and greater water-solubility were more astringent, but fractions with more colour and more oxidative structures were less astringent (Figure 9). These latter characteristics are also associated with aged wine tannins, so the differences in tannin structure that occur during wine ageing may reduce the perceived astringency of aged red wine.

## Nanotechnology helps in understanding tannin-protein interactions on surfaces

Tannins bind to proteins in the mouth which most likely leads to the perception of astringency, but little is known about how astringency is perceived once this binding happens. Visiting Scientist Joan Miquel Canals Bosch from the Faculty of Oenology, Universitat Rovira i Virgili in Spain, joined the AWRI to investigate the interaction of tannins with salivary proteins using advanced analytical techniques through an ongoing collaborative partnership with Flinders University. Using the analytical technique Surface Plasmon Resonance (SPR), the interactions of tannin and proteins on a solid surface were investigated to establish how thick layers of tannin and protein might form in the mouth. Work is ongoing to correlate these results with sensory data in collaboration with Flinders University.

## Influences on white wine mouth-feel perception

The contribution of white wine phenolic composition to mouth-feel, overall style and consumer acceptance is now better understood. This was achieved following a detailed meta-analysis of data arising from several studies, including controlled winemaking and addition trials, consumer studies, and from other projects conducted by the AWRI Industry Applications and Sensory groups.

The consistent and complementary messages were:

- pH and alcohol levels impact strongly on how phenolics manifest in the taste and texture of white wine.
- While high levels of phenolics can contribute to astringency in white wine, typical variations in wine pH will produce a similar effect.
- Total phenolics contribute to palate viscosity and hotness/pungency but their impact is most apparent in lower alcohol wines.
- Phenolic content is a distinguishing feature of some white wine styles.
- Consumer liking of white wines is influenced more by alcohol content and sweetness than by phenolic concentration.
- Phenolic compounds have the potential to reduce hotness and dryness resulting from alcohol and acidity which suggests that their presence might enhance white wine quality under some circumstances.

The AWRI demonstrated for the first time that the in-mouth texture of white wines is influenced by phenolic composition. This was achieved by assessing the textural and taste effects of adding phenolics isolated from high phenolic wines to two commercial wines with varying alcohol levels. The effect of alcohol level on the perception of phenolics was clearly apparent, with higher alcohol levels suppressing the sensory effects from phenolics.

Other studies confirmed that alcohol and pH strongly influence the perception of phenolic characters. Adding white wine phenolics at a level equivalent to those encountered in wines made from hard pressings were shown to increase the astringency, bitterness and viscosity. However, the additional phenolics only strongly impacted astringency when pH was in a moderate range, and increased hotness was only apparent when the base wine was at the lower end of alcohol in dry white wines.

Phenolics were shown to be important in defining wine style. Total phenolics were one of the major factors that differentiated the two internationally recognised styles of 'Pinot G' (Pinot Grigio and Gris) as assessed by a highly experienced tasting panel. Consistent with the abovementioned

studies, higher perceived astringency of these commercial 'Pinot G' wines were again mostly associated with lower pH. The perception of the overall quality of market leading commercial Rieslings by Australian winemakers were found to be associated with lower total phenolics, higher acidity and lower alcohol. On the other hand, the acceptability by 205 consumers based in Sydney of high selling commercial white wines appeared to be influenced more by residual sugar and alcohol than total phenolic levels.

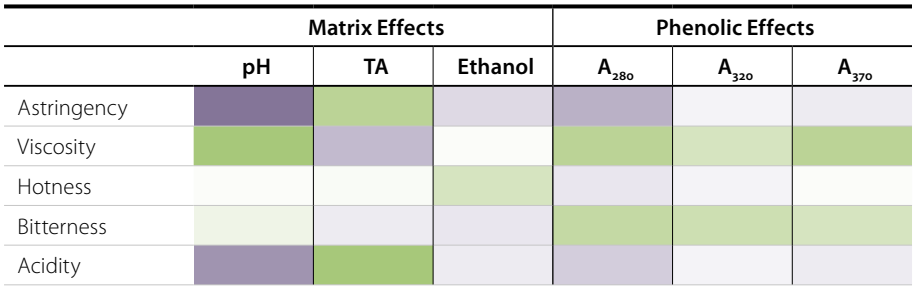


*Figure 10. Correlation between sensory attributes of 2010 white wines made using different winemaking treatments and indices of their phenolic content and general wine matrix. Purple indicates a negative association and green positive. Depth of colour represents strength of association.*

The fundamental wine components pH and alcohol were shown to have an overarching effect on those tastes normally associated with total phenolic content – sometimes greater than the phenolics themselves. Studies involving total phenolic concentration, pH and alcohol were important steps towards understanding the molecular basis of textural perception in white wine, but it remained unclear what specific phenolic compounds (or groups of compounds) caused differences in white wine texture. To tackle this, the two most dominant phenolic molecules in Australian white wines (caftaric acid and its derivative Grape Reaction Product (GRP), which is formed during oxidative juice handling), were isolated and subjected to formal sensory profiling. Caftaric acid was shown to reduce the burning hotness from alcohol and GRP was shown to increase palate oiliness. These findings were unexpected, as was the discovery that these two phenolics decreased the dry mouth-feel produced by alcohol and acidity. It has long been assumed that most 'phenolic taste' elements come from phenolics and that acidity and alcohol modulated these perceptions. Therefore it was unexpected to find that some principal taste and textural attributes normally associated with phenolics might arise principally from the wine matrix, and that these attributes are then modulated by phenolics. This has significant practical implications because these two phenolic compounds, caftaric acid and GRP, can be varied in winemaking through oxygen exposure, and so variations in their concentrations might allow modulation of the significant sensory effects from alcohol and pH.

An advanced HPLC method has been developed for separating of more than 80 identified (40 of which can currently be quantified) phenolics in white juices and wines. The minimal sample preparation required in this method represents a notable advancement on the previous methods. This was a challenging aspect to the project that was critical to analysing the winemaking experiments described next.

In order to elicit measurable differences in both taste and texture of phenolic compounds, a set of white wines differing greatly in phenolic composition was made. A mix of both conventional and less practiced white winemaking techniques were used over three vintages and most winemaking treatments were repeated over two of the years (2010 and 2011). The winemaking experiments, together with the outcomes of the previous model experiments, allowed insights into the molecular basis of 'phenolic' taste.

Observations from winemaking treatments show that, as anticipated, wines made with pre-ferment skin contact, or those made from press fractions had higher total phenolics. However, unexpectedly, these more macerated wines were less astringent and were perceptively more viscous than the corresponding free run wine. A strong negative relationship between 'astringency' and pH, and a correspondingly strong positive relationship with 'viscosity' suggests a direct role of pH in the perception of both astringency and viscosity. Therefore, the desired phenolic outcome of any given winemaking treatment needs to be carefully considered from the perspective of the concomitant effect of pH on astringency and viscosity. Observations from winemaking treatments (which were adjusted to similar pH levels) show that skin contact before and during fermentation did not generally produce wines which differed much in 'phenolic taste' compared to wines made from whole bunch pressed, free run or hyper-oxidised wines, despite large differences in phenolics. These are among several findings of significance that contradict the widely held assumption that phenolics are the main cause of astringency in white wines.

'Hotness' and 'burning after taste' are most highly associated with alcohol concentration. While an increase in phenolics was shown to increase hotness, this was only observed in wines with alcohol levels at the lower end of the commercial scale (around 11.5%). At more typical alcohol levels (around 13.5%), hotness from alcohol appears to limit any further contribution by phenolics. Indeed, as discussed above, alcohol hotness was suppressed by the most abundant phenolic in white wine: caftaric acid. This shows that, in the absence of variations to matrix composition, phenolics might allow winemakers to 'dial down' white wine hotness in some circumstances.

'Bitterness' was generally shown to be positively associated with phenolics. However, the two major phenolics in Australian white wines (GRP and caftaric acid) do not contribute significantly to bitterness. This means some other phenolic or phenolic class in white wine does contribute to bitterness, but their identity remains unknown.

In summary, significant progress has been made in finding the molecular drivers of phenolic tastes in white wine and Figure 10 gives a graphical representation of the complex matrix effects that influence white wine taste. The task was, and remains, challenging as white wine contains over 100 different phenolic compounds spanning a dozen or more structural classes. While the direct effect of only some of the most abundant phenolic compounds were investigated, a further body of correlative work allowed AWRI to focus on certain phenolic classes as candidates for either causing or suppressing phenolic tastes in white wine. The studies have shed some new light on the impact of phenolic compounds in white wine which might allow winemakers to better manage palate texture in their wines. The results also point to the importance of managing phenolics in lighter bodied lower alcohol wines. At the low alcohol levels typical of lighter bodied white wines, phenolics contributed to these tastes and textures, but at higher alcohol levels their impact was less apparent. Lower alcohol white wines are often accused of being thin and lacking in complexity. This body of research results presents the possibility of increasing the commercially desirable attributes of palate fullness and overall complexity in white wines by building in or retaining white wine phenolics.

## Tannin extractability

Based on earlier studies which showed that insoluble grape fibres are very good at binding tannin, a project was initiated where the AWRI aimed to exploit this potential as a novel fining agent for application in wines. A need for new fining products derived from plant sources has been precipitated by labeling implications of the animal-derived fining agents currently in use. The team was joined by a postdoctoral fellow, Raúl Guerrero, who together with the team investigated the interaction of fibres

isolated from processing wastes (grape and apple pomaces) with purified wine tannins and whole wine. The results show that grape-pomace fibres performed similarly, and were able to remove tannin from wine in a dose-specific way. Interestingly, apple-pomace fibres had a higher capacity to adsorb tannin from wine. In terms of their performance in comparison with protein fining agents, fibres required a higher dose, but were able to more reproducibly remove tannin. A further benefit of fibres is their insolubility, since some protein fining agents remain in wine after the application. Some variability was found in the type of tannins removed between the different fining agents, with grape-pomace fibres generally being more selective for tannins of intermediate molecular mass, and apple-pomace fibres and proteins removing tannins of higher molecular mass. How this will impact wine astringency and clarification is unknown, and will be followed up by a sensory study.

A three-year study on tannin extraction during grape ripening was completed. The team was joined by visiting student Christina Linke from Bonne, Germany. They explored trends in tannin extraction from Cabernet Sauvignon and Shiraz grapes. To simulate 'partial' (wine-like) versus 'total' extraction conditions, dilute ethanol (10-50% v/v) was compared to 70% acetone. The use of dilute ethanol as a tannin solvent approximates the quantity of tannin extracted into wine, but the relationship between the 'partial' and 'total' extraction of grape tannin is not linear. This might be a contributing factor in the frequently observed poor correlation between grape and wine tannin. It was found that apart from a cool, wet season such as 2011, skin tannin extraction increased during ripening. On the other hand, seed tannin extraction generally decreased. These trends were consistent for both 'partial' and 'total' extractions of grapes (Figure 11). For Cabernet Sauvignon, changes in grape tannin composition were also tracked into wine, which confirmed that later-harvested grapes had higher total tannin, due to an increased skin tannin contribution, but proportionally decreased seed tannin.

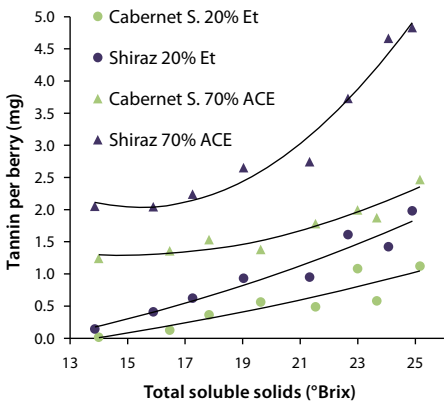


*Figure 11. The effect of extraction solvent on skin tannin content in Cabernet Sauvignon and Shiraz berries at different stages of ripeness during the 2012 season, compared using dilute ethanol (20% v/v Et) and acetone (70% v/v ACE).*

This work has been described in the following publications: McRae, J.M., Schulkin, A., Kassara, S., Holt, H.E., Pearson, W., Francis, L., Smith, P.A. Wine tannin fractionation: Sensory impact and implications for red wine astringency. *J. Agr. Food Chem.* 2012, *in press*; McRae, J.M., Dambergs, R.G., Kassara, S., Parker, M., Jeffery, D.W., Herderich, M.J., Smith, P.A. Phenolic compositions of 50 and 30 year sequences of Australian red wines – The impact of wine age. *J. Agr. Food Chem.* 2012, *in press*; and Bindon, K.A. and Smith, P.A. Comparison of the affinity and selectivity of insoluble fibers and commercial proteins for wine proanthocyanidins. *Food Chem.* 2012, *in press*.

## Shining further light on regionality and wine styles

### Staff

Dr Eric Wilkes, Dr Wies Cynkar, Peter Godden, Emma Kennedy, Dr Richard Muhlack, Ella Robinson, Neil Scrimgeour, Dr Bob Dambergs

### Collaborators

Accolade Wines (Chris Bevin); Bay of Fires (Peter Dredge); Bruker Instruments (Andrew Bales); Casella Wines (Steve Warne, Laura Thompson); Cellarmaster Wines (Mark Robertson, Stuart Robinson); De Bortoli Wines (Rob Glastonbury, Tarek Heiland, John Coughlan, Sharon Adams, Henry Perez, Julie Mortlock); Frogmore Creek (Nick Glaetzer); Jansz (Natalie Fryar); Joseph Chromy (Jeremy Dineen); Lillypilly Wines (Robert Fiumara); McWilliam's Wines (Andrew Higgins, Nevil Shah); Pirie Tasmania (Andrew Pirie); Pressing Matters (Paul Smart); Riverina Wine Grapes Marketing Board (Kristy Bartrop); Tamar Ridge (Tom Ravech); Treasury Wine Estates (Ian Shepherd, Kevin McCarthy, Alex Hill); University of Adelaide (Peter Ashman); Vinpac Packaging (Greg Edwards); Warburn Estate (Moreno Chiappin, Amba Goldsmith); Westend Estate (Jeremy Nascimben, Bryan Currie); Winemaking Tasmania (Julian Alcorso); Wynns Coonawarra (Catherine Kidman, Allen Jenkins, Sue Hodder); The Yalumba Wine Company (Luke Wilson, Claire Doughty, Alana Capaldo, Teresa Heuzenroeder)

## Collaboration with industry yields valuable results

A four-year collaborative project with Wynns Coonawarra Estate was concluded this year. It was initiated in 2009 to assess the tannin and anthocyanin accumulation from five different Cabernet Sauvignon clones grown on two soil types (Rendzina and Terra Rossa). For a comparison of the clones' performance, grapes were sampled at veraison, approximately four weeks before harvest and at harvest during vintages 2009-2012 and analysed at the AWRI. Wines were made from these fruit parcels in small lots by Wynns Coonawarra Estate, with resultant quality assessed by their winemakers through formal sensory evaluation.

This collaboration provided a rare opportunity to relate grape attributes measured through laboratory analysis to the resultant wine attributes, with a focus on colour and tannin development. Outputs include the following:

» Based on the results of the trial, Wynns Coonawarra Estate are able to make informed decisions when choosing their preferred clones of Cabernet Sauvignon for future planting.

» Results provided an insight into the link between grape and wine attributes and their dependence on vintage climatic conditions.

» The importance of tannin concentration in grapes as the 'backbone' of wine colour was reinforced through data collected over the four vintages.

» Data highlighted the importance of early tannin measurement, preferably at four weeks before harvest, as an indicator of potential tannin concentration at harvest and therefore potential concentration in the resultant wines.

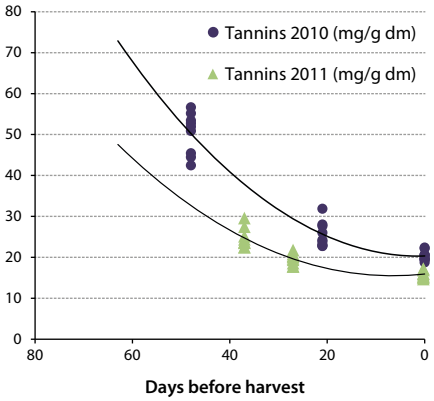


*Figure 12. Tannin concentration measured at different points during grape berry ripening and at harvest over two separate vintages.*

Tannin and colour data generated over the four vintages from 2009 through to 2012 have highlighted the importance of monitoring grape tannin and grape colour, to better understand the colour stability of the resultant wines. Data show that low grape tannin levels in 2011 were a significant influence on the resultant low (stable) colour levels of the wines made in that year and this corresponded to a comparatively low preference rating from winemakers during sensory evaluation of the wines. A combination of high grape tannin and high grape colour, such as that achieved in 2010, are required to achieve high levels of tannin and (stable) colour in the wines, leading to a correspondingly higher sensory preference rating.

## Exploring the concept of spectral fingerprinting

AWRI experts in the spectral analysis of grapes and wine have developed the concept of 'spectral fingerprinting'. Spectral fingerprinting involves taking scans of samples across various parts of the electromagnetic spectrum, thereby encompassing many compositional variables of the sample, rather than evaluting a few specific variables as is done with traditional grape and wine analysis.

The technique might be considered analogous to the holistic experience of drinking a wine, as opposed to tasting wine in an analytical way. The data obtained from the spectral scans, when combined with multi-variate data analysis techniques, can be used to group samples according to the similarity of their 'fingerprints', and the technique is seen to have many potential applications. Many examples of the ability of this technology to differentiate among wines by variety, region, country and wine style, have been demonstrated, and the fingerprints can be used as objective targets of desired wine style. The most high profile application of the spectral fingerprinting technique to date is the Pinot G Style Spectrum.

The Spectrum is a labelling scale for Pinot Grigio and Pinot Gris wines which informs consumers of the style of the wine in the bottle at the point of sale or before opening, with a wine's style being classified by the AWRI using a mid-infrared spectral scan. The Spectrum was developed in response to industry demand from producers who were concerned that the two names being used for the same grape variety, as well as the wide range of wines styles being offered, was causing confusion in the marketplace.

During the year, 46 wines were classified for commercial labelling with the Pinot G Style Spectrum. A Pinot G Style Spectrum marketing group was formed, which is led by commercial users of the Spectrum, with users contributing to a joint promotional effort. A number of events were organised during the year, most notably at the Noosa International Food and Wine Festival.

In addition, seven presentations on the Spectrum were made by AWRI staff during the year: five to technical and/or marketing groups of Australian wine producers which are either using, or have interest in using the device; one at the Crush scientific conference staged in Adelaide; and one to the Wine Communicators Australia NSW chapter. Each presentation included a tasting of wines classified at various points on the Spectrum.

During the year, Trademarks for both the 'Pinot G Style Spectrum' Word Mark and the labelling 'device' were granted by both IP Australia and the European Community. In New Zealand, a Trademark has been granted for the device only. Trademark applications for the Pinot G Style Spectrum Word Mark and device are still being pursued in the USA.

There appears to be interest from industry for the Pinot G Style Spectrum technology to be applied to other uses, such as for bottled wine from other varieties, or for regional 'typicity' classification. The potential application which generates most interest is for use on bottled Chardonnay wine.

As an extension of work conducted with Treasury Wine Estates (TWE) in the previous reporting year, a further tasting was conducted using a set of twenty commercial Chardonnay wines in which representatives of TWE, The Yalumba wine company, Premium Wine Brands and the AWRI participated. A further evaluation of twelve of those wines was made using the AWRI's trained sensory panel and the wines were also subjected to chemical and spectral analysis.

Analysis of the resulting data confirms that Chardonnay wine style could realistically be rated and communicated via a similar labelling device to the Pinot G Style Spectrum. However, significant industry support for further development and marketing of this spectral measurement tool, and a commitment to use it once developed, will be required from key industry stakeholders before this project can be further progressed.

## Using rapid spectral methods to support objective measurement of grape and wine attributes

**Staff**

Dr Eric Wilkes, Dr Wies Cynkar, Peter Godden, Emma Kennedy, Dr Richard Muhlack, Ella Robinson, Neil Scrimgeour, Dr Bob Dambergs

**Collaborators**

Casella Wines (Laura Thompson); DeBortoli Wines (Sharon Adams, Henry Perez); McWilliam's Wines (Nevil Shah); Riverina Wine Grapes Marketing Board (Kristy Bartrop)

### Application of mid-infrared spectroscopy for simultaneous measurement of compositional parameters in grape juice and grape homogenates

The ability of spectroscopy methods to rapidly predict multiple grape and wine composition parameters has been well proven. However, the adoption of these methods developed through research at the AWRI has been slow, due to the high cost of the instruments available on the market. Now, with affordable, 'off-the-shelf' spectroscopy instruments such as the Bruker Alpha or Grape Scan available, methods suitable for application to measure grape and juice attributes can be accessed for lower cost.

L to R: Neil Scrimgeour, Peter Godden and Bob Dambergs (location: Hickinbotham Roseworthy Wine Science Laboratory)

The development of spectral calibrations for measurement of Yeast Assimilable Nitrogen (YAN) in juices and ferments has been carried out through the last two vintages (2011-2012). This has progressed well with the participation of a number of major wine producers in the Riverina region, via the AWRI's Riverina Node. The wineries involved collected the spectral data using Bruker Alpha FT-IR instruments (loaned for this purpose by Bruker), whilst the AWRI provided reference laboratory analysis of YAN. Models for prediction of YAN concentration, as well as pH, TA and Brix, have been developed and are currently being validated. It is anticipated that these calibration models will be made available to wine producers for the 2013 vintage, in order to prove the effectiveness of the calibrations.

Measuring YAN in juice and monitoring its concentration during the fermentation process is very important as insufficient YAN (<160 mg/L) in the juice/must can result in sluggish or stuck fermentations and the production of hydrogen sulfide. Conversely, elevated levels of YAN (>350 mg/L) can lead to the formation of undesirable flavour and aroma characteristics in the resultant wine. However, few producers measure YAN on a regular basis, relying rather on 'preventative' DAP additions to the juice.

Data on YAN concentration in the juices, collected for the duration of the project, have shown that approximately 37% of samples analysed from the 2012 vintage would not have required a DAP adjustment, as values fall within the AWRI's suggested range of 160-350 mg/L. However, many producers both in the Riverina and elsewhere make routine standardised DAP additions. Not only is this an unnecessary waste of raw materials, but it also creates additional risk to wine quality. This finding further emphasises the value in providing a means of rapid juice analysis, which reduces operating costs and quality risks by directing an addition only when and where needed.

The same Bruker Alpha instrument has been used to develop methods for simultaneously measuring a number of grape composition parameters. With the collaboration of AWRI Commercial Services, robust calibrations have been developed for measurement of total soluble solids (TSS), total anthocyanins, pH, TA and dry matter in grape homogenates. These rapid measurements could replace the expensive and time consuming traditional laboratory methods and could ultimately be extended to measurements using hand-held devices during grape berry ripening and at harvest.

## BevScan provides solutions for rapid non-destructive assessment of wines

### Collaborators

Bay of Fires (Peter Dredge); Frogmore Creek (Nick Glaetzer); Jansz (Natalie Fryar); Pirie Tasmania (Andrew Pirie); Tamar Ridge (Tom Ravech); The Yalumba Wine Company (Alana Capaldo, Luke Warner)

The AWRI receives a number of enquiries each year from wine producers who have issues with the variability of their products due to inadequate storage conditions, insufficient care taken by distributors and retailers through the supply chain, and/or variability during bottling. Sometimes, a large proportion of bottles are unsaleable due to high sulfur dioxide ($SO_2$) depletion, microbiological contamination, elevated colour development or oxidative sensory characteristics.

Typically, when such problems exist, bottles of the affected wine are subjected to sensory assessment and/or chemical analysis. While this approach makes it fairly simple to identify a variability problem such as oxidation, producers are still left with the difficult task of sorting the acceptable from the unacceptable. In most cases, the expense of opening, assessing and re-sealing all bottles cannot be justified.

The BevScan™, an in-bottle spectrophotometer developed by the AWRI, Jeffress Engineering, and the software company Camo, can be used to identify spectral differences among bottles of wine, non-destructively. Wines which appear to be damaged by oxidation, accelerated development or contamination during storage and distribution can be analysed without opening the bottle. Using Vis-NIR spectroscopy, matrix differences in wines can be identified, categorised and quantified rapidly.

A number of viable applications of the BevScan™ technology have been identified, including analysis of wine differences due to closure performance, identification of flat sparkling wines due to low $CO_2$ content and monitoring changes due to temperature impact.

In one example, a spectral classification model was built using samples of a commercial red wine that were exhibiting sporadic patterns of oxidation during storage. This calibration model was then used to screen approximately 750 stored cases of wine and identify those bottles that had acceptable development characteristics, allowing the mobilisation of stock for overseas markets.

Work continues on investigating the potential use of the BevScan™ instrument during bottle-fermented sparkling wine production, primarily via the AWRI's Tasmania Node. Two applications are being evaluated: to assess the progress of the fermentation itself and to monitor the development of autolysis during lees ageing. The latter application is generally a rate limiting and cost sensitive part of the sparkling winemaking process, where wines are kept on yeast lees until desirable autolysis/ageing characters have evolved. Currently, many winemakers use informal sensory assessment to evaluate the degree of autolysis and formation of desirable sensory characteristics. BevScan™ has the potential to improve understanding of how these characters develop over time and what influences the speed of development, thereby streamlining the production process, with high economic impact.

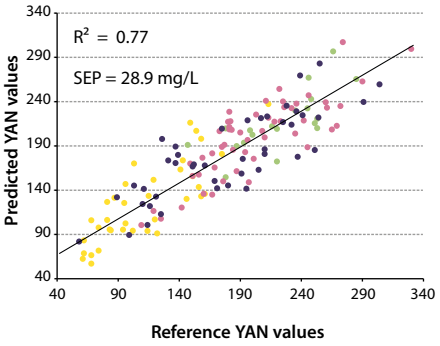


*Figure 13. Scatterplot comparing YAN values measured using reference enzymatic method against those predicted using FT-IR data. YAN values are measured as mg/L in juice samples analysed from four different producers (shown as different coloured data points).*

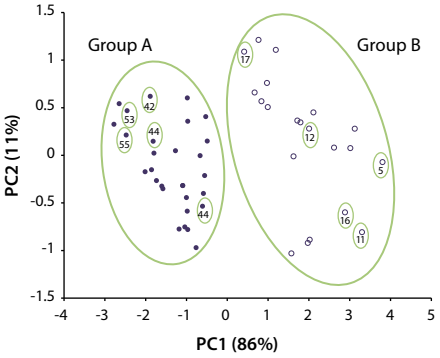


*Figure 14. Principal component analysis (PCA) plot based on spectral analysis of a damaged red wine, showing acceptable (Group A) and unacceptable (Group B) wines. Numbers in ellipses indicate the concentrations of total $SO_2$ (mg/L).*

Previous work reported at the 14th Australian Wine Industry Technical Conference showed that UV-Vis spectral fingerprinting could be used to predict sensory autolysis ratings in sparkling wines, but UV wavelengths cannot be used when scanning bottles as glass is not transparent to UV. Current work has focussed on using fingerprinting methods with BevScan™, using visible and short wavelength near-infrared spectroscopy.

Preliminary trials carried out in collaboration with a number of sparkling wine producers in Tasmania have shown that secondary fermentatio n can be tracked using spectral fingerprinting through application of advanced statistical techniques to the BevScan™ generated data. This could be a particularly valuable method of application, especially in scenarios where wine value is high and wastage cannot be afforded. It has also been shown that BevScan™ fingerprinting could be used to discriminate among sparkling wines stored at different temperatures; this will be investigated further to support the use of elevated temperatures to accelerate the autolysis process.

# Grape and wine production

## Improving microbial performance, wine diversity and wine quality

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**Collaborators**

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Bioscience research at the AWRI aims to improve microbial performance in wine fermentations and provide options for winemakers to shape wine style. The fields of biology utilised include: microbiology, physiology, genetics, molecular biology, biochemistry and systems biology. This mix of skills and experience seek to achieve valuable outcomes to: identify and generate novel yeasts with improved winemaking and sensory-imparting properties; optimise fermentation outcomes by developing improved yeast nutrient supplementation regimes; improve robustness of wine yeasts and MLF bacteria; utilise MLF to enhance wine quality; and develop 'low-alcohol' yeasts. The following is an overview of some of the activities of the Biosciences team.

### 'Big Science' is made more accessible for wine research at the AWRI

Biological sciences are currently changing rapidly with an increased emphasis on 'big data' technologies and computers. Biologists now routinely: sequence the entire genetic make-up (the genome) of an organism; take a snapshot of a large part of the protein content (the proteome) of a cells, tissues, organs or whole organisms; and determine the metabolite content (the metabolome) of a living system. Because of this, biologists are scrambling to keep up with the data deluge. In wine sciences, complete genomes are being elucidated for both beneficial (wine yeast and MLF bacteria) and harmful microorganisms (e.g. *Brettanomyces*). Far more complex genomes of grapevines are also being sequenced. And the fermentation process itself can now be monitored more closely and dynamically, simultaneously following the action of hundreds of enzymes and hundreds of fermentation products at once.

Bioinformatics is a branch of science that marries computational, informational, and biological sciences. Bioinformatics starts with the raw material of 'big data' and applies data mining methods to transform it into useful knowledge. It does this, in part, by matching a biologist's understanding of the underlying questions with a computer scientist's understanding of emerging data analysis methods. In the medical field, big data and bioinformatics are driving an excitement about the prospects of personalised medicine. In the wine world, this kind of thinking might ultimately lead to personalised fermentation, matching the right yeast and the right conditions based on detailed knowledge of the varietal, the harvest, the yeast and the winemaker's designs.

The Australian Government-funded BioPlatforms Australia (BPA) has recognised the role of bioinformatics as part of its objective of bringing state-of-the-art research infrastructure and associated capabilities to Australia. In South Australia, BPA is supporting a team of three bioinformatics scientists at the AWRI. The team's efforts include applying bioinformatic methods to support platforms and projects run at BPA's local research nodes: AWRI's Metabolomics team, the Adelaide Proteomics Centre (housed at the University of Adelaide) and the Australian Genome Research Facility (Adelaide Node located on the Waite Campus). Additionally, the team is driving outreach initiatives providing awareness, access and training to the wider scientific community. The AWRI-BPA Bioinformatics team works closely with the South Australian Metabolomics Facility, which is supported by funding from the Premier's Science and Research Fund, Government of South Australia, and Bioplatform Australia's EIF/Super Science program.

By providing expertise, in-house training of AWRI researchers and enabling access to advanced computing technologies, the AWRI-BPA Bioinformatics team brings many advantages to AWRI research activities, including the following example.

### Systems Biology for the development of low-alcohol yeasts

One of the major initiatives benefitting from the services provided by the AWRI-BPA Bioinformatics team is the national, collaborative Wine Yeast Systems Biology project, which is part of AWRI's broader effort to facilitate the production of wines with lower alcohol content for reasons associated with health, economics and product quality.

The AWRI-BPA Wine Yeast Systems Biology project harnesses expertise, infrastructure and technologies available at each of the participating 'omics platforms around Australia, to develop systems-based mathematical models of yeast metabolism, which will be used to develop predictive models to inform the design of new strains with improved, wine relevant, traits such as a low ethanol production.

Systems Biology typically involves simultaneous monitoring of numerous biological processes using 'omics technologies (i.e. technologies that attempt the analysis of complete sets of cellular components, such as proteins, in a single experiment) and high powered computing for the formulation of mathematical models. The AWRI has studied the transcriptome (all transcripts present within the yeast cell), the proteome (all proteins present at a given state) and the metabolome (all metabolites in the yeast cell) during fermentation using yeast strains that produce different levels of alcohol. The AWRI has quantified the expression of more than 5000 genes, the abundance of over 400

proteins and the concentration of 100 metabolites. Integration of datasets from the different platforms is ongoing, and represents the key challenge from a Bioinformatics perspective, but is key for successful development of mathematical models which enable informed predictions of the development of improved, novel wine yeast strains to be made.

## Making the best choice when matching a wine yeast with a grape juice

Grape juice and wine yeasts are complex, and their interaction to produce wine reflects this. For example predicting, with accuracy, the quality of a wine from its starting ingredients or the efficiency with which a fermentation will progress can be a rather 'hit and miss' affair; suboptimal fermentations still take winemakers by surprise from time to time.

Previous work on grape juice composition identified grape juice pH and potassium concentration as key parameters affecting wine yeast performance. For example, for some yeast strains there was a significant loss in viability following inoculation into low pH juice, resulting in significant delays in the onset of fermentative activity; in other words, a sluggish start to fermentation.

Many commercially available wine yeasts were screened, in order to determine their common susceptibility to low pH. Approximately 25% of the strains screened had some degree of intolerance to low pH conditions. The magnitude of intolerance ranged from simply failing to grow without viability loss to cell viability reaching undetectable levels within 24 hours following inoculation. In the latter case, this led to a delay in fermentation initiation of 5-10 days. In an industrial context, such a lengthy delay can result in other effects such as juice oxidation or nutrient loss due to the metabolic action of other microorganisms within the juice, which in turn can contribute to other fermentation issues and spoilage.

For the most susceptible strains, being inoculated into even moderately low pH juices (pH 3.2) can stress yeast to the point of viability loss. The AWRI is currently exploring how moderate shocks, such as inoculation into pH 3.2 juice, can interact with other suboptimal conditions. Results from this work will enable the development of strategies for winemakers to minimise the risk of suboptimal ferments and associated problems.

## AWRI-developed *Saccharomyces* interspecies hybrid yeasts as valuable tools for winemakers

The AWRI's yeast breeding program aims to develop new commercial yeast capable of generating a far wider range of yeast flavour and aroma metabolites than typically observed for the predominant wine yeast, *Saccharomyces cerevisiae*. By mating different species of yeast from the *Saccharomyces* genus with a proven commercial *S. cerevisiae* strain, the AWRI has produced interspecific wine yeast hybrids. Incorporating the genome of a non-*S. cerevisiae* yeast into a wine yeast background has resulted in hybrid strains that display desirable traits of both parents: robust fermentation properties along with novel flavour and aroma profiles.

Active dried yeast products of these hybrid strains allows winemakers to shape new wine styles while remaining firmly in control of the fermentation micro-flora. To date, two interspecific wine yeast hybrids have been commercialised by AB Mauri Yeast Australia: AWRI 1503 (*S. cerevisiae* x *Saccharomyces kudriavzevii*) and AWRI Fusion (*S. cerevisiae* x *Saccharomyces cariocanus*). Both hybrid yeast strains have been embraced by winemakers around Australia for their unique characteristics. At a workshop on Pinot Noir (2012 International Cool Climate Symposium, Hobart, Tasmania), winemakers overwhelmingly preferred wine made with AWRI Fusion over an industry standard Pinot Noir yeast.

Successful industrial trials on a third hybrid yeast, AWRI 1505 (*S. cerevisiae* x *Saccharomyces bayanus*), has lead to the planned manufacture of an active dried yeast of this hybrid strain (re-named AWRI Cerebay) in time for the 2013 Australian vintage.

Fermentation trials have shown that AWRI 1505 impacts on wine flavour compounds in both white and red varietals, with the greatest effect seen in Chardonnay wines relative to Semillon and Merlot (Figure 15, Figure 16, Figure 17). However, not all flavour compounds are produced in the same manner in each of the varietals. For example, ethyl hexanoate, a 'green apple' sensory attribute, is produced in much higher concentration in both Semillon and Chardonnay wines (150-240%) relative to the wines made by the *S. cerevisiae* parent, but at a lower level (70%) in Merlot. There are also differences in trends between the white varietals, with 2-methyl propyl acetate, 'banana' flavour, produced in a high concentration in Chardonnay (250% relative to wines made by *S. cerevisiae* parent), but at a reduced level in Semillon (85% of the *S. cerevisiae*-made wine).

On the other hand, AWRI 1505 consistently produced lower acetic acid concentrations across all three of the varietals (75-80% relative to the *S. cerevisiae* parent-made wines). Decreasing acetic acid levels not only minimises the negative impact of the 'vinegar' sensory attribute of this compound, but might also unmask some of the more positive sensory attributes of other flavour compounds.

The release of interspecific wine yeast hybrids as active dried yeast products provides an easy-to-use tool for winemakers wishing to produce wines that can be clearly differentiated from others in the marketplace.

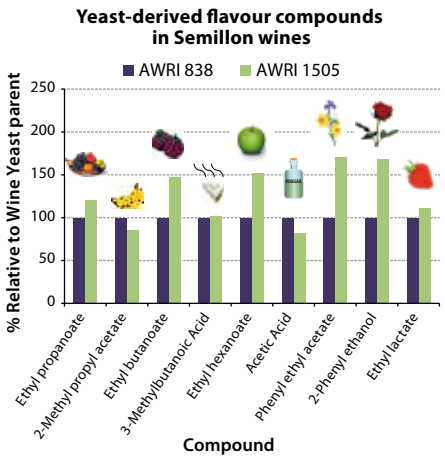


*Figure 15. Sample of yeast-derived flavour compounds analysed in Semillon wines made with* S. cerevisiae *parent AWRI 838 and hybrid strain AWRI 1505.*

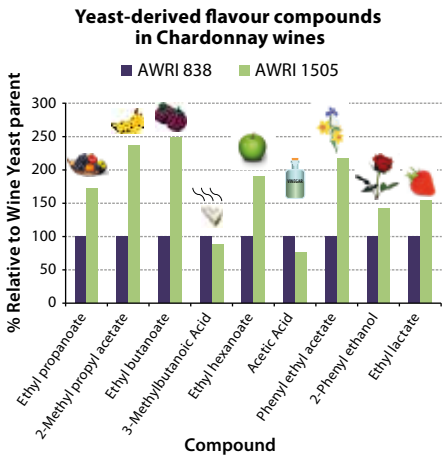


*Figure 16. Sample of yeast-derived flavour compounds analysed in Chardonnay wines made with* S. cerevisiae *parent AWRI 838 and hybrid strain AWRI 1505.*

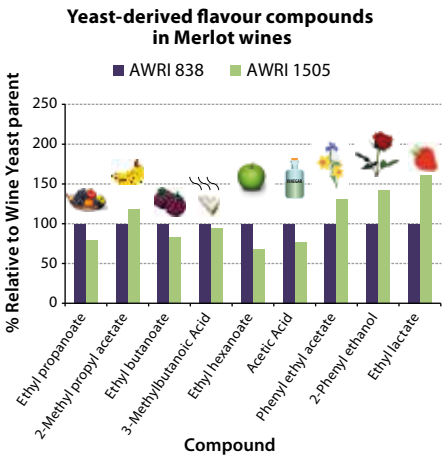


*Figure 17. Sample of yeast-derived flavour compounds analysed in Merlot wines made with* S. cerevisiae *parent AWRI 838 and hybrid strain AWRI 1505.*

## Harnessing flavour diversity of *Saccharomyces* interspecies hybrids while minimising sulfide production

Wine yeast confront the challenging tasks of: surviving in the harsh environment of grape must; converting sugar to alcohol within timeframes suitable for commercial wine production; and contributing to wine styles by producing desirable aromas and flavours. Many wine yeast have been selected on the basis of their contribution to wine flavour, with *Saccharomyces* interspecies hybrids emerging as particularly useful for crafting of diverse wine styles, as described in the above report. For maximum utility, such strains need to retain good fermentation kinetics and ideally produce low concentrations of undesirable flavour compounds, such as hydrogen sulfide ($H_2S$). So how can you take a good interspecies hybrid, and improve it further?

Normally, interspecies hybrids are considered breeding 'dead-ends' due to low rates of sporulation and poor spore viability (they do not undergo sexual reproduction). The AWRI recently devised a strategy that enables existing interspecies hybrids to be used in breeding programs with *S. cerevisiae* low-$H_2S$ mutant strains. This proof-of-concept study generated new hybrid strains that produced, on average, less than 3% of the amount of $H_2S$ produced by the original interspecies hybrids. As shown in Figure 18 below, when the profile of volatile aroma compounds produced by the strains were compared, some of the new hybrids (e.g. strain 1809) exhibited profiles closer to the 'high flavour' parental interspecies hybrids, than the low-$H_2S$ parent (strain 1640).

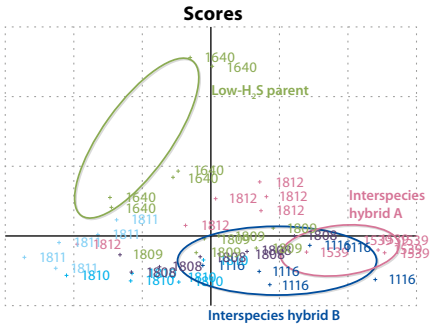


*Figure 18. Comparison of volatile aroma compound profiles for low-$H_2S$ and interspecies hybrid parental strains (A & B), and their breeding progeny (1808, 1809, 1810, 1811 and 1812).*

## Effects of juice exposure to oxygen on formation of volatile fermentation products: case study of Chardonnay

As summarised in the previous AWRI Annual Report (2011), exposure to oxygen is carefully controlled during winemaking according to the type and style of wine being made. In addition to promoting tannin maturation and colour stability in red wine, oxygen, being a powerful fermentation stimulant, can be used to lower the risk of suboptimal fermentation performance in white as well as red wines. For example, brief exposure of high Brix, clarified musts containing suboptimal nutrients to oxygen can greatly shorten fermentation duration and lower residual sugar. Similarly, the addition of grape solids, which contain lipids, can lower the risk of fermentation failure. However, the affects that oxygen and lipids have on the aromatic profile of wines are not well documented.

In the previous report, the affects of oxygen and lipids supplements using model media were described. By using a dual-factorial design fermentation experiment, the effects of four different fermentation conditions were studied: no oxygen/no lipids (NO-NL); no oxygen/lipids (NO-L); oxygen/no lipids (O-NL); and oxygen/lipids (O-L) on fermentation kinetics and formation of the three major groups of fermentation aromatic products, namely esters, higher alcohols and volatile fatty acids. The results clearly showed that both oxygen and lipids greatly enhanced fermentation rate and modified wine aromatic profile. In particular, the formation of esters, higher alcohols and volatile fatty acids were affected.

The trends observed in model media have now been confirmed in a second experiment which was performed with an authentic grape juice. A low nutrient Chardonnay juice was selected, having moderately high Brix, being highly clarified and with moderate yeast assimilable nitrogen (YAN) content. Such juices can be problematic under winery conditions. In the absence of the nutrient supplements oxygen and lipids, fermentation progressed at a low rate and failed to reduce residual sugar to below 10 g/L within four weeks duration. On the other hand, either or both nutrient supplements stimulated fermentation to an extent typically obtained with moderate nitrogen (DAP) addition.

As was observed previously with the model medium system, oxygen and lipids supplements produced similar profiles of yeast aromatic products in Chardonnay (see AWRI publication #1456). A graphical representation of the association between yeast aromatic products and fermentation treatments is shown in Figure 19. The absence of nutrient supplements resulted in wine with more prominent acetaldehyde and acetic acid and less prominent esters and higher alcohols. The main affect of oxygen was to increase the ratio of higher alcohols to esters, which could be expected to modify the aromatic profile and increase intensity. The main effect of lipids was to increase production of both esters (especially acetates) and higher alcohols, which would be predicted to intensify the wine's aromatic profile.

These observations show that oxygen and grape solids can potentially be used to manipulate wine style. Work is in progress to examine the affects of fermentation oxygen on the formation of volatile sulfur compounds, which are associated with the 'reduced' character in wine.

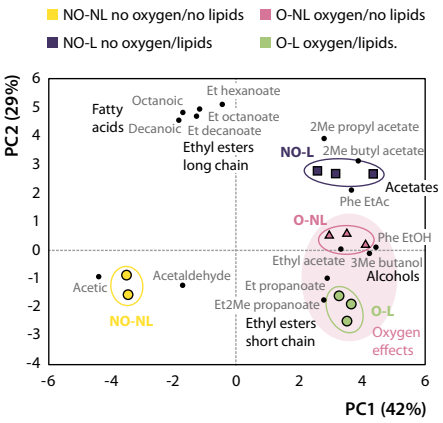


*Figure 19. Principal component analysis of effects of oxygen and/or lipids supplements on formation of yeast aroma compounds in Chardonnay wine. The highlighted zone (O-NL and O-L) shows the impact of oxygen on aromatic compounds relative to the non oxygen-exposed control treatment (NO-NL).*

## *Oenococcus oeni* and malolactic fermentation

Malolactic fermentation (MLF) is an important secondary fermentation in winemaking, particularly for red wine, but also for certain styles of white and sparkling wines. The lactic acid bacterium, *Oenococcus oeni* is the predominant microorganism associated with MLF. The major metabolic feature of MLF is the enzymatic conversion of malic acid to lactic acid and $CO_2$. However, it is becoming increasingly recognised that *O. oeni* exhibits a diverse array of secondary metabolic activities during MLF which can modify the sensory properties of wine thereby impacting on colour aroma and mouth-feel.

In previous studies, the AWRI investigated how choice of *O. oeni* strain in winemaking can be used to modulate the buttery character in red and white wines (AWRI publications #546, #637, #709, #721, #795). More recently, the AWRI has conducted research into the fruity attributes of red wine and how *O. oeni* and MLF can be used to enhance these desirable characters. The impact of three commercial *O. oeni* strains on the modulation of a wide range of chemical components was investigated using two different styles of Cabernet Sauvignon wines (a lighter fruity style [L] and a fuller bodied more complex style [C]). In order to understand the effect of pre-MLF pH on changes in the chemical and sensory properties of these wines, MLF was conducted at two different wine pHs (3.3 and 3.7).

L to R: Paul Chambers, Nathan Watson-Haigh, Wade Hinds and Jeremy Hack

MLF was completed efficiently by the three *O. oeni* strains in three of the four wines, within 20 days. However, the more harsh conditions of Wine C at pH 3.3 and 14.8% v/v alcohol resulted in a slower malic acid metabolism with the *O. oeni* strains requiring 78 days to complete MLF. Volatile compound composition and descriptive sensory analyses were conducted on the Cabernet Sauvignon wines. The extent and diversity of the impacts of MLF on wine chemical and sensory properties were directly influenced by choice of bacterial strains, pre-MLF pH and wine matrix composition (Figure 20). Such effects were particularly evident in the concentrations of a range of aroma volatiles, including many esters, higher alcohols and volatile acids. Coupled with changes in the profile of volatile compounds, the intensities of a number of sensory properties were affected by MLF treatments, including dark fruit aroma, savoury aroma, overall fruit flavour intensity, viscosity and bitterness. Changes in fruity volatile compounds could be directly linked to positive changes in sensory attributes, overall fruit flavour intensity and dark fruit aroma; higher concentrations of total berry fruity esters correlated with wines rated as fruitier (ML-A and ML-B in Wine-C pH 3.3). This observation is consistent with previous data in other studies with red wines (AWRI publication #1063).

The concentration of diacetyl, which is responsible for the buttery character in wine, was determined in the same Cabernet Sauvignon wines (Figure 21). The three *O. oeni* strains varied in diacetyl concentration, and showed consistent behavior throughout the wines; strain ML-B produced the most diacetyl. Pre-MLF pH influenced the diacetyl concentration in Wine C with overall lower diacetyl content in pH 3.3 wines. This observation is consistent with previous observations that longer or slower MLFs reduce diacetyl concentrations in wine (winemaking factors which can be used to modulate diacetyl in wine are summarised in AWRI publications #637 and #795). For more detail on the above work see AWRI publication #1370 and #1457.

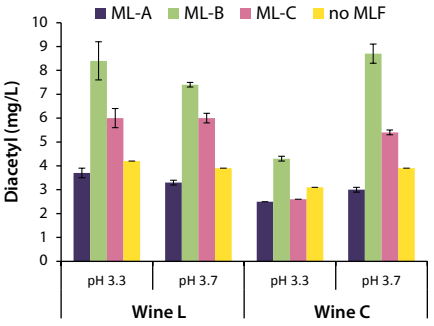


*Figure 21. Diacetyl content of two different styles of Cabernet Sauvignon wines (a lighter fruity style [Wine L] and a fuller bodied more complex style [Wine C]) following inoculation for MLF with three different* Oenococcus oeni *strains. Prior to MLF, wine pH was adjusted to either 3.3 or 3.7.*

## Genetic diversity in *Oenococcus oeni*

In parallel with the phenotypic characterisation of *O. oeni* with respect to desirable winemaking characteristics, a broad survey of the genetic variation present in both commercial strains and Australian wine isolates of *O. oeni* has been conducted. This follows-on from previous work where the genome of the *O. oeni* strain, AWRIB429, was investigated by genome sequencing of an additional eleven strains. This now provides a total of fourteen strains of *O. oeni* for which whole genome data is available.

By comparing the genomes of this group of strains it was possible to define three main groups of strains (Figure 22). Interestingly, Group 1, which contains the commercial strain VP41 (AWRIB429) also contains all of the Australian wine isolates that were used in the study. These strains were isolated from different locations in Australia over a fifty-year period suggesting that the unique genetic make-up of this group might provide an advantage in performing MLF under Australian wine conditions.

This work also identified significant variation across the *O. oeni* strains, with well over half of the proteins identified in this work being found only in specific subsets of strains. This large pool of genetic variation has the potential to impact mouth-feel through the presence of several distinct sub-groups of *O. oeni* with different cell wall polysaccharide genes, sugar utilisation and in the liberation of aroma molecules via variation in the presence of β-glycosidases. It will be possible to produce markers to enable rapid screening of new *O. oeni* isolates for desirable winemaking properties through relating these genetic differences to phenotypic traits.

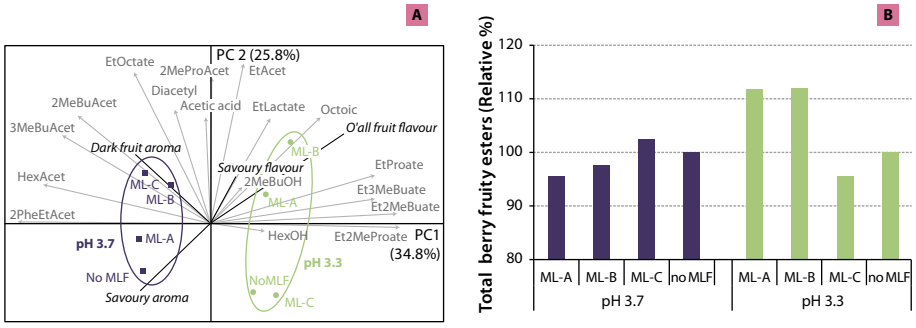


*Figure 20. Principal component analysis of volatile compounds and sensory descriptors (A) and total fruity esters (B) of Cabernet Sauvignon wine-C following MLF with three different* O. oeni *strains.*

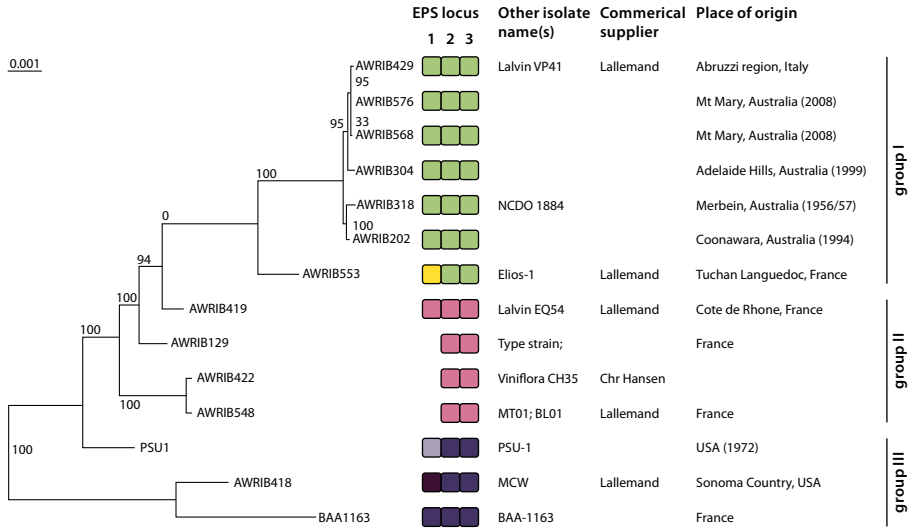


*Figure 22. Genetic variation in* O. oeni. *A phylogenetic tree was assembled from the genome sequences of fourteen isolates of* O. oeni *(left). Strains that are positioned closer together on the tree display higher levels of genetic relatedness. These isolates were shown to form three major groups (green, red and blue) based upon the gene content of three exopolysaccharide (EPS) clusters. These EPS clusters regulate the type of polysaccharides that are present in the cell wall (and released into wine).*

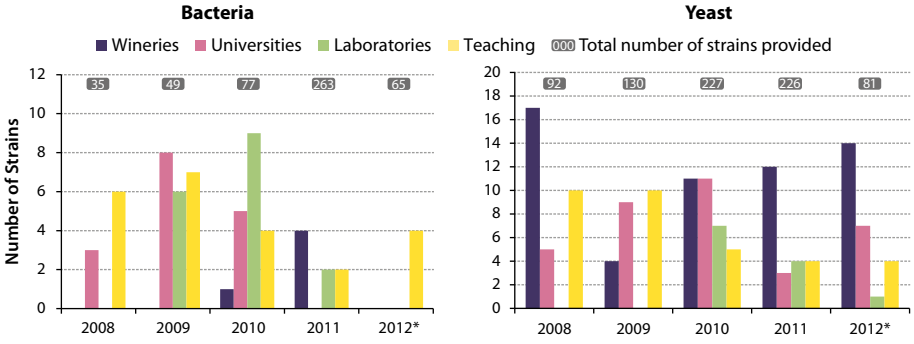


*Figure 23. Bacterial and yeast strains provided to Australian wineries, universities, testing laboratories, and Australian oenology teaching courses from the AWRI Wine Microorganism Culture Collection over the last five years. Remaining cultures per year were provided for AWRI Research projects. * – strains provided January-June 2012.*

## AWRI Wine Microorganism Culture Collection

The AWRI Wine Microorganism Culture Collection (AWMCC) is a world-recognised collection and an active member of World Federation of Culture Collections, Australian Microbial Resources information Network (AMRiN) and part of the Atlas of Living Australia. The role of the AWMCC is to maintain a repository of diverse wine-relevant yeast and bacterial strains that can be easily accessed by Australian wine producers and for research purposes. It currently houses over 2300 specimens and is an invaluable resource for the Australian wine industry.

In addition to maintaining AWRI research strains, the collection houses proprietary strains for numerous wineries which are stored and provided exclusively for their own winemaking. The AWMCC also provides cultures for oenology teaching, testing laboratories for routine controls within their systems, and universities (Figure 23). All strains are provided as live cultures on agar slopes. Provision of all cultures, except experimental strains, incurs a modest fee to cover costs of materials.

## Processing steps to optimise wine quality and development in bottle

### Staff and students

Dr Paul Smith, Dr Martin Day, Richard Gawel, Dr Matteo Marangon, Alex Schulkin, Dr Mark Smith, Dr Marlize Viviers, Prof. Ignacio Nevares (Visiting scientist)

### Collaborators

Flinders University (Dr Ian Menz); Treasury Wine Estates (Dr Vanessa Stockdale); INRA UMR-SPO, France (Dr Aude Vernhet); University of Padua, Italy (Diana Gazzola, visiting PhD student); University of Sheffield (Dr Robert Falconer)

The main aim of these projects is to improve winemaking processes after fermentation. The current focus is on two broad areas: protein stabilisation and post-bottling reductive aroma formation.

### How do 'reductive' sulfur aromas form post-bottling?

Aromas caused by some sulfur compounds can be quite positive (e.g. passion-fruit, grapefruit) while others can impact negatively on the aroma of wine. Boiled or rotten egg, sewage and rubber are descriptors associated with these negative impact low molecular weight sulfur compounds (LMWSC). The identity of several of these molecules (hydrogen sulfide, methanethiol and dimethylsulfide) is known, but debate continues over their source and ways to manage them. To minimise negative consumer response from wines with these compounds, it is important to determine their origins and the most effective methods to control them.

Over the last decade, research from the AWRI has demonstrated that managing the oxygen that travels through closures into wine after bottling can have a big effect on the aroma, texture and colour of the wine. If this 'oxygen transfer rate' (OTR) is low and the wine is also bottled without much oxygen then the wine can form a 'reductive' aroma characterised by 'stinky sulfur'-type aromas. This is quite variable though; one type of wine might form these aromas, while another type under similar conditions might not. To address this issue, a project is underway to work out what causes this formation of post-bottling reductive aroma.

As part of the management strategy to deal with this pre-bottling reductive aroma, copper is often added to wine prior to bottling to treat unpleasant 'sulfidic' aromas such as rotten egg. It is thought that the copper ions react with the hydrogen sulfide ($H_2S$—partly responsible for the unpleasant sulfidic aroma) to produce an insoluble solid (copper sulfide) which results in the removal of both copper and $H_2S$ from the wine.

However, recent work at the AWRI (AWRI publication #1283) has shown that copper additions at bottling can promote the accumulation of $H_2S$ post-bottling. Following on from this observation, the AWRI has further probed the role of copper as well as other transition metals in the development of LMWSCs in wine. Dissolved oxygen (DO) levels in a bottled wine were monitored over time to evaluate the impact of oxygen and metal ions on the production of LMWSC. Preliminary results confirm the previous observation that copper initially reduces the concentration of $H_2S$ coinciding with measureable DO levels. However, after four months, during which time the wine had used up all of the DO, the $H_2S$ concentration increased due to the presence of copper. This effect was observed to a lower extent with the other metals and a similar effect was noted for methanethiol (MeSH). This would therefore mean that the use and timing of copper fining pre-bottling should be given careful consideration.

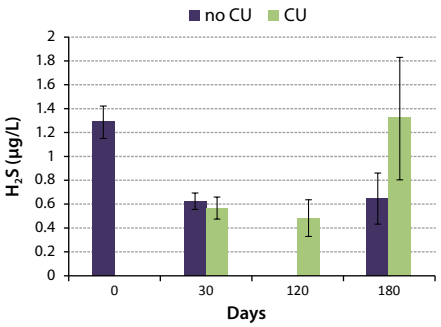


*Figure 24. The concentration of $H_2S$ (ug/L) with or without Cu over time in a red wine.*

## The effects of early exposure of red wine to oxygen in rotary fermenters

The wine industry better understands the effects of oxygen in the bottle, thanks in part to work carried out over previous years at the AWRI. Less well understood though are the effects of early oxygen exposure in must, which occurs from the point of harvesting and crushing until bottling and might play also an important role in determining the outcome of a wine.

Anecdotes from winemakers suggest that although red wine made in closed tanks might potentially preserve fruit characters, this approach can frequently lead to the development of 'stinky sulfur' aromas. Even with correct management of nitrogen (i.e. YAN management through supplementation with diammonium phosphate) during the fermentation, wine might potentially retain or develop these negative aromas during storage. To manage these aromas, oxygen can be introduced at different stages of the winemaking process but the reasons that the treatment works are not well understood nor are the post-bottling effects.

Introducing oxygen into an active red ferment can be achieved with the use of aerative pump-overs or by introducing air through fixed or removable sinters inside the tank. To remove any residual post-ferment reductive aromas, aerial racking (or splashing) or copper addition are frequently employed. However, it is unclear whether the splashing involved in these operations is physically displacing (i.e. sparging) any $H_2S$ or whether it is reacting chemically with oxygen in air to create other types of sulfur molecules, which might possibly re-emerge as negative aromas post-bottling. To test these ideas, a winemaking experiment using pilot-scale rotary fermenters (900 L) was carried out with Shiraz grapes during the 2012 vintage. The control ferments involved no injection of gas; the treatments used different gas mixtures, oxygen (20% or 40%) or nitrogen, which were injected for 60 minutes twice in a 24-hour period prior to fermenter rotation.

Initial results show that use of oxygen early in the fermentation stops the production of hydrogen sulfide ($H_2S$). Also, nitrogen 'sparging' did not decrease $H_2S$, dispelling the notion that it is being physically stripped out of the wine. Methyl thioacetate production was also lower in the oxygen treatments and methane thiol was not observed.

Oxygen in an active red ferment can also have an effect on the phenolics. In this experiment, the oxygen treatments stabilised the pigments, giving the wines a different hue. Chemical analysis of tannin structure indicated that the tannin appeared aged and with a lower amount of skin-like tannin character. These observations were made before malolactic fermentation and pre-bottling maturation. The wines will be monitored over time to determine whether the oxygen-treated bottled wines will redevelop reductive aromas or whether they will age differently.

## Uncovering the secrets behind wine stabilisation

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### Protein stabilisation

Protein haze formation in white wines is a serious quality defect because consumers perceive hazy wines as faulty. Protein haze is caused by the presence of residual grape pathogenesis-related (PR) proteins in wines after bottling, in particular thaumatin-like proteins (TLPs) and chitinases. It is widely understood that protein haze formation in wine is associated with the elevated temperatures that the wines can be exposed to during storage or transportation. This can affect the stability of the PR proteins resulting in their aggregation into particles visible to the naked eye. Hence PR proteins need to be removed, and the current method to achieve this result is bentonite fining. Research into alternatives to bentonite has been pursued because the bentonite fining method has several drawbacks, including cost and undesirable processing complexity. In order to find a valid substitute for bentonite, a better understanding of the mechanism of protein haze formation is required. It is currently proposed that protein instability in wines is a two-step phenomenon: protein unfolding (a temperature mediated step), followed by growth of particles (colloidal aggregation) due to the unfolded proteins sticking together.

This year, research continued using two approaches:

- working out the mechanism of haze formation in wines by investigating the role of proteins and other compounds that contribute to wine hazing; and
- developing and testing alternatives to bentonite for the stabilisation of white wines.

The GWRDC Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry was awarded to Dr Matteo Marangon in March 2011 and allowed the AWRI to lease the qNano System. This instrument uses a technique called Scanning Ion Occlusion Sensing (SIOS) to detect small particles (nanoparticles), such as proteins, tannins and polysaccharides. By using an approach where the AWRI 'rebuilds' wine using purified compounds, the heat-induced aggregation behavior of five purified wine proteins was studied. A chitinase, four thaumatin-like proteins (TLP isoforms), phenolics and polysaccharides were the 'building blocks' used and they were isolated from a Chardonnay wine. The same wine was stripped of these compounds and used as the base from which to rebuild the wine using each of the proteins alone or in combination with the isolated phenolics and/or polysaccharides. After heating and cooling cycles, the size and concentration of the aggregates formed were measured by SIOS and it was demonstrated that this technique and approach proved to be a useful tool to understand the mechanism of aggregation in wine. It was found that one particular type of protein (chitinase) was the protein most prone to aggregation and the one that formed the largest particles; phenolics and polysaccharides did not have a significant impact on its aggregation behavior suggesting that for chitinases, protein unfolding/aggregation is the main driver of hazing and that phenolics and polysaccharides only have a marginal role on this process.

The four TLP isoforms showed large differences in their aggregation behaviour, and this work demonstrated that it is possible to have large variability of behavior within this protein class, indicating a more important role for TLPs than previously thought. These insights might allow the development of haze management strategies that target the molecules responsible for haze formation.

The AWRI also continued its collaboration with Dr Aude Vernhet's group (Montpellier SupAgro, France). In this part of the project the knowledge

gained using SIOS technology was applied to investigate in more detail the role played by important wine macromolecules. By using a technique called Dynamic Light Scattering (DLS), and by again following a reconstitution approach, the AWRI studied the roles of total polysaccharides (PS), fractionated PS (RGII: Rhamnogalacturonan II, PRAGs: Polysaccharides rich in Arabinose and Galactose, and MP: mannoproteins) and total phenolics towards the aggregation of chitinases and TLPs upon heating. PS in general, and RGII in particular, were found to have an important effect in modulating the level of haze and the haze appearance. It was also shown that the addition of polysaccharides at wine concentration in a wine (or a model wine matrix) does not change the aggregation of chitinases dramatically. In fact, chitinases always aggregated completely and polysaccharides could only modify the visual aspect of the haze.

This is an important discovery because polysaccharides are usually proposed to have a stabilising effect towards protein aggregation that would minimise haze formation. However, the AWRI demonstrated that in normal wine conditions and with normal polysaccharide concentrations this stabilising effect is not likely to happen.

## An exciting new alternative to bentonite; flash pasteurisation combined with protease treatment

The knowledge generated by this project in recent years, in particular about the temperature required to unfold the haze forming proteins (AWRI publication #1187) was used to develop a strategy for protein stabilisation of white wines.

Juice flash pasteurisation was used to unfold the proteins so that they could be more easily cleavable by a food grade mixture (Proctase) of enzymes (known as proteases) called Aspergillopepsin I and II (AGP) [EC no. 3.4.23.18 and 3.4.23.19]. AGP was added to two clarified grape juices with and without heat treatments (75°C, 1 min) prior to fermentation. AGP showed some activity at fermentation temperatures (≈20% total protein reduction compared to control wine) and excellent activity when combined with juice heating (≈90% total protein reduction) (Figure 25).

Proctase was effective at removing the proteins (mainly chitinases, but also a large percentage of the thaumatin-like proteins [TLPs]), which are primarily responsible for the formation of heat induced hazes in white wines. The more heat-stable grape proteins, i.e. those that do not usually contribute to wine hazing, were not affected by the treatments and therefore accounted for the remaining 10% of protein still in solution after the treatments. The main chemistry parameters and, importantly, the sensorial profile of wines produced with AGP were not different from controls (AWRI publication #1444). This is particularly relevant given that anecdotally there is resistance to the use of pasteurisation of juice in practice, whereas this work suggests no discernible sensory effect from such a treatment. Experiments conducted in small-scale in 2011 were replicated in larger-scale (5,000 L) trials in 2012 and the efficacy of this strategy was confirmed. Analysis of juices and wines following treatment showed, again, that all chitinases and a significant proportion of TLPs are removed by the process, resulting in a low protein level in the finished wines. A control treatment using bentonite was shown to result in similar levels of proteins in the three wines being assessed.

Detailed analysis of these wines has highlighted that some of the residual proteins remaining after Proctase treatment can contribute to a false positive result when the industry 'standard' heat test of 80°C/6 h is used to assess the protein stability of the wines. Current work is focussed on identifying the proteins responsible for this effect and identifying an appropriate alternative heat-stability test that will provide a more meaningful analytical result when wines have been treated with Proctase. It is hoped that this can become the new industry 'standard' test and provide a more rapid analysis of protein stability in all white wines, irrespective of the method used for protein stabilisation.

A review of the regulatory environment indicates that enzymes of the same origin and in the same class as those present in Proctase (*Aspergillus niger var. macrosporus)* are already approved winemaking additives: Carboxyl proteinase is listed as a permitted class of enzymes under clause 17 of the Food Standards Code 1.3.3.

The AWRI is currently seeking clarification on the regulatory status of the enzymes present in Proctase from the Food Standards Australia New Zealand (FSANZ). Once formally approved, Proctase could be used for wine production in Australia, provided that the finished wine is destined for the domestic market. Wines treated with Proctase are not currently permitted for export to the EU, but the AWRI will be working with the OIV (International Organisation of Vine and Wine) to overcome this in the coming months.

This is one of the first efficient and cost-effective alternatives to bentonite treatment proposed, and the most likely to become, in the near future, a commercially viable application for the wine industry.

L to R: Matteo Marangon, Markus Herderich, Paul Smith

## Exploring the use of plant polysaccharides as alternatives to bentonite

Another strategy explored for protein stabilisation of white wines was assessing the feasibility of the addition of polysaccharide adsorbents such as carrageenan and pectin (AWRI publication #1437) to juice. Pectin and carrageenan are negatively charged at wine pH and therefore can bind the positively charged wine proteins in a similar way as bentonite. In small-scale winemaking experiments with Chardonnay the AWRI found that the addition of the polysaccharide adsorbents to the juice before fermentation could yield wines with up to 75% less proteins than the controls, thus increasing wine protein stability. Overall results were promising, and because carrageenan was more efficient in terms of protein removal and wine stabilisation than pectin, current studies are focussing on optimising its use.

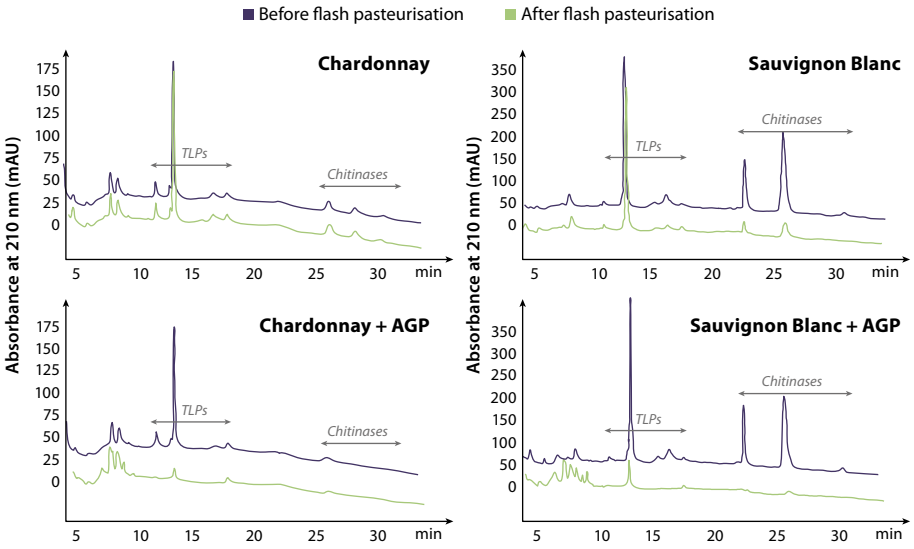


*Figure 25. Protein profiles by RP-HPLC of Chardonnay and Sauvignon Blanc juices before (blue lines) and after (red lines) heating at 75°C for 1 min in absence (chromatograms on top) and presence (chromatograms on bottom) of 15 mg/L AGP.*

## Carboxymethyl cellulose (CMC) as a viable alternative for tartrate stabilisation

Potassium bitartrate is a compound commonly found in wines. If not removed, crystals resembling shards of glass can precipitate out under low temperatures, causing potential alarm for a consumer. Typically, the application of low temperature for extended periods of time is used to remove the potassium bitartrate during processing. With increasing focus on energy efficiency and the impact of the carbon tax, producers are constantly looking for alternative ways to stabilise their wines.

Carboxymethyl cellulose (CMC) products have been touted as a viable alternative for achieving tartrate stability. CMC is a cellulose gum and is currently available from a myriad of different suppliers, both in Australia and overseas. Sodium CMC has recently been approved as a permitted winemaking additive through an amendment to Standard 1.3.1 – Food Additives and Standard 4.5.1 – Wine Production Requirements of the Australia New Zealand Food Standards Code for still and sparkling wine.

The AWRI's Industry Applications Group is currently trying to gain a better understanding of the relative performance of different CMC products and the impact that different wine varieties and phenotypes might have on that performance. This work includes characterisation of the CMC products, in terms of molecular weight and degree of substitution, as well investigating the impact of CMC addition on downstream processing such as filterability and long-term stability.

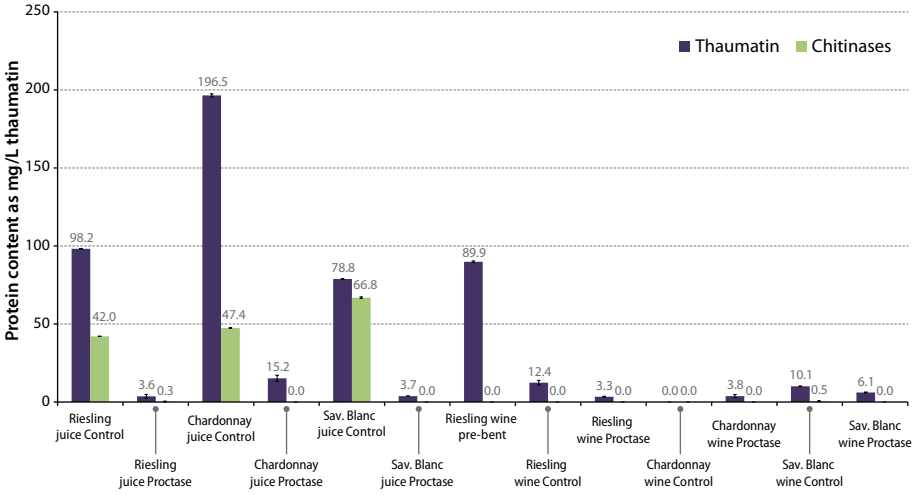


*Figure 26. Level of protein classes found in Riesling, Sauvignon Blanc and Chardonnay juices and wines following treatment with bentonite and Proctase.*


AWRI publication #1341. Marangon, M.; Van Sluyter S.C.; Robinson, E.; Schmidt, S.C.; Smith, P.A.; Godden, P.; Waters, E.J. (2011). A promising enzyme for the stabilisation of white wines. New alternative to bentonite. *Australian & New Zealand Grapegrower and Winemaker,* 573, 78-80.

AWRI publication #1437. Marangon, M.; Lucchetta, M.; Duan, D.; Stockdale, V.J.; Hart, A.; Rogers, P.J.; Waters, E.J. (2012). Protein removal from a Chardonnay juice by addition of carrageenan and pectin. *Australian Journal of Grape and Wine Research,* 18 (2), 194-202.

AWRI publication #1441. Marangon, M.; Pocock, K.F.; Waters, E.J. (2012). The addition of bentonite at different stages of white winemaking and its effect on protein stability. *Australian & New Zealand Grapegrower and Winemaker,* 580, 71-73.

AWRI publication #1444. Marangon, M.; van Sluyter, S.C.; Robinson, E.M.C.; Muhlack, R.; Holt, H.; Haynes, P.A.; Godden, P.W.; Smith, P.A.; Waters, E.J. (2012). Degradation of white wine haze proteins by Aspergillopepsin I and II during juice flash pasteurisation. *Food Chemistry,* doi: http://dx.doi.org/10.1016/j.foodchem.2012.05.042


## Extending research through regional nodes

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Amba Goldsmith); Winemaking Tasmania (Julian Alcorso); The Yalumba Wine Company (Luke Wilson); The Tasmanian Institute of Agriculture; Wine Victoria, the Grape and Wine Research and Development Corporation and the Victorian Department of Primary Industries.

## Developing a better understanding of Pinot Noir vinification in Tasmania

The AWRI has implemented a strategy to establish a network of regional AWRI Nodes. The primary aims of the Nodes are to: work hands-on with local producers on projects which address regional priorities; to facilitate the adoption of new technology by producers in those regions; and to act as a conduit through which grape and wine producers can more readily obtain greater value from their previous investments in R,D & E at the AWRI, and elsewhere. The strategy is proving to be extremely successful with many of the exciting initiatives described in this report having resulted from current AWRI Nodes. The concept is now being extended to other regions.

A focus at the AWRI's Tasmanian Node, in conjunction with the Tasmanian Institute of Agriculture (TIA), has been work on Pinot Noir maceration methods and understanding their impact on phenolic extraction. Pinot Noir is a difficult variety to use for red wine production, due to its unusual phenolic profile and low concentration of colour (anthocyanins). With Pinot Noir, it is very important that the red pigment is efficiently extracted and stabilised during the maceration/fermentation process.

Although Pinot Noir *grapes* have high tannin concentrations, information held on the AWRI Tannin Portal demonstrates that Pinot Noir *wines* tend to be low in tannin. This anomaly is most likely due to Pinot's low ratio of skin-to-seed tannin, when compared with other varieties. Seed tannin is more difficult to extract than skin tannin and tends to come out later during fermentation.

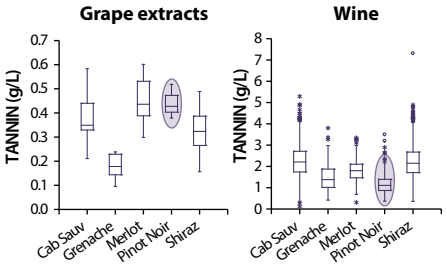


*Figure 27. The level of tannin commonly found in grapes (concentration in extracts) and wines for different red wine varieties.*

Work in Tasmania using small-lot winemaking methods has shown that, for example, by manipulating maceration methods, tannin levels in Pinot Noir wines made from the same batch of fruit could be manipulated four-fold. Further detail on manipulating tannin and pigment has been elaborated with the work of TIA PhD students, Angela Sparrow and Anna Carew, with joint supervision by the AWRI's Bob Dambergs and the TIA's Dugald Close.

Angela Sparrow's work has focused on utilising the various tannin components in grapes—skin, seed and stalks. Analysis of grape fractions has revealed that the highest concentration of tannin by weight occurred in seeds, followed by stalks, then skin. Small ferments performed with grape fractions removed or added back have shown some unusual interactions between grape pulp and tannin extraction, aligning with other AWRI work describing binding of tannins to grape subcellular material.

Anna Carew's focus has been on yeast effects and thermal maceration methods. Wild ferments are being used by an increasing number of Pinot Noir makers to create complexity and express 'microbiological terroir'. Under controlled conditions, wild ferments finished with EC1118 (w-EC1118 in Figure 28), showed lower tannin concentrations than RC212 (a commonly used strain for Pinot Noir) and EC1118 mediated ferments. Similarly, an attempt to mimic wild ferments in a controlled way, by fermenting with the non-*Saccharomyces* strain *Torulaspora delbruekii* and finishing with EC1118 (T.d.EC1118 in Figure 28), also resulted in lower tannin concentrations than with RC212.

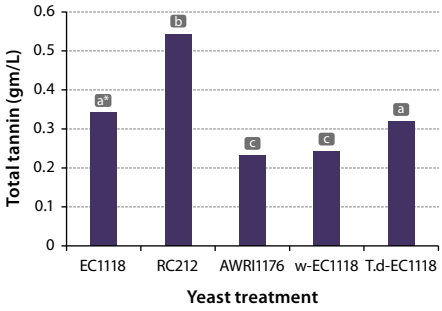


*Figure 28. The impact of different yeast strains added during fermentation on total tannin in resultant Pinot Noir wines. Different letters indicate significant differences between the tannin levels achieved with the yeast treatments.*

Thermal maceration, by heating must to 70°C, has been shown to affect rapid extraction of tannin and pigment, before alcoholic fermentation. This offers the potential advantage of speeding up the maceration process, by reducing the skin contact time required. It also has the benefit of sterilising the must, to allow complete expression of a yeast inoculum.

Much of the work in Tasmania has been the subject of a number of posters, plenary and workshop presentations at the 8th International Cool Climate Symposium held in Hobart in February 2012.

The AWRI's Tasmanian Node activities have also included collaboration with Jo Jones and Fiona Kerslake working on a TIA project centred on manipulating wine quality through viticultural management. This project was part of the AusIndustry program 'Improving Australian sparkling and Pinot Noir wines' which was supported by the AWRI. The effects of crop load, fruit exposure and pruning method were examined with commercial Chardonnay and Pinot Noir vineyards at two sites in the North and South of Tasmania. Crop load was manipulated through winter pruning and fruit exposure was altered by leaf removal at various phenological stages, starting at pre-flowering and finishing at veraison. Grapes were analysed and small-lot wines also prepared.

The strongest treatment effects on grape, juice and wine were on phenolic profiles as determined by UV spectral fingerprinting. The effects were strongest with Chardonnay and were site specific. Pre-flowering leaf removal had the most consistent effect on phenolic profiles and there were also effects relating to cane versus spur pruning. Crop load had an effect when comparing high and low extremes.

## Planning for environmental and business sustainability in the Riverina region

Rising energy and labour costs, together with currency volatility, finance costs and credit availability are all impacting on bottom-line profitability for wine producers. Market and social pressures relating to carbon footprint, emissions trading, water shortage and sustainability further add to the mix. Energy price increases far in excess of CPI trends have been experienced across the country, with further increases expected over time as a result of carbon trading and energy commodity price movements.

With these pressures affecting business activities now, efficient, low-cost solutions are needed for immediate deployment. The AWRI's recently established Riverina Node has a particular emphasis on optimising process efficiency and reducing energy inputs, with a major focus on the development of tools that provide wine producers with greater control over processes and related engineering systems.

Opportunities exist for the wine industry to mitigate increasing costs through energy efficiency and renewable energy technology. Through desktop research and laboratory studies on the use of grape biomass for energy production, the AWRI's work suggests that this might be an approach that could be used by the wine industry to reduce grid-supplied power consumption. Interest in 'renewables' and other energy efficiency technology within the wine industry remains strong,

however for more emerging renewable technologies such as bioenergy, the perceived technical risk remains a deterrent to investment.

The potential savings in grid-supplied energy and emission are significant in encouraging power users to move to emerging renewable technologies, (perhaps as much as 75% depending on the technology employed), and the capital payback period coupled with the transformation of a waste stream into a valuable resource, are attractive. However, due to uncertainty around the likely performance of touted biomass power generation plants and high capital costs, it is unlikely that the wine industry will move forward in this area until real-world case study data from a pilot or commercial-sized winery installation are available. The AWRI is currently exploring process options and funding scenarios to break that deadlock.

In the meantime, so-called 'low-tech' solutions and existing small-scale process improvement solutions will likely be the transitional answer. That is, application of established process knowledge that can be used now to achieve an efficiency gain. Fortunately, there is a significant body of existing knowledge and relevant proven solutions for industrial process improvement that can be implemented relatively quickly and, in many cases, with favourable economic return on investment.

The AWRI's Riverina Node continues to explore technologies which have the potential to add substantial value and competitive advantage to the Australian wine sector in the future, across the entire value chain. The AWRI has also been working to ensure awareness of technologies on offer in regional Australia. Potential process services within the winery, where high impact and/or low cost improvements are typically achievable include: refrigeration control, process heating and waste heat recovery, hot water generation, air compressor performance, lighting and wastewater treatment. Alternative low energy wine processing strategies, such as floatation, in place of cold settling and centrifugation can also provide energy cost savings in certain circumstances. Process opportunities in each of these areas have been presented at the AWRI's roadshows and seminars throughout the year, as well as local technical briefings conducted through the AWRI's Riverina Node.

## Extension to Greater Victoria

The AWRI successfully established a three-year Memorandum of Understanding (MOU) with Wine Victoria, the Grape and Wine Research and Development Corporation and the Victorian Department of Primary Industries to fund and deliver extension and adoption services to the Greater Victorian wine industry. Mark Krstic was appointed to the position of Extension Services Manager – Victoria in late January 2012. Mark has extensive experience in viticulture extension and has previously held a role as Program Manager with the Grape and Wine Research and Development Corporation. The AWRI's Victorian Node office has been operational since February 2012, with an office based in Port Melbourne, collocating with Wine Victoria and the Rathbone Wine Group. The AWRI has:

» established an MOU for the scientific, technological and business co-operation between AWRI and the Victorian Department of Primary Industries (DPI). This MOU aims to strengthen research ties between the AWRI and DPI grape and wine research teams, especially in the areas of smoke taint and tannin research;

» delivered an additional eight key extension events across Greater Victoria, including a smoke taint symposium. These were delivered in partnership with Wine Victoria and the regional grape and wine industry associations across Greater Victoria; and

» established a joint AWRI/Melbourne University-supervised PhD program investigating the influence of terroir, growth environment and vine physiology on the accumulation of rotundone in Shiraz wine grapes.

## Development of web-based tools continues

**Staff**

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**Collaborators**

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### Measuring and monitoring phenolic attributes

In 2010, the AWRI Tannin Portal was launched, allowing wine producers to measure the level of tannins, phenolics and colour (pigments) in their red ferments and finished wines using a web-based calculation tool. This provided the industry with a simple and rapid method that can be used to provide valuable process data and allows winemakers to make informed decisions to achieve enhanced structure and mouth-feel in their wines.

In late 2011, the web-based tool was extended to include additional measures that provide insight into the colour stability of red wines. Through a simple additional laboratory step, the unstable (free anthocyanins) and stable (pigmented tannins) level of colour can now be assessed, adding further value to the tool.

Users of the Tannin Portal have benefitted from the extensive database of wines that has been built up (currently over 10,000 samples) in the Portal, allowing benchmark comparisons of the attributes of their wines against others by a combination of vintage, variety and region. Due to the rapid feedback that the tool can provide for winemakers, producers are starting to use the tool to make real-time decisions on the winemaking process and use it as a means of achieving specific targeted style outcomes in their wines.

A number of trials have been undertaken in the last 18 months to identify key winemaking processes and variables that have the ability to impact on colour, tannin and phenolics in red wines. The data have highlighted the importance of process understanding and control to achieve targeted outcomes in wine style, and the important role web-based tools can play in supporting the generation of such data in real-time.

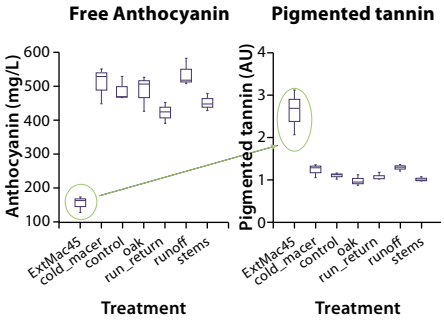



*Figure 29. The impact of various winemaking treatments on resultant stable (pigmented tannin) colour and unstable (free anthocyanins) colour in red wines. Extended maceration shows comparatively high levels of stable colour and low levels of unstable colour.*

Work during 2012 has focussed on extending this web platform further, to include the capability to measure tannins, colour and phenolics in red *grapes*. It will also provide additional graphical tools that will allow simple generation of grape maturity trends, attribute profile charts and benchmarking plots. Again, supporting this is a simple rapid spectral method, which allows users to generate this valuable data using their own UV-Vis spectrophotometers. The Grape Portal tool is currently under development and is expected to be launched commercially later this year.

A number of small-scale vineyard trials, conducted by the AWRI's Tasmania Node, have highlighted the impact that soil type, clone, rootstock selection and weather patterns can have on anthocyanins, tannin and phenolics in red grapes during ripening. The Grape Portal will provide opportunities for these attributes, as well as the standard grape maturity measures such as pH, TA and Brix, to be closely monitored and analysed during ripening. This will help to ensure that effective and informed decisions can be made on harvesting time and logistics associated with winery processing operations. Armed with knowledge of grape composition and using information from maceration trials, deficiencies in fruit composition can realistically be addressed through application of different maceration methods.

## Reducing vintage costs and improving process control with ferment simulation

Process optimisation and efficiency gains across a range of operations are critical to business sustainability, and the AWRI is actively working to develop and promote practical tools and process solutions that can have an immediate impact on the bottom line. The AWRI's Fermentation Simulator has been developed over several vintages, with input from industry collaborators into the performance and feature set requirements.

A broad range of commercial fermentation data across multiple production sites has been used during development to assess model performance under different operating conditions. This has also incorporated a variety of parameters, such as temperature, yeast type, wine type, nutrient levels, agitation regime and fermentor size. Performance has been evaluated on both the ability to consistently fit a full fermentation profile, as well as the capability to reliably predict fermentation performance from initial conditions. The simulator was trialled by several producers during the 2012 vintage in collaboration with the AWRI's Riverina Node.

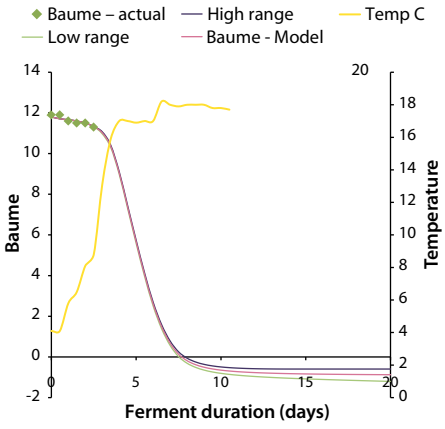



*Figure 30. AWRI Fermentation Simulator – model prediction carried out at day 2.5 for a commercial white ferment.*

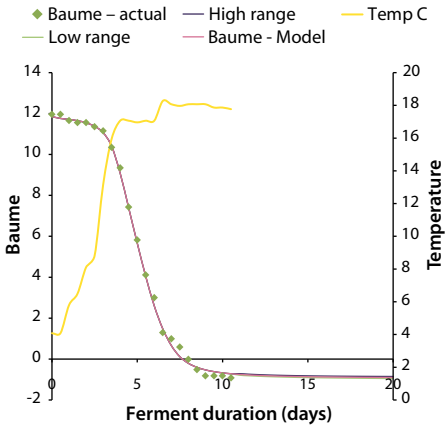



*Figure 31. AWRI Fermentation Simulator – the complete ferment curve overlaid on the prediction made at day 2.5.*

The benefits from improved fermentation control are significant. Current fermentation management practices place huge demands on winery resources. Those demands range from daily sample collection, laboratory analysis and winemaker tastings, to infrastructure constraints such as equipment availability, energy and water use and refrigeration capacity. Process efficiency is further impacted by stuck and sluggish fermentation, with additional resources and logistical management being required as a result. The ability therefore to reliably and accurately monitor and control fermentation in real-time is crucial to minimising operating costs whilst maintaining wine quality. "How can this be improved?" is the question that has been the continual driving force behind this new ferment simulation technology.

Among the features of this new Fermentation Simulator is the ability to predict problem fermentation behaviour, giving winemakers advanced warning on potential issues before they occur. Streamlined ferment behaviour further helps to reduce the resources required for monitoring and operations control and provides the means for real-time control to achieve quantified quality targets: this could be residual sugar level, colour development or tannin concentration. Automated warnings are displayed on fermentations that are moving away from desired specifications.

When combined with weather forecasts and specifications for the winery's refrigeration system, the models can be used to predict refrigeration requirements throughout the fermentation period across the entire tank farm. This provides possibilities for reducing overall energy demand on hot days during vintage and potentially reduce or avoid punitive electricity tariffs. It is the simulation model which makes this possible, combining ferment data (*information*) with ferment behaviour (*knowledge*) to drive action in the winery to ensure a quality outcome.

Planning is now underway for migration of the Fermentation Simulator to a web-based platform that can be accessed from a range of devices including PCs, smart phones and tablets. On-line electronic storage and analysis of fermentation data, together with the ability to model future performance or to retrieve historic fermentation records will further add to the utility of the AWRI Fermentation Simulator. This powerful tool will provide wine producers with a unique and powerful way to control the continuous quality improvement and product consistency for which the Australian grape and wine sector is famous.

## WIC Winemaking Services

**Staff**

Gemma West, Con Simos

**Collaborator**

The University of Adelaide (Stephen Clarke)

WIC Winemaking Services, a joint venture between the AWRI and the University of Adelaide since 2010, is based at the Hickinbotham-Roseworthy Wine Science Laboratory (also known as Wine Innovation Cluster East [WIC East]). It shares the University's purpose-built small- and pilot-scale winemaking facility. This service has been set up to provide consistent small- and pilot-scale quality wines for research and commercial projects to aid the Australian wine industry.

WIC Winemaking Services is managed by qualified winemaker, Gemma West, and the service offers an opportunity to outsource the winemaking component of R&D projects for viticulture, winemaking or processing treatments. A small amount of contract winemaking of less than one tonne is also offered.

The service also provides industry with the opportunity to trial new varietals, and in 2012, there was an increase in the number of small- and pilot-scale commercial wines made from alternative varieties.

Gemma West has worked closely with clients to design trials to ensure effective fruit selection and volumes for vintage 2012, resulting in good quality fruit being delivered for research. She has also improved collaboration amongst internal clients performing complementary trials, through a web-based system.

In addition to the provision of micro-, small- and pilot-scale winemaking, the WIC Winemaking Services managed an increase in out-of-vintage fermentations and winemaking support activities this year.

# Wine in society

## Wine quality and consumer needs

**Staff**

Dr Leigh Francis, Dr Helen Holt, Patricia Osidacz, Belinda Bramley (to October 2011), Wes Pearson (from October 2011), Jennifer O'Mahony, Dr Christine Mayr

**Collaborators**

Accolade Wines (Chris Bevin); CSIRO Plant Industry (Dr Rob Walker), Orlando Wines (Kate Lattey, Shane Hanna); Sensory Insights (Mark Stevens); University of Adelaide (Dr Sue Bastian); University of South Australia (Prof. Larry Lockshin, Dr Armando Corsi, Dr Simone Mueller).

The sensory and consumer science team provides specialist expertise for all AWRI sensory evaluation work. The team runs sensory panels of several different types for expert assessments, trained panel profiling, difference testing and untrained consumer acceptance testing. The bulk of the work involves specialist sensory panellists recruited from the local community as a highly trained and experienced sensory descriptive analysis panel. During the past year, five new members of the panel were recruited and trained. The sensory team works closely on projects across the AWRI, to run tests, analyse and report results, and relate sensory and consumer data to chemical and other information about the wines, and thus evaluate sensory properties and consumer perceptions of quality.

The AWRI technical quality panel has evaluated 148 individual wines for client wineries in collaboration with the AWRI Industry Development and Support group. The difficulty of extracting closures from bottles was also evaluated from a consumer point of view. As part of the 'Pinot G' project reported above, a dedicated 'Pinot G' panel continued to assess wines to deliver the innovative labelling service, and the approach has been explored for Chardonnay.

There has been numerous sensory research studies conducted through the year which are reported elsewhere in this report. Studies have included: effect of phenolics on white wine flavour and mouth-feel; a study of malolactic strains and nutrients in Cabernet Sauvignon; hybrid yeast strains effect on Chardonnay flavour; commercial red wines as part of a study with the University of South Australia; characterising the sensory properties of tannin fractions isolated from younger and older red wines; and a study on reproducing smoke taint through volatile compounds and release of smoke flavour from precursors while tasting.

In a sensory descriptive analysis study conducted in collaboration with Rob Walker of CSIRO Plant Industry, Chardonnay and Shiraz wines made from grapes from a rootstock study from vineyards with historically elevated salt levels were studied. While, in 2011, the salt levels were lower than found in previous seasons, there were significant differences in salty taste and viscous mouth-feel in the Chardonnay set, and also differences in sensory properties for the Shiraz wines. However, for the Shiraz set, the salt levels were low and thus there were no salty taste differences. This project will continue with wines made from grapes from different rootstocks in 2012. As a part of this work, sodium chloride and potassium chloride sensory detection thresholds were also assessed in white and red wine.

A research project to assess the effect of closure type on a Shiraz wine over time involved two formal sensory profiling studies, and a set of wines was submitted for consumer testing. While there were only small sensory differences among the wines, they were sufficient for consumers to respond, with the majority of consumers preferring the wine bottled under the closures that gave the freshest, least developed sensory properties. The testing will be again conducted in six months time and will allow evaluation of consumer tolerance for aged flavours in red wine. Sensory testing was also completed in a Semillon closure study at 24 months post-bottling. A detection threshold determination of the sulfur compound benzyl mercaptan, implicated in post-bottling 'struck flint' aroma, was completed in white and red wine, with the results showing a value of approximately 10 ng/L in both matrices. This information will assist in developing an analytical method to quantify this compound at such trace concentrations in wines.

A fault sensory panel has been trained and screened according to Australian Standards methods, providing a resource for wine companies to access an independent assessment of the presence of specific off-flavours in wines.

## Human health, nutrition and food safety issues impacting on the Australian wine sector

**Staff**

Creina Stockley

**Collaborators**

Brain Sciences Institute, Swinburne University (Prof. Andrew Scholey); Department of Colorectal Medicine and Genetics at The Royal Melbourne Hospital (Prof. Finlay Macrae); Edmund Mach Foundation, Italy (Prof. Fulvio Mattivi); University of Aberdeen, Scotland (Prof. Arduino Mangoni).

One of the activities of the AWRI is to provide health and nutritional advice and assistance to the Australian wine sector, through Creina Stockley, the Health and Regulatory Information Manager. From 1 July 2011 until 30 June 2012, 61 information health and nutrition requests from industry, the general public and government were managed by Creina Stockley.

L to R: Pauline Jorgensen, Jeanette Tooley, June Robinson and Fang Tang

## Health and nutrition issues

During the year, the AWRI database of research on the beneficial and detrimental health effects of alcohol, and in particular wine, has been added to and these records are available on-line for levy paying members of the Australian grape and wine sector. This is facilitated by the subscription to relevant medical and scientific journals, and by the formal and informal exchange of information between complementary organisations, both national and international. The journals have been regularly scanned, and articles have been prepared for inclusion in the AWRI's publication, *Technical Review,* and for other Australian wine sector and international alcohol industry newsletters. Articles and other material have also been prepared for the electronic and print media (see Appendix 5). For example, one article has been prepared for each of: *Australian and New Zealand Grapegrower and Winemaker, Wine and Viticulture Journal, AIM-Alcohol in Moderation, Australian Atherosclerosis Society E-news* and *Technical Review.* In addition, three peer-reviewed papers have been published in *Food and Function*, *Journal of Science and Food Agriculture* and *Journal of Wine Research*. Furthermore, a book chapter was also prepared entitled *Protective effects of wine and wine-derived phenolic compounds on brain function*. Creina was also Guest editor of the special issue 'Wine and health' for the *Journal of Wine Research*, which published the Proceedings of the WineHealth 2010 International Congress on Wine and Health.

Three media interviews were conducted (see Appendix 4). *The A-Z of information on wine and health issues* booklet was also revised, reprinted and uploaded to the AWRI website.

Submissions were also prepared for: the *Labelling Review Response Secretariat on Alcoholic Beverages* (60 pages), *Inquiry into Foetal Alcohol Spectrum Disorder* by the House Standing Committee on Social Policy and Legal Affairs (40 pages) and National Health & Medical Research Council's *Draft for Public Consultation Alcohol Dietary Guidelines* (12 pages). She also provided expert evidence at the Inquiry into the incidence and prevention of Foetal Alcohol Spectrum Disorder by the Social Policy and Legal Affairs Committee, House of Representatives on 24 May 2012. At the request of the Winemakers' Federation of Australia, a 30-page referenced commentary was prepared on *Myth busted: red wine no magic remedy for heart disease* from the Alcohol Policy Coalition Position Statement entitled *Cancer, cardiovascular disease and alcohol consumption,* which was published in mid-2011, as well as a 4-page fact sheet on *Research into the health impacts of wine*.

Invited presentations were made by Creina Stockley at: the Premium Wine Brands' wine seminar on 4 August 2011; the 5th International Conference on Polyphenols and Health, Sitges, Spain on 16 October 2011; the University of Melbourne's Lecture series: Food for a healthy plant - bioactive phenolic compounds on 12 October 2011; and the Organisation de la Vigne et du Vin (OIV) Commission IV Expert Group meetings in Paris, France on 5-16 March 2012 (see Appendix 1).

## Project coordination

The project entitled *Resveratrol in the chemoprevention of colorectal neoplasia* funded by Cancer Australia has continued, in collaboration with Finlay Macrae, Head of the Department of Colorectal Medicine and Genetics at The Royal Melbourne Hospital.

The project entitled *Determination of the beneficial cardiovascular effects of red wine and the three primary wine-derived phenolic compounds and their metabolites in humans* has continued, in collaboration with Arduino Mangoni of the University of Aberdeen, Scotland, UK.

A project entitled *Effect of resveratrol in red wine on cognitive function in older adults – a pilot study has commenced* in collaboration with Andrew Scholey, of the Centre for Human Psychopharmacology, Swinburne University. The project is investigating the effects of grape-derived resveratrol, administered in a moderate amount of red wine on specific and sensitive biomarkers for cognitive function in an elderly patient population; an aim is to attribute any beneficial effects to resveratrol and /or its metabolites.

The project entitled *Tracking the metabolome of grapes into wine* has commenced, in collaboration with Fulvio Mattivi of the Fondazione Edmund Mach and University of Trento, Italy. This two-year project will use metabolomics and aims to identify, quantify and potentially characterise compounds in grapes (that are transferred from grapes to wine) which might have therapeutic effects in humans in order to demonstrate the role of wine as part of a healthy diet and lifestyle.

# Communications and information delivery

**Staff**

Con Simos, Rae Blair, Linda Bevin, Sean Boden, Anne Lord, Michael Downie

The Communication and Information Services team (CIS) is a service unit within the AWRI and forms part of the Industry Development and Support group. The CIS team is responsible for the strategic sourcing of relevant technical information and, in collaboration with the AWRI's stakeholders, for its effective delivery to Australian grape and wine producers of all sizes. The operations of the CIS team also complement and support the knowledge management and communication activities of all of the AWRI staff.

## Highlights and activity

Specific activities of the team include:

- Corporate communication and brand management (facilitating effective communication between the AWRI and its stakeholders);
- Information and knowledge management;
- Provision of library services via the John Fornachon Memorial Library;
- Management of the AWRI website, and web-accessible information databases;
- Production of corporate publications, including *eBulletins*, *eNews*, *Technical Review* and the Annual Report;
- Provision of an editorial service for the staff of the AWRI; and
- Managing requests from media.

Progress reports on key activities are shown in subsequent sections. Highlights for the 2011/2012 financial year include:

- The establishment of a 'Vintage Collaboration Project' in the AWRI's intranet and collaboration system has improved the sharing of grape, juice and wine for research projects, and improved outputs from enabling some trials to occur as researchers are able to access grape, juice and wine samples for analyses.
- The consolidation of legacy databases into a single solution for tracking winemaking, viticulture, health and information services queries means over 20 years of knowledge is now captured and preserved

in a system, enabling the AWRI to improve the access to that information and knowledge to support Australian grape and wine producers.

» As an extension to the AWRI's roadshow program, the first webinar program was conducted in 2011/2012. Over 100 participants from all over Australian attended the sessions.

» Twenty-four *eBulletins* were issued, which proved a particularly effective way of distributing crucial information about agrochemical and other important technical issues.

» The 'AWRI Report' and the AWRI's 'Alternative Varieties' column was published in every issue of the *Wine and Viticulture Journal*, and the 'Ask the AWRI' column was published in every issue of the *Australian and New Zealand Grapegrower and Winemaker* throughout the year.

» The AWRI's electronic newsletter *eNews* was distributed six times throughout the year, in alternate months to the production of *Technical Review*.

» Twenty-eight new Fact Sheets were uploaded to the AWRI website.

» The AWRI website has undergone a re-development using an open-sourced content management system. The new website introduced a new feature focusing content delivery to four key user groups – grape producers, wine producers, exporters and consumers.

» The Information Services team managed 2964 requests for information, including an increase of 13% in requests for journal articles which were included in *Technical Review*.

## Provision and development of mechanisms for the efficient transfer of knowledge and technical information to the Australian grape and wine sector

**Staff**

Rae Blair, Linda Bevin, Sean Boden, Michael Downie

The AWRI utilises several strategic and effective mechanisms to disseminate knowledge and information to Australian grape and wine producers. Reported elsewhere in this report are the face-to-face extension activities – the 'body contact sport', such as Roadshows – undertaken by the other members of the Industry Development and Support group. Below are details of the other, less direct, extension/communication mechanisms which make information available to the AWRI's stakeholders.

### Annual report

For the past 57 years, the AWRI has produced a printed annual report such as this one, as its formal report to Australian winemakers and grapegrowers. Since 1999, the annual reports have been made available also for downloading on the AWRI's website. In an endeavour to improve the circulation across Australia of the AWRI's annual activities, the AWRI also publishes a four-page supplement in the November issue of the *Australian and New Zealand Grapegrower and Winemaker*, and the AWRI approaches all the major State-based winemaking bodies and offers an annual presentation to their members. This formal activity complements the vast range of presentations and publications undertaken by AWRI staff members throughout the year (Appendix 1).

### AWRI website

As part of the AWRI's extension capability, the website is a key communication tool for disseminating research outcomes to Australian grape and wine producers. The redevelopment of the website in 2011/2012 introduced a new feature focusing content delivery to four key user groups:

» Resources for vineyard.

» Resources for wineries.

» Resources for exporters.

» Resources for consumers.

The on-line databases and tools available to grape and wine producers include:

» winemaking calculators;

» Total Package Oxygen calculator;

» agrochemical on-line search;

» maximum residue limits on-line search;

» export requirements;

» permitted additives and processing aids;

» winemaking products and suppliers; and

» on-line ordering of staff publications and *Technical Review* articles.

Although the number of pageviews has decreased by 5% (337,183 pageviews) from previous year, the number of visitors using the AWRI website has increased by 6% to 52,699 unique visitors and the number of new visitors has also increased by 17%.

The number of visits to the website using a mobile device such as a smart phone or tablet has increased from 1,487 visits in 2010/2011 to 4,932 in the 2011/2012. As a result, the AWRI is in the process of optimising the website content for delivery to mobile devices.

### *Technical Review*

Following a survey of readers in April 2011, the AWRI's *Technical Review* is now only received in a printed format by those grape and wine producers who request it in writing and other interested parties who are subscribers. All other grape and wine producers can access *Technical Review* through the AWRI's website. Six issues of *Technical Review* were produced which provides a crucial summary of current grape and wine literature. Over 538 articles featured in *Technical* Review were requested and forwarded to readers.

### Editorial services

The Australian Wine Research Institute contributes regular columns in each of the *Wine and Viticulture Journal* and the *Australian and New Zealand Grapegrower and Winemaker* and also contributes other papers to these and other Australian and international industry journals. All papers authored by the AWRI staff, to be published in non-peer reviewed publications, are edited by the Communication Manager, Rae Blair (details of the articles published are in Appendix 5).

Teams across the AWRI continued the development of Fact Sheets relevant to their area of expertise. Fact Sheets are presented in an easy to understand, single topic, format and are all downloadable from the AWRI website. 28 Fact Sheets were prepared during 2011/2012 and are listed in Table 4.

### Improvement of knowledge management and stakeholder communication The Australian Wine Research Institute

**Staff**

Rae Blair, Linda Bevin

In its 57 years of operation, the AWRI has generated (and continues to generate) substantial amounts of unique information on the technical aspects of viticulture and oenology. A key aim of its activities is to ensure knowledge is both fully utilised for innovation in industry and acts as a catalyst to create new knowledge more freely. This can only be achieved if the information and knowledge is managed to become more useful and 'user friendly' not only to Australian grape and wine producers, but also for the research community. New technology to manage

knowledge and information continues to be investigated to fulfill objectives. These project activities complement the communication objectives of all staff members at the AWRI. The aim is to ensure greater penetration of information to the stakeholders of the AWRI, whilst supporting the positive perception of Brand Australia to the ultimate benefit of the Australian grape and wine sector.

### Information and knowledge management

The AWRI continues to use W*i*SE (the AWRI's Intranet and collaboration system) for communication and project management. The establishment of a 'Vintage Collaboration Project' has improved the sharing of grape, juice and wine for research projects, and improved outputs from some trials as researchers are able to access grape, juice and wine samples for analyses.

### Improved communication with stakeholders

The AWRI continued its focus of connecting with stakeholders throughout the year. Specific evidence of this can be found under the Appendices, which detail the number of Roadshow/workshop presentations and other presentations given, and papers published, by staff at the AWRI. In this project, the team collaborates with the entire AWRI staff to facilitate the effective delivery of information to stakeholders via various mechanisms. Electronic delivery of information to stakeholders' desktops has continued to be a priority. The AWRI uses three email address lists to communicate with its stakeholders. Users can automatically subscribe, or unsubscribe from the list at any time, thus ensuring that only those who want the information receive it. With a continued emphasis on agrochemical updates, 24 email bulletins were delivered during the year and are shown in Table 5.

The AWRI's electronic newsletter, *eNews*, continued to be distributed bi-monthly. *eNews* provides snapshot updates of the AWRI's activities. With the distribution of *eNews*, in alternate months to *Technical Review*, means information is formally received by stakeholders from the AWRI at least monthly. Six *eNews* (Table 6) were distributed throughout the year.

Support for the AWRI's Twitter presence is continuing with more than 1,150 followers. The use of social media and other communication methods is providing the AWRI with a multi-platform approach to ensure grape and wine producers are empowered and engaged, and have access to innovative and collaborative tools to learn, access information and improve processes in wineries and vineyards.

*Table 4. Fact Sheets prepared and uploaded to the AWRI website during 2011/2012.*

| Fact Sheet title | Group |
|---|---|
| Ochratoxin A | Commercial Services |
| Agrochemicals | Commercial Services |
| Low molecular weight sulfur compounds | Commercial Services |
| Methoxypyrazines | Commercial Services |
| Bottling audits | Commercial Services |
| Microbiological identification | Commercial Services |
| Allergen residues | Commercial Services |
| Export analysis | Commercial Services |
| Wine assessment tasting | Research |
| 13 x Wine and health | Industry Development and Support |
| Grapevine management in extreme heat | Industry Development and Support |
| AWRI mini-lot fermentation | Industry Development and Support |
| Micro audit service | Commercial Services |
| Low alcohol | Research |
| Malolactic fermentation | Research |
| 1,8 cineole (*Eucalyptus*) | Research |

*Table 6.* eNews *produced and distributed during 2011/2012.*

| Date | No. of email addresses |
|---|---|
| 5/7/11 | 2,551 |
| 1/9/11 | 2,520 |
| 2/11/11 | 2,490 |
| 16/1/12 | 2,447 |
| 2/3/12 | 2,432 |
| 8/5/12 | 2,410 |

*Table 7. Media releases prepared and distributed 2011/2012.*

| Announcement | Date distributed | Author |
|---|---|---|
| AWRI Managing Director moves on | 26/7/11 | R.J. Blair |
| Long Gully winemaker takes AWAC top honours | 15/8/11 | R.J. Blair |
| AWRI Board announces new Managing Director | 22/9/11 | R.J. Blair |
| Wine researchers sequence 'Brett' genome in world first | 23/11/11 | R.J. Blair |
| AWRI welcomes new Board members | 9/12/11 | R.J. Blair |
| Grapegrowers and wineries in Greater Victoria to benefit from new AWRI node | 12/1/12 | R.J. Blair with node partners |
| Canada-Australia collaboration to reveal Chardonnay's secrets | 18/1/12 | R.J. Blair and University of British Colombia |
| Events website launched for the grape and wine industry | 1/5/12 | R.J. Blair |
| Symposium to unlock latest smoke taint research | 12/6/12 | R.J. Blair and DPI Victoria |

### Media liaison

The AWRI is regularly approached for comment on wine technical matters from national and international media. This provides an excellent opportunity to ensure accurate information is published about wine made in Australia and to generate further communication opportunities with AWRI's stakeholders. Many requests from the media were handled during the year, and specific details can be found in Appendix 4. Nine media releases were prepared and distributed during the year and are listed in Table 7.

## Provision of scientific, technical and regulatory information

**Staff**
Linda Bevin, Sean Boden, Anne Lord and Michael Downie

### The John Fornachon Memorial Library

The John Fornachon Memorial Library holds the largest collection of grape and wine technical literature in the Southern Hemisphere, covering winemaking, viticulture, wine microbiology, flavour chemistry, phenolics, food chemistry, wine and health, wine and the environment. The collection includes books, journals, article reprints, conference proceedings, reports, theses, standards and legislations, as well as a reference collection of directories, foreign dictionaries and atlases.

While the John Fornachon Memorial Library's print book and journal collections continue to grow, rapid changes in digital technologies are providing opportunities to provide information to stakeholders in a variety of formats, resulting in an increasing emphasis being placed on building collections of digital resources. In line with past years, the majority of information requests received by the library are filled by electronic


*Table 5.* eBulletins *issued during 2011/2012.*

| Date | eBulletin | Authored by | Delivered to number of addresses |
|---|---|---|---|
| 26/7 | AWRI Managing Director moves on | Rae Blair | 2,577 |
| 28/7 | Agrochemical update | Marcel Essling | 2,559 |
| 15/8 | AWRI's August issue of *Technical Review* now available on-line (levy payer version) | Rae Blair | 2,769 |
| 15/8 | AWRI's August issue of *Technical Review* now available on-line (general version) | Rae Blair | 2,546 |
| 15/8 | The Dux of the AWRI's 2011 Advanced Wine Assessment Course announced | Rae Blair | 2,539 |
| 19/8 | Alternative varieties workshop at the AWRI 9 September | Peter Dry | 2,542 |
| 22/8 | Agrochemical update | Marcel Essling | 2,541 |
| 6/9 | Agrochemical update | Marcel Essling | 2,533 |
| 13/9 | AWRI webinar series 2011 | Linda Bevin | 2,518 |
| 22/9 | AWRI Board announces new Managing Director | Rae Blair | 2,514 |
| 5/10 | Unlike individual consumers, companies can sign their rights away | Con Simos | 2,503 |
| 10/10 | Agrochemical update | Marcel Essling | 2,521 |
| 15/8 | AWRI's October issue of *Technical Review* now available on-line (levy payer version) | Rae Blair | 2,569 |
| 6/12 | AWRI's December issue of *Technical Review* now available on-line | Rae Blair | 2,549 |
| 7/12 | AWRI's 2011 annual report now available on-line | Rae Blair | 2,545 |
| 20/12 | Agrochemical update | Marcel Essling | 2,532 |
| 7/4 | Botrytis and laccase winemaking strategies | Con Simos | 2,609 |
| 19/4 | Fruit Fly baiting and release of Pest and Disease survey | Marcel Essling | 2,595 |
| 20/4 | Imminent new requirement for wine exported to Canada – labels to require allergen information | Creina Stockley | 2,586 |
| 28/4 | Your opinion helps to improve our information delivery | Rae Blair | 2,580 |
| 4/5 | Using wastewater to create greater business sustainability | Rae Blair | 2,583 |
| 17/5 | Wine quality the winner in research funding boost | Rae Blair | 2,586 |
| 7/6 | 2011/2012 agrochemicals book now available | Marcel Essling | 2,581 |
| 8/6 | Winemaking consultancy included in your levy investment | Matt Holdstock and Rae Blair | 2,822 |

document delivery. Electronic document delivery continues to provide a fast and cost-effective method of information dissemination to the Australian grape and wine sector. While most requests are received via email or the AWRI website ordering system, requests can also be made in person, by phone or by mail.

The past 12 months has seen the continuation of a digitisation initative with over 30,500 of the 46,500 reprints held in the collection now available in pdf format. The launch of the new AWRI website in May 2012 enabled website visitors access to the print format through an on-line interactive contents page. Titles of papers are hyperlinked to a current literature search and order system which includes the copyright declaration. The on-line search and shopping cart system provides a simple platform for *Technical Review* readers to order papers. The team is now investigating the implementation of an e-book platform from which the circulation of an e-book collection will be managed.

## On-line information databases

Three information databases, available via the AWRI website, can be accessed by all grape and wine producers who pay the *Grape Research Levy* or *Winegrapes Levy*. The library databases, which include the records of books, journal articles, conference proceedings, reports, standards and legislation held in the AWRI collection, enable on-line information search and ordering options.

There continues to be strong demand for information access via the web, either directly via the on-line information databases; through the reference lists on common topics (such as botrytis and general taints and faults); or by direct contact with the library. The library continues to investigate new technologies to improve the accessibility of information relevant to the needs of the Australian grape and wine sector.

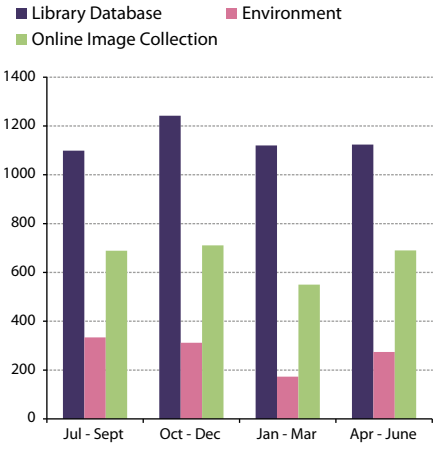



*Figure 32. Summary of database usage during 2011/2012.*

## John Fornachon Memorial Library catalogue databases

The Library holds over 71,000 records of books, conference proceedings, theses and scientific, technical and medical reprint articles. These records are indexed in the John Fornachon Memorial Library's database catalogue which is accessible on-line via the AWRI website. Records of the library's journal holdings including newsletters, statistics and annual reports are held in the *Journals* database. A summary of the library catalogue's holdings and information databases is given in Table 8.

## Specialised information services

While the usage of the AWRI's *Industry* on-line information database is available to all Australian grapegrowers and winemakers who pay the *Grape Research Levy* or *Winegrapes Levy,* customers are continuing to request that the AWRI library perform literature searches across in-house databases and other external resources in order to meet their information requirements.

## Document delivery services

'Document delivery' services entails the supply of journal articles, books, DVDs or other library items to customers upon request via the AWRI website, email, fax, phone or mail. Other Australian and overseas libraries or publishers are used to source requested items which are not held in the John Fornachon Memorial Library. The ability to order items on-line means that the majority of document requests are able to be completed within 48 hours.

## Library collection

A total of 62 monographs were added to the collection in the financial year of 2011/2012. The Library subscribed to, or received through exchange or donation, 76 journal titles. The collection also holds over 46,500 reprints which include AWRI staff publications, articles featured in *Technical Review* and articles obtained from other suppliers.

## Donations to the Library collection

The AWRI wishes to thank all individuals and companies who contribute to the collection through donations or exchange agreements. The support of the following persons and organisations who have donated books, journals or photographic material is acknowledged: Australian Dried Fruits Corporation, Australian Society of Viticulture and Oenology, Australian Wine and Brandy Corporation, Australian Wine and Brandy Producers' Association, Commonwealth Scientific and Industrial Research Organisation, Creina Stockley, Kym Anderson, Markus Herderich, Patrick Iland, Sakkie Pretorius, Sally-Jean Bell, the Winemakers' Federation of Australia Incorporated and Winetitles Pty Ltd.

*Table 8. Description and number of records of on-line information databases and library catalogues.*

| **Web accessible information databases** | |
|---|---|
| *Library catalogue* | 71,908 |
| *Environment* | 2,218 |
| *AWRI On-line Image Collection* | 2,338 |
| | |
| **Reprint Collection to date (see below for details)** | 45,521 |
| *– Reprints* | 37,572 |
| *– AWRI publications* | 1,433 |
| *– Articles indexed via* Technical Review | 8,917 |

*Table 9. Summary of information requests during 2011/2012.*

| | **Wine industry** | **Staff** | **Other[5]** | **Total** |
|---|---|---|---|---|
| Information requests[1] | 1061 | 1195 | 708 | 2964 |
| *Technical Review* requests[2] | | | | 182 |
| *Technical Review* articles forwarded[3] | | | | 538 |
| Articles forwarded[4] | | | | 1696 |
| Number of AWRI publications forwarded[5] | | | | 592 |

1. Includes the number of articles and books requested, reference requests, copyright advice, literature searches and website account enquiries.
2. Number of requests received for articles published in *Technical Review.*
3. Number of articles forwarded from *Technical Review* (usually more than one article is requested).
4. Number of articles forwarded from the library collection, excluding staff publications.
5. Requests from students, Government agencies, private companies and overseas customers for publications authored by AWRI staff.

# Commercial Services

**Staff**

Dr Eric Wilkes, Leanne Hoxey, Randell Taylor, Matthew Cream, Alana Spears, Heather Tosen, Slavko Bekavac, Tim Reilly, Bryan Newell, Dr Simon Nordestgaard, Pamela Solomon, Daniel Tynan, Warren Roget, Dr Tina Tran, Karl Forsyth, Robyn Gleeson, Tadro Abbott and Dr Kerry Pinchbeck

The last 12 months proved to be another challenging one for the Australian wine sector with both environmental and financial issues having a major impact. This challenging environment directly affects Commercial Services' revenue streams. However, it also means it is more important than ever for the AWRI to provide services that help the industry be more competitive. As such, the AWRI Commercial Services has continued to offer a high quality service at competitive pricing with a range of new offerings in an environment where much of the industry is downsizing its technical footprint. The initiatives and activities of the AWRI Commercial Services can be grouped into the following impacts:

» Reducing costs to suppliers.

» Lowering the risk for the wine sector.

» Extending our markets.

» Benchmarking performance.

» Creating a sustainable future.

## Reducing costs to producers

Carrying on from last year's initiative, the AWRI has held down or reduced the pricing of all its offerings while ensuring that the time it takes for results to reach the end user is at an all time low. This has been achieved through careful application of lean systems and the constant search for more efficient processes and methods. The laboratories are also increasing the range of testing that can be undertaken internally to reduce need for outsourcing and hence the cost and turnaround times for end users.

> *"The high level of analytical support and technical troubleshooting expertise within the AWRI Commercial Services team is a valuable resource to the Australian wine industry. The team's responsiveness and ability to prioritise analysis upon request is greatly appreciated."*
> ***Iain Jones,*** *Global Director Technical Services, Treasury Wine Estates*

In the area of residue testing in wine and grapes, the AWRI has been able to leverage its experience to improve an already industry-leading competitive service. The team increased the range of analytes covered by its standard screens with seven new compounds while keeping costs and turnaround times the same as the previous year. The high standard of this service is evidenced by the close working relationship that the AWRI has with Wine Australia in ensuring that agricultural testing meets the needs of the sector.

## Lowering the risks for the wine sector

While it is not always possible to lower production costs, it can be just as important to lower the production risks that wine and grape producers face. One of the most obvious of these risks is that posed by contamination from substandard or degraded additives and processing aids. This year, the AWRI has introduced Codex-level testing for a number of the most common raw materials used in Australian wineries. This testing helps to ensure that the materials used in wineries do not add any unwanted taints or chemical impacts during the course of normal processing. Increasingly, this service is being used by wine additive suppliers proactively before they offer their products to the wine sector.

Another very public area of concern currently for wineries is in the area of allergen labelling. Recently, Canada has changed its labelling requirements and the EU is currently drafting changes to its regulations. The AWRI has been proactive in finding reagent kits to satisfy these requirements and validating them against standards accepted by the international community. This testing is now available to the wine sector. The AWRI will continue to monitor changes in regulations to ensure that the testing it provides continues to meet the needs of the sector.

The AWRI has also introduced a 'bottling line microbiological audit' program to add to its already well-known bottling line oxygen audits. This service allows packaging providers, or their customers, to commission a third-party audit of the packaging process to ensure its integrity in regards to microbiological contamination. The audit process does more than just provide reassurance, however, with auditors actively identifying weaknesses or problems in the process and providing suggestions on improvements or solutions. Combined with an oxygen audit, this process can do much to ensure that any given packaging provider is meeting best practice in ensuring that wine reaches customers in optimum condition.

## Extending our markets

With the increased emphasis on finding and extending new markets for Australian wine, the AWRI has been actively developing services to help the wine sector access and expand its success in these markets. Primary in this area is the provision of internationally recognised accredited testing certificates that facilitate or meet legislative requirements for export to a

L to R: Tim Reilly, Eric Wilkes, Pamela Solomon and Bryan Newell

L to R: Simon Nordestgaard, Warren Roget, Tina Tran and Tadro Abbott (location: Hickinbotham Roseworthy Wine Science Laboratory)

wide range of countries. The AWRI is constantly monitoring international requirements and tailoring its certificate services for the wine sector.

An example of this has arisen with the changes in export procedure by Wine Australia. A number of wine importers approached the AWRI seeking a certificate to indicate that a wine was free from common faults. To meet this demand, the AWRI introduced a technical sensory panel certificate which assesses wine for seven common wine faults, reporting on their absence or presence independent of wine style or age. The panel uses five highly trained assessors and positive and negative controls in parallel with the wine assessment to ensure that the process is analytical and highly repeatable. Wines that have common wine faults detected then have the option to be assessed by the AWRI's well established Quality Sensory Panel to produce a more detailed report on the wines status.

## Benchmarking performance

Highly successful consortium-style projects that benchmark/prove the performance of technologies involved in the production and packaging of wine, have continued, with the red wine closure trial now having been in bottle for over 18 months. This trial is evaluating the impact of the 10 most popular closure technologies on the flavour, aroma and shelf-life of a premium red wine. Trial participants are learning how one of the most important performance criterion of a closure, the oxygen transmission rate (OTR), drives wine style evolution. They will also benefit from an insight into consumer preferences for the variations that result from different closures.

Building on this experience, a commercial trial to evaluate the performance of sparkling closures has been initiated and will be structured in a manner similar to that of the red wine closure trial. The sparkling closure trial, to be bottled in August 2012, consists of a consortium of both wine producers and closure suppliers with participants receiving information of closure performance and its impact on wine sensory parameters as well as consumer insights. The trial will involve a range of traditional and innovative closures, all of which are commercially available.

The consortium-style benchmarking trials are not restricted to packaging assessment with a major trial to assess the performance of the cold stabilisation additive, carboxymethylcellulose (CMC), underway. Participants have submitted wines to be tested against a number of nominated CMCs to understand the efficacy and production constraints of using these products. A number of major additive suppliers are involved in the project and trial participants will receive information on both the short- and long-term ability of CMCs to inhibit tartrate precipitation in a range of different wine styles, as well as the sensory impact of these treatments.

The AWRI has been able to leverage the knowledge gained in developing these trials to become the provider of choice for suppliers wishing to have products tested for performance in the wine sector. These trials cover a range of products including innovative closures, barrel and barrel alternatives, and alternative methods for cold stabilisation and filtration. The ability of a reliable and independent third-party such as the AWRI to evaluate objectively performance not only benefits suppliers but gives wine sector producers data upon which to base purchasing decisions.

## Creating a sustainable future

The AWRI has continued the development of its leadership role in the areas of sustainability and environmental management within the wine and grape sector. Key to this has been the continued development of capability in areas such as life cycle analysis (LCA) and energy and water management. To ensure that the AWRI is at the forefront of these areas it has joined The Sustainability Consortium, a global organisation which collaborates on scientific research and the development of standards and tools related to the environmental, social and economic impacts of products. Its membership consists of numerous companies (including Walmart, Tesco, Coca Cola and Unilever), as well as NGOs and government. The AWRI is the only Australian wine industry participant and is well placed to communicate what it learns as a member and provide services to grape and wine producers in this important and growing area.

The AWRI Commercial Services has also contributed to fora on improving greenhouse gas emissions inventories including a workshop held by the Department of Climate Change and Energy Efficiency on improving the national greenhouse gas inventory for horticulture. Participation in such fora and the continued offering of workshops in areas such as refrigeration and wastewater ensures that the industry has the most up-to-date information possible.

To support the development of the baseline knowledge in this area, work has continued on a number of major GWRDC-funded projects. A project entitled 'Improving winery refrigeration efficiency' has been completed. The reference guide, produced as part of the project, was updated to incorporate findings from the most recent project case studies. This project has provided invaluable information on the real costs of winery refrigeration and the practical means available to the wine sector to reduce costs and improve efficiency. This reference guide and detailed case study reports have been made available on the GWRDC and AWRI websites.

Work has also continued on the GWRDC-funded project on 'Cleaner production'. This has included work on caustic reuse, evaluation of lees cross-flow filters, and a study to understand product movements in large complex wineries which produce many interdependent products. Performed in conjunction with the CSIRO, the report and case studies will be available to industry in the second half of 2012.

The AWRI Commercial Services has also been active in seeking funding for new projects in the sustainability and environment space, and recently obtained funding from the Department of Agriculture Fisheries and Forestry under the 'Filling the research gap' program. The funding is for a project to investigate the use of grape marc as an alternative feedstock to reduce livestock ruminant methane emissions (livestock enteric fermentation contributes approximately 10% of Australia's greenhouse gas emissions). This is a way for the wine industry to potentially contribute to reducing Australia's greenhouse gas emissions to a much larger extent than possible through its own industry alone.

# Corporate Services

**Staff**

Hans Muhlack, Catherine Borneman, Mark Braybrook, Alfons Cuijvers, Chris Day, Linda Halse, Adam Holland, Pauline Jorgensen, Jan O'Donnell, Fang Tang, Deborah Thornton-Wakeford, Jeanette Tooley.

The Corporate Services Group is a dedicated team of specialists who work together to provide infrastructure, administration, financial, human resources, OH&S and IT services in a seamless manner. Its aim is to enable the AWRI's staff to focus on their core capabilities to ensure the AWRI meets its business objectives and in turn meets the expectations of its stakeholders.

The Group continues to explore ways to effectively support the AWRI's operations with a minimal demand on resources. Following the prior year's contraction in staffing levels and a number of new faces within the Group, the current year saw these relatively new staff with responsibilities in finance, IT, human resources and OH&S explore new ways to add value within these functions. The Group Manager – Corporate Services, Hans Muhlack, retired in July 2012, and the AWRI acknowledges and thanks Hans for his many years of dedicated and effective service. Hans has been a critical member of the AWRI Executive Management Group for many years, and has overseen a number of important imrovements to the AWRI's corporate governance practices and financial management systems. Hans is wished all the best for his retirement. Fang Tang joined the AWRI this year, filling a vacancy created in the accounts team, bringing not only formal qualifications in economics and accounting but international experience with Ford Motor Company and IBM in her native China. These skills and experience enabled Fang to quickly settle in and become 'up to speed', as well as Fang adding to the organisation's rich cultural diversity.

The Operations Manager, Mark Braybrook, continues to manage and attend to the AWRI's infrastructure needs including representing the AWRI on the WIC Management Committee. Effective tailored solutions are made available to support the organisation's infrastructure requirements, in a considerably more cost-effective manner than would be the case if these needs were to be met externally. Considerable time was devoted to the installation of infrastructure to support new high-end analytical equipment, which included engineering a more effective liquid Nitrogen distribution system throughout the premises. In preparation for 2012 vintage trials, rotary fermenters located within the Hickinbotham Roseworthy Wine Science Laboratory (WIC East) were modified and re-engineered to enable ferment sparging with different gases and doses as required by the 'effects on wine style of oxygen during fermentation' trials.

The IT Coordinator, Adam Holland, has focused upon delivering productivity improvements to the AWRI under a 'centralise, virtualise and standardise' strategy. Following the completion of the virtualisation of the organisation's server network, attention is now focussed on the virtualisation of AWRI's desktop environment, as well as a complete IT software and hardware audit.

The critical activity this year for the HR Manager, Linda Halse, was the recruitment of the new Managing Director. Together with members of the AWRI Board, this entailed an exhaustive international search, resulting in Dan Johnson's appointment. Other significant positions recruited for during the year include that of the Business Development Manager and Victorian Node Manager, for which very high quality candidates were secured. A 'Great Place to Work' survey, completed by AWRI staff, returned excellent results— for example, 96% of AWRI employees agreed with the statement "taking everything into account, I would say this is a great place to work".

The Payroll/OH&S officer, Alfons Cuijvers, continues to further apply his management experience and legal qualifications to reviewing and drafting new funding and contract research agreements in support of AWRI's activities. Over the course of the year he also undertook the considerable task of an organisation-wide risk review, which will serve to guide the AWRI's future risk management strategies.

The finance team welcomed the return of the Accountant, Catherine Borneman, from maternity leave in October 2011. Catherine and the rest of the team focused on implementing a number of productivity improvements, as well as enhancing the quality of reporting to management and the AWRI Board. The Finance Manager, Chris Day, saw the scope of his responsibilities expand over the year in anticipation of the retirement of the Group Manager – Corporate Services. In addition to playing a more strategic role within the AWRI, Chris took on the position of Director and Treasurer of the Australian Wine Industry Technical Conference Inc. in late 2011.

The current year will sadly be the last one with AWRI for receptionist, Jan O'Donnell, who will be retiring in August 2012. Together with Deborah Thornton-Wakefield, the AWRI's reception service provides a professional and personable face for the organisation, and Jan has become one of the best known and most liked characters within the AWRI over her six years of service. She will be greatly missed, and is wished a happy and healthy retirement. Jan will be replaced by Jennifer O'Mahony, who has already gained a good understanding of the organisation through her time on the AWRI external sensory panel.

L to R: Chris Day, Mark Braybrook and Adam Holland

# Financial statements – Directors' report

The directors present this report to the members of The Australian Wine Research Institute Limited (the Company) for the year ended 30 June 2012.

## Directors

The names of each person who has been a director during the year and to the date of this report are:

| | Date of appointment | Cessation date | Board meetings | |
|---|---|---|---|---|
| | | | A | B |
| Mr Peter J. Dawson (Chair) | 31 Jan 2002 | - | 4 | 4 |
| Mr John C. Angove | 1 Jan 2010 | - | 4 | 4 |
| Mr James F. Brayne | 1 Jan 2009 | - | 3 | 4 |
| Mr Paul D. Conroy | 2 May 2006 | - | 4 | 4 |
| Dr John S. Harvey | 1 Jan 2012 | - | 2 | 2 |
| Dr Daniel L. Johnson | 1 Dec 2011 | - | 3 | 3 |
| Mr James A. Lumbers | 1 Jan 2009 | 31 Dec 2011 | 1 | 2 |
| Mr Brett M. McKinnon | 1 Jan 2008 | - | 2 | 4 |
| Ms Jan S. O'Connor | 8 May 2007 | 31 Dec 2011 | 2 | 2 |
| Prof Isak S. Pretorius | 10 Sep 2004 | 30 Nov 2011 | 1 | 1 |
| Ms Elizabeth A. Riley | 1 Jan 2012 | - | 2 | 2 |
| Ms Louisa E. Rose | 1 Jan 2011 | - | 4 | 4 |
| Mr Mark E. Watson | 24 Jun 2008 | - | 3 | 4 |
| | | | | |
| *Alternate directors* | | | | |
| Mr Michael R. DeGaris | 22 Mar 2011 | 31 Dec 2011 | - | 1 |
| Mr Neil A. McGuigan | 22 Mar 2011 | - | - | 2 |
| Mr Corey B. Ryan | 18 May 2010 | - | - | 1 |
| Mr Alexander N. Sas | 25 May 2004 | - | - | - |

**A** – Number of meetings attended

**B** – number of meetings held during the time the director held office during the year, or number of meetings held that the alternate director was eligible to attend during the year

Directors have been in office since the start of the financial year to the date of this report unless otherwise stated.

## Overview of result

For the year ended 30 June 2012 the organisation recorded a surplus of $1,143,214 (2011: surplus of $470,432). This surplus is primarily due to the recognition of $991,347 in funding specifically for the purchase of capital equipment, provided by the Grape and Wine Research and Development Corporation ($327,537) and under the Commonwealth Government's Super Science Project for the Education Investment Fund ($663,810), and requiring recognition as income within the reported upon period in accordance with applicable accounting standards.

## Objectives and strategy

The organisation's long-term objective is to contribute substantially in a measurable way to the ongoing success of the Australian wine industry, delivering high value through world-class research and integrated solutions, and providing thought leadership to the industry's research activities.

The organisation's short-term objectives are reflected in its 7 Year Research, Development and Extension Plan. This plan articulates 41 research projects designed to contribute to the achievement of the Company's vision, grouped within four main researchable themes:

» Grape and wine composition

» Grape and wine production

» Wine in society

» Information and knowledge transfer

For each project, the Research, Development and Extension Plan specifies relevant objectives, outputs, milestones and expected outcomes of benefit to the Australian wine industry as well as approaches and methodologies for their achievement.

The Company's activities are implemented through a 10 Year Business Plan which is subject to periodic review. To achieve the Company's objectives, this plan articulates the following strategies:

» Advance the competitive edge of the Australian wine industry through the delivery of world-class research and development activities.

» Provide integrated solutions to proactively manage industry problems.

» Deliver high value information and outcomes to the Australian wine industry.

» Ensure the AWRI is 'top of mind' in wine innovation knowledge for all stakeholders of the Australian wine industry.

Executive summaries of both the Research, Development and Extension Plan and Business Plan are available on-line at awri.com.au.

## Principal activities

The Company's principal activities during the year were:

**Research** activities which strive for scientific excellence and industry relevance;

**Development** activities which seek to bridge the gap between scientific discovery and value adding technology or processes;

**Extension** activities which seek to disseminate research and development outcomes to facilitate rapid uptake by the viticultural and winemaking sectors. In addition, problem solving services and an on-line search capacity across a range of technical websites are also provided; and

**Commercial** services aimed at providing competitive specific and/or tailored solutions for individual entities across all industry sectors which leverage the other key activities of the AWRI.

These activities collectively constitute a mechanism to implement the strategies outlined in the 10 Year Business Plan, enabling the achievement of the long- and short-term objectives of the organisation as articulated above.

### Performance measures

The Company measures its performance through considering the number, quality and impact of the AWRI's scientific publications; its research and development outcomes; the extent to which those outcomes have been adopted by industry practitioners to improve the quality and consistency of wine produced in Australia; and the extent to which that new knowledge has enabled the Australian wine industry to be successful in new and emerging markets. Progress against specific objectives is monitored though the achievement of specific milestones, outputs and performance targets as articulated in the 10 Year Business Plan and 7 Year Research, Development and Extension Plan, combined with measures of utilisation of the AWRI's extension platforms such as roadshows and company website and feedback provided through surveys distributed to service end-users. Financial performance measures include the value of funding and grants received, demand for the organisation's commercial services and contract research capabilities and performance relative to budget. From time to time the Company or parts of its operations are subject to independent review against externally established criteria, with the outcome of such reviews contributing to the Company's assessment of its own performance.

## Information on directors

**Mr Peter J. Dawson**
*Chair (non-executive)*
**Qualifications:** BSc BAppSc (Wine Science)
**Experience:** Principal Peter Dawson Consulting, Chair and Managing Director of Taransaud Australasia, director of Dawson and James, formerly Senior Vice President Group Operations and Technical Constellation Wines, Adjunct Professor of the Faculty of Science and Technology Deakin University, national wine show judge, 34 years technical and winemaking experience in the Australian wine industry.
**Special Responsibilities:** Mr Dawson is the Chair of the Nomination and Remuneration committee.

**Mr John C. Angove**
*Non-executive director*
**Qualifications:** BSc
**Experience:** Chair and Managing Director of Angove Family Winemakers, founding member of Winemakers Federation of Australia in 1988. Chair of WFA/AWBC Wine Industry Technical Advisory Committee, member WFA Medium Winemakers Membership Committee and member of WFA Executive.

**Mr James F. Brayne**
*Non-executive director*
**Qualifications:** BAppSc (Wine Science)
**Experience:** Production Director/Chief Winemaker McWilliam's Wines Pty Ltd, national wine show judge, 38 years technical and winemaking experience in the Australian wine industry.
**Special Responsibilities:** Mr Brayne is a member of the Nomination and Remuneration committee.

**Mr Paul D. Conroy**
*Non-executive director*
**Qualifications:** LLB (Hons) BComm
**Experience:** Chief Legal Officer and Company Secretary Treasury Wine Estates Ltd, admitted as a solicitor in the Supreme Courts of NSW, Victoria and the High Court of Australia, more than 20 years legal and management experience working in Australia, Asia, United Kingdom and the USA.
**Special Responsibilities:** Mr Conroy is a member of the Audit committee.

**Dr John S. Harvey**
*Non-executive director (from 1 January 2012)*
**Qualifications:** BSc (Hon) PhD MBA GAICD
**Experience:** Managing Director and owner of Bathe Wines Pty Ltd, member of the Executive Committee of the Adelaide Hills Wine Region, member of the Journal Advisory Committee of the *Australian Journal of Grape and Wine Research* and formerly Executive Director of the Grape and Wine Research and Development Corporation. Twelve years of wine industry research, R&D management and commercial experience. Director of the Can:Do 4 Kids Group, Spina Bifida and Hydrocephalus Association of SA and External Appointed Member of the Programs Committee of the Adelaide Women's and Children's Hospital Foundation.

**Dr Daniel L. Johnson**
*Managing Director (from 1 December 2011)*
**Qualifications:** BSc (Hons) PhD MBA GAICD
**Experience:** Chair of the Australian Wine Industry Technical Conference Ltd (from December 2011), Chair of the WineHealth 2013 Steering Committee, member of the *Australian Journal of Grape and Wine Research* Journal Advisory Board, member of the International Scientific Board of l'Institut des Sciences de la Vigne et du Vin (ISVV) Bordeaux (France), member of the Winemakers' Federation of Australia Innovation Policy Committee and Wine Industry Technical Advisory Committee, member of the National Wine Foundation, member of the Wine Innovation Cluster Leadership Group, member of the Waite Strategic Leadership Group, graduate of the Australian Wine Industry Future Leaders Program, director of Tacnia Pty Ltd, 15 years experience in research, development and innovation.

**Mr James A. Lumbers**
*Non-executive director (to 31 December 2011)*
**Qualifications:** BSc Lit B (Public Policy)
**Experience:** Principal Lumbers Consulting and Chair Lerida Estate. Associate Principal of Partners in Performance, member of the Canberra and District Wine Industry Association, Canberra and District Vignerons Association, ASVO and AIAS.

**Mr Brett M. McKinnon**
*Non-executive director*
**Qualifications:** BAgSc (Oenology) (Hons)
**Experience:** Managing Director Orlando Wines, professional member of the ASVO, graduate of the Leadership in Innovation Program INSEAD (France), 24 years technical, winemaking, viticulture and commercial experience.
**Special Responsibilities:** Mr McKinnon is a member of the Nomination and Remuneration committee.

**Ms Jan S. O'Connor**
*Non-executive director (to 31 December 2011)*
**Qualifications:** BEd (PE) MAICD
**Experience:** Managing Director O'Connor Harvesting, committee member of the Robinvale and District Wine Grape Growers Association, committee member of the Murray Valley Winegrowers Inc. and member of the Murray Valley Industry Development Committee, 25 years experience in the Australian wine industry.

**Prof Isak S. Pretorius**
*Managing Director (to 30 November 2011)*
**Qualifications:** BSc Agric (Hons) PhD
**Experience:** Affiliate Professor in Oenology University of Adelaide, member of the Winemakers Federation of Australia Wine Industry Technical Advisory Committee, committee member of the Royal Agricultural and Horticultural Society (South Australia), member of the International Commission of Yeasts, Scientific Board of l'Institut des Sciences de la Vinge et du vin (ISVV) Bordeaux (France), scientific committee member of the Institut Catalá de Recerca en Enologia i Viticultura (ICREV) Tarragona (Spain), editorial board member of the *American Journal of Enology and Viticulture, Annals of Microbiology, FEMS Yeast Research* and *Yeast*, Chair of the Australian Wine Industry Technical Conference Ltd (to November 2011), 34 years experience in microbiology and biotechnology.

**Ms Elizabeth A. Riley**
*Non-executive director (from 1 January 2012)*
**Qualifications:** BAppSc (Wine Science)
**Experience:** Nuffield Farming Scholar, Managing Director and Viticulturist Vitibit Pty Ltd, independent expert for the Wine Industry Code of Conduct – Wine Australia, professional member of the ASVO, associate member of the Hunter Valley Wine Industry Association and member of the Viticulture Sub-committee. Previously a viticulturist with Southcorp Wines between 1993 and 1999 in national and NSW-based roles, 20 years experience in the Australian wine industry.

**Ms Louisa E. Rose**
*Non-executive director*
**Qualifications:** BAppSc (Oenology) BSc
**Experience:** Head of Winemaking The Yalumba Wine Company and Hill Smith Family Vineyards, Co-Chair of the South Australian Wine Industry Council, member of Wine Barossa, former director of the Barossa Grape and Wine Association, national wine show judge, 21 years technical, winemaking, viticultural and commercial experience in the Australian wine industry.
**Special Responsibilities:** Ms Rose is a member of the Audit committee.

**Mr Mark R. Watson**
*Non-executive director*
**Qualifications:** MBA ACA IPAA AICD
**Experience:** Partner Corporate Finance KPMG, previously Chief Financial Officer Wirra Wirra and Manager – Corporate Strategy and Development FH Faulding & Co Ltd.
**Special Responsibilities:** Mr Watson is the Chair of the Audit committee

### *Alternate directors*

**Mr Michael R. DeGaris**
*Non-executive alternate director (for Mr Lumbers) (to 31 December 2011)*
**Qualifications:** BAppSc (Oenology) FACBS
**Experience:** Wine consultant, domestic and international wine show judging experience, previously winemaking positions at Tyrrells and Cellarmaster Wines, General Manager/Chief Winemaker of Cardmember Wines (NZ) and Rothbury Wines, over 30 years experience in the Australian wine industry.

**Mr Neil A. McGuigan**
*Non-executive alternate director (for Mr McKinnon)*
**Qualifications:** BAppSc (Oenology)
**Experience:** CEO Australian Vintage Ltd, domestic and international wine show judging experience, over 34 years technical, winemaking and management experience in the Australian wine industry.

**Mr Corey B. Ryan**
*Non-executive alternate director (for Mr Brayne)*
**Qualifications:** M. Oenology, Grad Dip Wine Bus
**Experience:** Group Chief Winemaker McWilliam's Wines Group Ltd and Echelon Wine Partners, former Chief Winemaker Villa Maria Estates NZ, domestic and international wine show judging experience, 22 years technical winemaking, viticulture and commercial experience.

**Mr Alexander N. Sas**
*Non-executive alternate director (for Mr Dawson)*
**Qualifications:** BSc Agric (Hons)
**Experience:** Chief Viticulturist Accolade Wines, 23 years experience in viticultural research & development and grape supply management.

## Indemnification of officers and auditors

During the financial year, the Company paid a premium in respect of a contract insuring the directors of the Company (named above), the Company Secretary, all members of the Company's Executive Management Group and members of the Biosafety Committee (a committee including two representatives who are not employees of the Company, charged with oversight of matters pertaining to the development and use of genetically modified organisms and required to be appropriately indemnified by the Office of the Gene Technology Regulator) against a liability incurred as such by a director, secretary, executive or committee member to the extent permitted by the Corporations Act 2001. The contract of insurance prohibits disclosure of the nature of the liability and the amount of the premium.

The Company has not otherwise, during or since the end of the financial year, except to the extent permitted by law, indemnified or agreed to indemnify an officer or auditor of the Company or of any related body corporate against a liability incurred as such an officer or auditor.

## Members' guarantee

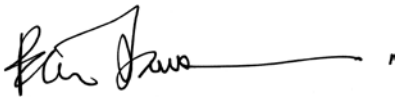
In accordance with the Company's constitution, each member (both during the time he or she is a member and within one year afterwards) is liable to contribute $2 in the event that the Company is wound up. The total amount members would contribute is $26 (2011: $20).

## Auditor's independence

The auditor's independence declaration under section 307C of the Corporations Act 2001 is attached and forms part of the Directors' report for the financial year ended 30 June 2012.

Dated at Urrbrae on this the 18th day of September 2012.

This Directors' report is signed in accordance with a resolution of the directors made pursuant to s.298(2) of the Corporations Act 2001.



**Peter J. Dawson**
Chair

**Daniel L. Johnson**
Managing Director

## Auditor's independence declaration

As lead auditor for the audit of The Australian Wine Research Institute Limited for the year ended 30 June 2012, I declare that to the best of my knowledge and belief, there have been:

(a) no contraventions of the auditor independence requirements of the Corporations Act 2001 in relation to the audit; and

(b) no contraventions of any applicable code of professional conduct in relation to the audit. This declaration is in respect of The Australian Wine Research Institute Limited.

PKF
Chartered Accountants

Ian J. Painter
Partner

Signed in Adelaide on 18th September 2012

# Financial statements

## The Australian Wine Research Institute Limited

A Company limited by guarantee

### Statement of comprehensive income

For the year ended 30 June 2012

| | Note | 2012 | 2011 |
|---|---|---|---|
| **Revenue from operating activities** | | | |
| Grape and Wine Research and Development Corporation | | | |
| Investment agreement project and capital funding | | 9,540,090 | 9,544,316 |
| Other project funding | | 202,080 | 462,376 |
| Other capital funding | | 221,068 | 44,230 |
| Capital specific grant funding | | 663,810 | – |
| Other grant funding | | 647,213 | 889,933 |
| Commercial Services analytical and consulting income | | 2,112,922 | 2,259,302 |
| Contract research and other commercial income | | 986,256 | 910,403 |
| Other revenue | | 395,833 | 222,729 |
| Total revenue | | 14,769,272 | 14,333,289 |
| Other income | **2** | 12,032 | 67,266 |
| **Expenses from operating activities** | | | |
| Personnel expenses | **3** | 9,636,919 | 9,839,750 |
| Analytical and project operating expenses | | 1,935,967 | 2,100,877 |
| Infrastructure and general services expenses | | 1,057,978 | 901,719 |
| Depreciation and amortisation expense | **8, 9** | 1,150,101 | 1,143,866 |
| Travel expenses | | 363,173 | 359,965 |
| Total expenses | | 14,144,138 | 14,346,177 |
| **Results from operating activities** | | 637,166 | 54,378 |
| **Finance income** | | 506,048 | 416,054 |
| **Profit for the period** | | 1,143,214 | 470,432 |
| Other comprehensive income | | – | – |
| **Total comprehensive income for the period** | | 1,143,214 | 470,432 |

*The notes on pages 58 to 63 are an integral part of these financial statements.*

## The Australian Wine Research Institute Limited

A Company limited by guarantee

### Statement of changes in equity

For the year ended 30 June 2012

| | Retained Earnings | Total Equity |
|---|---|---|
| Balance at 1 July 2010 | 11,728,281 | 11,728,281 |
| **Total comprehensive income for the period** | | |
| Profit or loss | 470,432 | 470,432 |
| Other comprehensive income | – | – |
| Total comprehensive income for the period | 470,432 | 470,432 |
| Balance at 30 June 2011 | 12,198,713 | 12,198,713 |
| Balance at 1 July 2011 | 12,198,713 | 12,198,713 |
| **Total comprehensive income for the period** | | |
| Profit or loss | 1,143,214 | 1,143,214 |
| Other comprehensive income | – | – |
| Total comprehensive income for the period | 1,143,214 | 1,143,214 |
| Balance at 30 June 2012 | 13,341,927 | 13,341,927 |

*The notes on pages 58 to 63 are an integral part of these financial statements.*

## The Australian Wine Research Institute Limited

A Company limited by guarantee

## Statement of financial position

As at 30 June 2012

| | Note | 2012 | 2011 |
|---|---|---|---|
| **Assets** | | | |
| Cash and cash equivalents | **4** | 4,436,091 | 4,592,218 |
| Other investments | **5** | 6,500,000 | 5,000,000 |
| Trade and other receivables | **6** | 1,145,972 | 747,977 |
| Inventories | **7** | 51,561 | 31,855 |
| Prepayments | | 294,800 | 186,248 |
| **Total current assets** | | 12,428,424 | 10,558,298 |
| Property, plant and equipment | **8** | 2,683,647 | 2,512,061 |
| Interest in WIC Building | **9** | 5,369,303 | 5,572,641 |
| **Total non current assets** | | 8,052,950 | 8,084,702 |
| **Total assets** | | 20,481,374 | 18,643,000 |
| **Liabilities** | | | |
| Payables and accruals | **10** | 4,951,235 | 4,192,256 |
| Project funds not expended and repayable | **11** | 303,670 | 321,412 |
| Provisions | **12** | 1,474,565 | 1,584,019 |
| **Total current liabilities** | | 6,729,470 | 6,097,687 |
| Payables and accruals | **10** | 81,001 | 61,001 |
| Provisions | **12** | 328,976 | 285,599 |
| **Total non-current liabilities** | | 409,977 | 346,600 |
| **Total liabilities** | | 7,139,447 | 6,444,287 |
| **Net assets** | | 13,341,927 | 12,198,713 |
| **Equity** | | | |
| Retained earnings | | 13,341,927 | 12,198,713 |
| **Total equity** | | 13,341,927 | 12,198,713 |

*The notes on pages 58 to 63 are an integral part of these financial statements.*

## The Australian Wine Research Institute Limited

A Company limited by guarantee

## Statement of cash flows

For the year ended 30 June 2012

| | Note | 2012 | 2011 |
|---|---|---|---|
| **Cash flows from operating activities** | | | |
| Cash receipts from project grants and other income | | 14,439,305 | 15,901,816 |
| Cash paid to suppliers and employees | | (13,244,801) | (13,095,122) |
| **Net cash from operating activities** | | 1,194,504 | 2,806,694 |
| **Cash flows from investing activities** | | | |
| Cash receipts from capital specific funding | | 759,215 | 221,068 |
| Interest received | | 478,370 | 131,811 |
| Proceeds from sale of property, plant and equipment | | 24,122 | 949 |
| Acquisition of property, plant and equipment | | (1,112,338) | (236,316) |
| Acquisition of other investments | | (1,500,000) | (5,000,000) |
| **Net cash used in investing activities** | | (1,350,631) | (4,882,488) |
| **Cash flows from financing activities** | | | |
| Payment of finance lease liabilities | | – | (20,340) |
| **Net cash used in financing activities** | | – | (20,340) |
| **Net increase (decrease) in cash and cash equivalents** | | (156,127) | (2,096,134) |
| Cash and cash equivalents at 1 July | | 4,592,218 | 6,688,352 |
| **Cash and cash equivalents at 30 June** | **4** | 4,436,091 | 4,592,218 |

*The notes on pages 58 to 63 are an integral part of these financial statements.*

# Notes to and forming part of the financial statements

## 1 Significant accounting policies

The Australian Wine Research Institute Limited (the "Company") is a company domiciled in Australia. The address of the Company's registered office is the corner of Hartley Grove and Paratoo Road, Urrbrae, South Australia.

The financial statements were authorised for issue by the Board of Directors on the 18th day of September 2012.

Australian Accounting Standards set out accounting policies that the AASB has concluded would result in financial statements containing relevant and reliable information about transactions, events and conditions. Material accounting policies adopted in the preparation of these financial statements are presented below and have been applied consistently to all periods presented in these financial statements, and have been applied consistently by the Company.

Where necessary, comparative information has been reclassified to achieve consistency in disclosure with current financial year amounts and disclosures.

**(a) Basis of preparation**

(i) Statement of compliance

The Company has elected to early adopt the Australian Accounting Standards – Reduced Disclosure Requirements as set out in AASB 1053 *Application of Tiers of Australian Accounting Standards* and AASB 2010-02 *Amendments to Australian Standards arising from Reduced Disclosure Requirements*. As a consequence, the Company has also adopted AASB 2011-2 *Amendments to Australian Accounting Standards arising from the Trans-Tasman Convergence Project – Reduced Disclosure Requirements* and AASB 2011-6 *Amendments to Australian Accounting Standards – Extending Relief from Consolidation, the Equity Method and Proportionate Consolidation – Reduced Disclosure Requirements*. This is because the reduced disclosure requirements in AASB 2011-2 and AASB 2011-6 relate to Australian Accounting Standards that mandatorily apply to annual reporting periods beginning on or after 1 July 2011.

The financial statements of the Company are Tier 2 general purpose financial statements which have been prepared in accordance with *Australian Accounting Standards – Reduced Disclosure Requirements* (AASB-RDRs) (including Australian Interpretations) adopted by the Australian Accounting Standards Board (AASB) and the Corporations Act 2001. The Company is a not-for-profit entity for financial reporting purposes under Australian Accounting Standards.

(ii) Basis of measurement

The financial statements, except for the cash flow information, have been prepared on an accruals basis and are based on historical costs, and do not take into account changing money values.

(iii) Functional and presentation currency

The financial statements are presented in Australian dollars, which is the Company's functional currency.

The Company is of a kind referred to in ASIC Class Order 98/100 dated 10 July 1988 and in accordance with that Class Order, all financial information presented has been rounded to the nearest dollar unless otherwise stated.

(iv) Use of estimates and judgements

The preparation of financial statements in conformity with AASBs requires management to make judgements, estimates and assumptions that affect the application of accounting policies and the reported amount of assets, liabilities, income and expenses. Actual results may differ from these estimates.

Estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimates are revised and in any future periods affected.

(v) Changes in accounting policies

The Company has not implemented any changes to its accounting policies for the year ended 30 June 2012 which would have a material impact upon the financial statements.

**(b) Financial instruments**

The Company initially recognises loans and receivables and deposits on the date that they are originated. All other financial assets are recognised initially on the trade date at which the Company becomes a party to the contractual provisions of the instrument.

The Company derecognises a financial asset when the contractual right to the cash flows from the asset expire, or it transfers the rights to receive the contractual cash flows in a transaction in which substantially all the risks and rewards of ownership of the financial asset are transferred.

Financial assets and liabilities are offset and the net amount presented in the statement of financial position when, and only when, the Company has a legal right to offset the amounts and intends either to settle on a net basis or to realise the asset and settle the liability simultaneously.

The Company has the following financial assets: held to maturity financial assets and loans and receivables.

*Held to maturity financial assets*

If the Company has the positive intent and ability to hold debt securities to maturity, then such financial assets are classified as held to maturity. Held to maturity financial assets are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition held to maturity financial assets are measured at amortised cost using the effective interest method, less any impairment losses.

*Loans and receivables*

Loans and receivables are financial assets with fixed or determinable payments that are not quoted in an active market. Such assets are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition loans and receivables are measured at amortised cost using the effective interest method, less any impairment losses. Loans and other receivables comprise trade and other receivables (see note 6).

Cash and cash equivalents comprise cash balances and call deposits with original maturities of three months or less. Bank overdrafts that are repayable on demand and form an integral part of the Company's cash management are included as a component of cash and cash equivalents for the purpose of the statement of cash flows.

**(c) Property, plant and equipment**

(i) Recognition and measurement

Items of property, plant and equipment are measured at cost less accumulated depreciation and accumulated impairment losses. Cost includes expenditure that is directly attributable to the acquisition of the asset, including borrowing costs directly attributable to the acquisition, construction or production of a qualifying asset. Cost also may include transfers from other comprehensive income of any gain or loss on qualifying cash flow hedges of foreign currency purchases of property, plant and equipment. Purchased software that is integral to the functionality of the related equipment is capitalised as part of that equipment.

When parts of an item of property, plant and equipment have different useful lives, they are accounted for as separate items (major components) of property, plant and equipment.

Gains and losses on disposal of an item of property, plant and equipment are determined by comparing the proceeds from disposal with the carrying amount of property, plant and equipment and are recognised net within other income in profit or loss.

(ii) Subsequent costs

The cost of replacing a part of an item of property, plant and equipment is recognised in the carrying amount of the item if it is probable that the future economic benefits embodied within the part will flow to the Company, and its cost can be measured reliably. The carrying amount of the replaced part is derecognised. The costs of the day to day servicing of property, plant and equipment are recognised in profit or loss as incurred.

(iii) Depreciation

Depreciation is calculated over the depreciable amount, which is the cost of an asset, or other amount substituted for cost, less its residual value.

Depreciation is recognised in profit or loss on a straight-line basis over the estimated useful lives of each part of an item of property, plant and equipment, since this most closely reflects the expected pattern of consumption of the future economic benefits embodied in the asset. Leased assets are depreciated over the shorter of the lease term and their useful lives unless it is reasonably certain that the Company will obtain ownership by the end of the lease term.

The estimated useful lives for the current and comparative periods are as follows:

| | |
|---|---|
| › buildings and improvements | 30 years |
| › plant and machinery | 3 – 10 years |
| › office furniture and IT | 3 – 10 years |
| › laboratory equipment | 3 – 10 years |

Depreciation methods, useful lives and residual values are reviewed at each financial year-end and adjusted if appropriate.

**(d) Intangible assets**

Intangible assets that are acquired by the Company and have finite useful lives are measured at cost less accumulated amortisation and accumulated impairment losses.

Amortisation is calculated over the cost of the asset, or another amount substituted for cost, less its residual value. Amortisation is recognised in profit or loss on a straight-line basis over the estimated useful lives of intangible assets from the date that they are available for use, since this most closely reflects the expected pattern of consumption of the future economic benefits embodied in the asset. Amortisation methods, useful lives and residual values are reviewed at each financial year-end and adjusted if appropriate.

**(e) Leased assets**

Leases in terms of which the Company assumes substantially all the risks and rewards of ownership are classified as finance leases. Upon initial recognition the leased asset is measured at an amount equal to the lower of its fair value and the present value of the minimum lease payments. Subsequent to initial recognition, the asset is accounted for in accordance with the accounting policy applicable to that asset.

Other leases are operating leases and the leased assets are not recognised in the Company's statement of financial position. The Company's commitments at reporting date in regards to operating leases are disclosed in note 13.

**(f) Inventories**

Inventories are measured at the lower of cost and net realisable value. The cost of inventories includes expenditure incurred in acquiring the inventories and other costs incurred in bringing them to their existing location and condition. Net realisable value is the estimated selling price in the ordinary course of business, less selling expenses.

**(g) Impairment**

(i) Financial assets (including receivables)

Financial assets are assessed at each reporting date to determine whether there is objective evidence that it is impaired. A financial asset is impaired if objective evidence indicates that a loss event has occurred after the initial recognition of the asset, and that the loss event had a negative effect on the estimated future cash flows of that asset that can be estimated reliably.

Objective evidence that financial assets are impaired can include default or delinquency by a debtor, restructuring of an amount due to the Company on terms that the Company would not consider otherwise and indications that a debtor or issuer will enter bankruptcy.

The Company considers evidence of impairment for receivables and held to maturity investments at both a specific asset and collective level. All individually significant receivables and held to maturity investments are assessed for specific impairment. All receivables and held to maturity investments found not to be specifically impaired are then collectively assessed for impairment by grouping together similar receivables and held to maturity investments with similar risk characteristics.

In assessing collective impairment the Company uses historical trends of the probability of default, timing of recoveries and the amount of loss incurred, adjusted for management's judgement as to whether current economic and credit conditions are such that the actual losses are likely to be greater or less than suggested by historical trends.

An impairment loss in respect of a financial asset measured at amortised cost is calculated as the difference between its carrying amount and the present value of the estimated future cash flows discounted at the asset's original effective interest rate. Losses are recognised in profit or loss and reflected in an allowance account against receivables. When a subsequent event causes the amount of impairment loss to decrease, the decrease in impairment loss is reversed through profit or loss.

(ii) Non-financial assets
The carrying amount of the Company's non-financial assets are reviewed at each reporting date to determine whether there is any indication of impairment. If any such indication exists, then the asset's recoverable amount is estimated.

The recoverable amount of an asset is the greater of its value in use and its fair value less costs to sell. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset.

An impairment loss is recognised if the carrying amount of an asset exceeds its estimated recoverable amount. Impairment losses are recognised in profit or loss. Impairment losses recognised in prior periods are assessed at each reporting date for any indications that the loss has decreased or no longer exists. An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount. An impairment loss is reversed only to the extent that would have been determined, net of depreciation or amortisation, if no impairment loss had been recognised.

**(h) Employee benefits**

(i) Defined contribution plans
A defined contribution plan is a post-employment benefit plan under which an entity pays fixed contributions into a separate entity and will have no legal or constructive obligation to pay further amounts. Obligations for contributions to defined contribution plans are recognised as an employee benefit expense in profit or loss in the periods during which services are rendered by employees. Prepaid contributions are recognised as an asset to the extent that a cash refund or reduction in future payments is available. Contributions to a defined contribution plan that are due more than 12 months after the end of the period in which the employees render the service are discounted to their present value.

(ii) Other long-term employee benefits
The Company's net obligation in respect of long-term employee benefits is the amount of future benefit that employees have earned in return for their service in the current and prior periods plus related on-costs. The liability is measured such that it is not materially different from the estimate determined by using the present value of the estimated future cash outflows, based on a discount rate that is the yield at the reporting date on AA credit-rated or government bonds that have maturity dates approximating the terms of the Company's obligations.

(iii) Termination benefits
Termination benefits are recognised as an expense when the Company is demonstrably committed, without realistic probability of withdrawal, to a formal detailed plan to either terminate employment before the normal retirement date, or to provide termination benefits as a result of an offer made to encourage voluntary redundancy. Termination benefits for voluntary redundancies are recognised as an expense if the Company has made an offer of voluntary redundancy, it is probable that the offer will be accepted, and the number of acceptances can be estimated reliably. If benefits are payable more than 12 months after the reporting period, then they are discounted to their present value.

(iv) Short-term benefits
Short-term employee benefit obligations are measured on an undiscounted basis and are expensed as the related service is provided.

A liability is recognised for the amount expected to be paid under short-term bonus plans if the Company has a present legal or constructive obligation to pay this amount as a result of past service provided by the employee and the obligation can be measured reliably. Such liabilities represent the best estimate of the amounts required to settle the obligation at the end of the reporting period.

**(i) Revenue**

(i) Goods sold
Revenue from the sale of goods in the course of ordinary activities is measured at the fair value of the consideration received or receivable, net of any applicable discounts or rebates. Revenue is recognised when persuasive evidence exists, usually in the form of an executed sales agreement, that the significant risks and rewards of ownership have been transferred to the buyer, recovery of the consideration is probable, the associated costs and possible return of goods can be estimated reliably, there is no continuing management involvement with the goods, and the amount of revenue can be measured reliably.

(ii) Services
Revenue from services rendered is recognised in profit or loss in proportion to the stage of completion of the transaction at the reporting date. The stage of completion is assessed by reference to an estimation of the work performed.

(iii) Grants
Grants are recognised at their fair value when there is reasonable assurance that they will be received and that the Company will comply with the conditions associated with the grant.

**(j) Finance income**

Finance income comprises interest income on funds invested. Interest income is recognised as it accrues in profit or loss using the effective interest rate method.

Finance costs comprise interest expense on borrowings and impairment losses recognised on financial assets other than trade receivables. Borrowing costs that are not directly attributable to the acquisition, construction or production of a qualifying asset are recognised in profit or loss using the effective interest rate method.

**(k) Lease payments**

Payments made under operating leases are recognised in profit or loss on a straight-line basis over the term of the lease. Lease incentives are recognised as an integral part of the total lease expense, over the term of the lease.

Minimum lease payments made under finance leases are apportioned between the finance expense and the reduction of the outstanding liability. The finance expense is allocated to each period during the lease term so as to produce a constant periodic rate of interest on the remaining balance of the liability.

Contingent lease payments are accounted for by revising the minimum lease payments over the remaining term of the lease when the lease adjustment is confirmed.

*Determining whether an arrangement contains a lease*

At inception of an arrangement, the Company determines whether such an arrangement is or contains a lease. A specific asset is the subject of a lease if fulfilment of the arrangement is dependent upon the use of that specified asset. An arrangement conveys the right to use the asset if the arrangement conveys to the Company the right to control the use of the underlying asset. At inception or upon reassessment of the arrangement, the Company separates payments and other consideration required by such an arrangement into those for the lease and those for other elements on the basis of their relative fair values. If the Company concludes for a finance lease that it is impracticable to separate the payments reliably, an asset and a liability are recognised at an amount equal to the fair value of the underlying asset. Subsequently the liability is reduced as payments are made and an imputed finance charge on the liability is recognised using the Company's incremental borrowing rate.

**(l) Goods and services tax**

Revenue, expenses and assets are recognised net of the amount of goods and services tax (GST), except where the amount of GST incurred is not recoverable from the taxation authority. In these circumstances, the GST is recognised as part of the cost of acquisition of the asset or as part of the expense.

Receivables and payables are stated with the amount of GST included. The net amount of GST recoverable from, or payable to, the ATO is included as a current asset or current liability in the statement of financial position.

Cash flows are included in the statement of cash flows on a gross basis. The GST components of the cash flows arising from investing and financing activities which are recoverable from, or payable to, the ATO are classified as operating cash flows.

## 2 Other income

| | 2012 | 2011 |
|---|---|---|
| Net gain / (loss) on sale of property, plant and equipment | 12,032 | 189 |
| Forgiveness of liabilities | – | 67,077 |
| | 12,032 | 67,266 |

## 3 Personnel expenses

| | 2012 | 2011 |
|---|---|---|
| Wages and salaries | 8,131,380 | 8,057,111 |
| Other associated personnel expenses | 779,988 | 1,069,288 |
| Contributions to defined contribution plans | 725,551 | 713,351 |
| | 9,636,919 | 9,839,750 |

## 4 Cash and cash equivalents

| | 2012 | 2011 |
|---|---|---|
| Cash on hand | 500 | 500 |
| Bank deposits at-call | 4,435,591 | 4,591,718 |
| Cash and cash equivalents in the statement of cash flows | 4,436,091 | 4,592,218 |

## 5 Other investments

| | 2012 | 2011 |
|---|---|---|
| Held-to-maturity investments | 6,500,000 | 5,000,000 |
| | 6,500,000 | 5,000,000 |

Held-to-maturity investments consist of term deposits with interest rates between 5.20 and 6.11 per cent (2011: between 6.00 and 6.26 per cent) and mature within seven months of balance date.

## 6 Trade and other receivables

| | 2012 | 2011 |
|---|---|---|
| Trade receivables due from those other than related parties | 573,399 | 409,658 |
| Trade receivables due from related parties | 53,930 | 8,977 |
| Other receivables | 518,643 | 329,342 |
| | 1,145,972 | 747,977 |

Trade receivables are shown net of impairment losses amounting to $12,925 (2011: $6,463) at reporting date. This allowance account is used to record impairment losses until the Company is satisfied that no recovery of the amount owing is possible; at that point the amounts are considered irrecoverable and are written off against the financial asset directly.

The movement in the allowance for impairment in respect of trade receivables during the year was as follows:

| | 2012 | 2011 |
|---|---|---|
| Balance at 1 July | 6,463 | – |
| Impairment loss recognised | 6,462 | 6,463 |
| Balance at 30 June | 12,925 | 6,463 |

## 7 Inventories

| | 2012 | 2011 |
|---|---|---|
| Course materials on hand – wine | 46,328 | 31,855 |
| Course materials in transit – wine | 5,233 | – |
| | 51,561 | 31,855 |

## 8 Property, plant and equipment

| | Plant and machinery | Office furniture and IT | Laboratory equipment | Total |
|---|---|---|---|---|
| **Cost** | | | | |
| Balance at 1 July 2011 | 368,376 | 1,048,698 | 7,179,496 | 8,596,570 |
| Additions | 16,766 | 175,820 | 937,853 | 1,130,439 |
| Transfers | – | 17,526 | (17,526) | – |
| Disposals | (38,828) | (74,165) | (127,472) | (240,465) |
| Balance at 30 June 2012 | 346,314 | 1,167,879 | 7,972,351 | 9,486,544 |
| **Depreciation and impairment losses** | | | | |
| Balance at 1 July 2011 | 178,572 | 684,442 | 5,221,495 | 6,084,509 |
| Depreciation charge for the year | 57,581 | 149,154 | 740,028 | 946,763 |
| Disposals | (30,978) | (74,165) | (123,232) | (228,375) |
| Balance at 30 June 2012 | 205,175 | 759,431 | 5,838,291 | 6,802,897 |
| **Carrying amounts** | | | | |
| at 1 July 2011 | 189,804 | 364,256 | 1,958,001 | 2,512,061 |
| at 30 June 2012 | 141,139 | 408,448 | 2,134,060 | 2,683,647 |

## 9 Interest in WIC building

The Company has a 50 year nominal occupancy right to approximately 53% of the space in the Wine Innovation Cluster (WIC) Central building owned by the University of Adelaide. The other occupants are the University of Adelaide and the South Australian Research and Development Institute (SARDI). The term of occupancy is reviewable after 30 years based on the remaining economic life of the building. The value assigned to AWRI's interest in the building is net of amounts contributed by the Grape and Wine Research and Development Corporation (GWRDC).

The building cost will be amortised over a period of 30 years from the date of practical completion (26th November 2008).

| | |
|---|---|
| **Cost** | |
| Balance at 1 July 2011 | 6,100,140 |
| Balance at 30 June 2012 | 6,100,140 |
| **Amortisation and impairment losses** | |
| Balance at 1 July 2011 | 527,499 |
| Amortisation charge for the year | 203,338 |
| Balance at 30 June 2012 | 730,837 |
| **Carrying amounts** | |
| at 1 July 2011 | 5,572,641 |
| at 30 June 2012 | 5,369,303 |

## 10 Trade and other payables

| | 2012 | 2011 |
|---|---|---|
| **Current** | | |
| Trade payables due to those other than related parties | 632,270 | 452,259 |
| Trade payables due to related parties | – | 35 |
| Income received in advance | 2,852,610 | 2,035,301 |
| PAYG and GST | 381,060 | 506,776 |
| Non-trade payables and accrued expenses | 1,085,295 | 1,197,885 |
| | 4,951,235 | 4,192,256 |
| **Non current** | | |
| Other payables and accrued expenses | 81,001 | 61,001 |
| | 81,001 | 61,001 |

## 11 Project funds not expended

Any unexpended GWRDC funding other than core equipment funding is reimbursable to the GWRDC, except where the Joint Agreement Committee agrees that amounts can be retained by AWRI for purposes approved by the Joint Agreement Committee.

The unspent investment agreement funds for the current year totalled $299,204 (2011: $278,857). The unspent funds from other GWRDC contracts for the current year totalled $4,466 (2011: $5,740).

During the year the Joint Agreement Committee approved the retention by the Company of unspent prior years' funds totalling $315,672 for the purpose of specific capital purchases. During the year unspent prior years' funds totalling $5,740 relating to other GWRDC contracts were utilised in the course of those projects' current year activities, in accordance with the applicable project agreements.

| | 2012 | 2011 |
|---|---|---|
| GWRDC current year's investment agreement funding unexpended | 299,204 | 278,857 |
| GWRDC current year's other contract funding unexpended | 4,466 | 5,740 |
| GWRDC prior years' funding unexpended | – | 36,815 |
| | 303,670 | 321,412 |

## 12 Provisions

| | 2012 | 2011 |
|---|---|---|
| **Current** | | |
| Employee entitlements | 1,474,565 | 1,584,019 |
| **Non current** | | |
| Employee entitlements | 328,976 | 285,599 |
| Number of Employees (FTEs) | 100.7 | 99.8 |

## 13 Operating leases

**Leases as lessee**

Non-cancellable operating lease rentals are payable as follows:

| | 2012 | 2011 |
|---|---|---|
| Within one year | 20,532 | – |
| One year or later and no later than five years | 39,212 | – |
| Later than five years | – | – |
| | 59,744 | – |

During the year the Company entered into leases for a number of vehicles and an item of office equipment under operating lease agreements. These leases run for a period of up to five years with no option to renew or purchase at completion of this term.

During the year ended 30 June 2012 an amount of $8,716 was recognised as an expense in respect of operating leases (2011: nil).

## 14 Capital commitments

| | 2012 | 2011 |
|---|---|---|
| **Plant and equipment** | | |
| *Contracted but not provided for and payable* | | |
| Within one year | 179,861 | – |
| One year or later and no later than five years | – | – |
| Later than five years | – | – |
| | 179,861 | – |

## 15 Related parties

**Key management personnel compensation**

Key management personnel comprises the directors of the company and other persons having authority and responsibility for planning, directing and controlling the activities of the Company. Key management personnel compensation comprised:

| | 2012 | 2011 |
|---|---|---|
| Total remuneration | 1,862,578 | 1,755,613 |

**Key management personnel and director transactions**

A number of key management personnel, or their related parties, hold positions in other entities that result in them having control or significant influence over the financial or operating policies of these entities.

A number of these entities transacted with the Company in the reporting period. The terms and conditions of the transactions with key management personnel and their related parties were no more favourable than those available, or which might reasonably be expected to be available, on similar transactions to non-key management personnel related entities on an arm's length basis.

Related parties arising through relationships with key management personnel:
Angove's Pty Ltd
Arrivo Wine
Dawson and James
Lerida Estate
O'Connor Harvesting
Peter Dawson Consulting
Vitibit Pty Ltd

**Other related party transactions**

During the year the Company purchased services from and provided services to a jointly controlled entity, The Australian Wine Industry Technical Conference Incorporated. The jointly controlled entity provided services encompassing conference and workshop activities to the Company, and the Company provided administrative services to the jointly controlled entity.

**Other related parties:**

The Australian Wine Industry Technical Conference Incorporated

**Transactions with related parties**

| | Transactions value for the year ended 30 June | | Balance outstanding as at 30 June | |
|---|---|---|---|---|
| | 2012 | 2011 | 2012 | 2011 |
| Services received from related parties | 10,719 | 6,176 | – | 35 |
| Services provided to related parties | 119,984 | 201,907 | 53,930 | 8,977 |

## 16 Contingencies

In the opinion of the Directors, there were no material or significant contingent liabilities at 30 June 2012 (2011: none).

## 17 Subsequent events

There has not arisen in the interval between the end of the financial year and the date of this report any item, transaction or event of a material and unusual nature likely to significantly affect the operations of the Company, the results of those operations, or the state of affairs of the Company, in subsequent financial years.

## 18 Limited liability

In accordance with the Company's constitution, each member (both during the time he or she is a member and within one year afterwards) is liable to contribute $2 in the event that the Company is wound up. The total amount members would contribute is $26 (2011: $20).

## Directors' declaration

In the opinion of the directors of The Australian Wine Research Institute Limited (the Company):

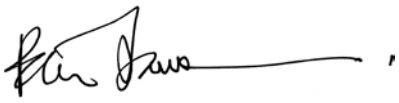
(a) the accompanying financial statement and notes that are contained on pages 56 to 63 are in accordance with the Corporations Act 2001, including:

(i) giving a true and fair view of the Company's financial position as at 30 June 2012 and of its performance for the financial year ended on that date; and

(ii) complying with Australian Accounting Standards – Reduced Disclosure Requirements and the Corporations Regulations 2001; and

(b) there are reasonable grounds to believe that the Company will be able to pay its debts as and when they become due and payable.

Signed in accordance with a resolution of the directors of The Australian Wine Research Institute Limited.



**Peter J. Dawson**
Chair

**Daniel L. Johnson**
Managing Director

Dated at Urrbrae on this the 18th day of September 2012.

## Independent auditor's report to the members of The Australian Wine Research Institute limited

Report on the Financial Report

We have audited the accompanying financial report of The Australian Wine Research Institute Limited, which comprises the statement of financial position as at 30 June 2012, the statement of comprehensive income, statement of changes in equity and statement of cash flows for the year then ended, notes comprising a summary of significant accounting policies and other explanatory information, and the directors' declaration.

*Directors' Responsibility for the Financial Report*

The directors of the company are responsible for the preparation of the financial report that gives a true and fair view in accordance with Australian Accounting Standards – Reduced Disclosure Requirements and the *Corporations Act 2001* and for such internal controls as the directors determine are necessary to enable the preparation of the financial report that is free from material misstatement, whether due to fraud or error.

*Auditor's Responsibility*

Our responsibility is to express an opinion on the financial report based on our audit. We conducted our audit in accordance with Australian Auditing Standards. Those standards require that we comply with relevant ethical requirements relating to audit engagements and plan and perform the audit to obtain reasonable assurance about whether the financial report is free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial report. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial report, whether due to fraud or error. In making those risk assessments, the auditor considers internal controls relevant to the entity's preparation of the financial report that gives a true and fair view in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal controls. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by the directors, as well as evaluating the overall presentation of the financial report.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

*Independence*

In conducting our audit, we have complied with the independence requirements of the *Corporations Act 2001.*

*Opinion*

In our opinion the financial report of The Australian Wine Research Institute Limited is in accordance with the *Corporations Act 2001,* including:

(i) giving a true and fair view of the company's financial position as at 30 June 2012 and of its performance for the year ended on that date; and

(ii) complying with Australian Accounting Standards – Reduced Disclosure Requirements and the *Corporations Regulations 2001.*

PKF
Chartered Accountants

Ian J. Painter
Partner

Dated this 18th day of September 2012

# Memorial funds

Consisting of (and collectively the "Trusts"):

The John Fornachon Memorial Library Endowment Fund

The Thomas Walter Hardy Memorial Trust Fund

The H.R. Haselgrove Memorial Trust Fund

The Stephen Hickinbotham Memorial Research Trust

## Statement by directors of the trustee company

The Australian Wine Research Institute Limited (the "Trustee") acts as unrewarded trustee for the above listed Trusts. As detailed in note 2 to these financial statements, the Trusts are not reporting entities because, in the Trustee's opinion, it is unlikely that users exist who are unable to command the preparation of reports tailored so as to satisfy, specifically, all of their information needs. This is a special purpose financial report that has been prepared to meet the reporting obligations of the Trustee.

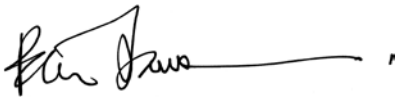
In the opinion of the directors of The Australian Wine Research Institute Limited (the Trustee):

(a) (i) the Statements of comprehensive income give a true and fair view of each Trust's surplus for the year ended 30 June 2012; and

(ii) the Statements of financial position give a true and fair view of each Trust's state of affairs as at 30 June 2012.

(b) at the date of this statement, there are reasonable grounds to believe that the Trusts will be able to pay their debts as and when they fall due.

This statement is made in accordance with a resolution of the directors of the trustee company and is signed for and on behalf of the directors by:



**Peter J. Dawson**
Chair

Dated at Urrbrae on this the 18th day of September 2012.

## Notes to the financial statements

**1. Nature and purpose of the Trusts**

(a) The John Fornachon Memorial Library Endowment Fund was established on 30 September 1970, to provide for the establishment and maintenance of the Fornachon Memorial Library, for the promotion of study and general knowledge of the wine industry. The Fund was established by way of public appeal on a memorial to the late John Charles Macleod Fornachon, the Director of Research of The Australian Wine Research Institute Limited from 1955 to 1968.

(b) The Thomas Walter Hardy Memorial Trust Fund was established on 29 June 1993 to assist in the communication of information within the wine industry and associated activities, allied to the wine industry on behalf of the Trust. The Trust was established in memory of the late Thomas Walter Hardy.

(c) The H.R. Haselgrove Memorial Trust Fund was established on 12 December 1979 to provide for the promotion and encouragement of wine research by, or under the direction of, The Australian Wine Research Institute Limited as a memorial to the late Harry Ronald Haselgrove.

(d) The Stephen Hickinbotham Memorial Research Trust was established on 7 October 1986 to provide financial assistance and support in the pursuit of scientific research and associated activities, allied to the wine industry. The Trust was established in memory of the late Stephen John Hickinbotham. The Australian Wine Research Institute Limited assumed responsibility for the Trust on 25 May 1992.

**2. Statement of accounting policies**

In the opinion of the Trustee, the Trusts are of a type identified in Statement of Accounting Concepts 1 as non-reporting entities. Accordingly, the financial statements constitute 'special purpose financial reports' which have been prepared solely to meet the reporting obligations of the Trustee, and the limited information needs of the Trusts' members.

The financial statements have been prepared in accordance with accounting standards, except as stated below, and other mandatory professional reporting requirements.

The following accounting standards have not been adopted because, in the opinion of the Trustee, the cost of compliance outweighs the benefit of the resultant information:

» AASB 7 Financial Instruments: Disclosures

» AASB 107 Statement of Cash Flows

» AASB 124 Related Party Disclosures

» AASB 132 Financial Instruments: Presentation

The financial statements have been prepared on an accrual basis.

Accounting policies have been consistently applied, with the only significant policy being in relation to investments.

Investments comprise money on deposit, and are recorded at their nominal value. Interest is brought to account as earned, with accrued interest at balance date being included in the Statement of financial position as receivables.

| STATEMENTS OF COMPREHENSIVE INCOME | The John Fornachon Memorial Library Endowment Fund | | The Thomas Walter Hardy Memorial Trust Fund | | The H.R. Haselgrove Memorial Trust Fund | | The Stephen Hickinbotham Memorial Research Trust | |
|---|---|---|---|---|---|---|---|---|
| **For the year ended 30 June 2012** | **2012** | **2011** | **2012** | **2011** | **2012** | **2011** | **2012** | **2011** |
| **Income** | | | | | | | | |
| Interest | 4,920 | 4,741 | 4,054 | 3,894 | 3,218 | 3,321 | 4,364 | 4,236 |
| Donations and other income | 347 | – | – | – | – | – | – | – |
| Total income | 5,267 | 4,741 | 4,054 | 3,894 | 3,218 | 3,321 | 4,364 | 4,236 |
| **Expenses** | | | | | | | | |
| Advertising | – | – | – | – | – | – | – | – |
| Audit fees | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Bank charges | – | – | – | – | – | – | – | – |
| *Technical Review* contributions | – | – | – | – | – | – | – | – |
| Sponsorship | – | – | – | 10,000 | – | – | – | 5,000 |
| Total expenses | 550 | 550 | 550 | 10,550 | 550 | 550 | 550 | 5,550 |
| **Profit / (loss) from ordinary activities** | 4,717 | 4,191 | 3,504 | (6,656) | 2,668 | 2,771 | 3,814 | (1,314) |
| Other comprehensive income | – | – | – | – | – | – | – | – |
| **Total comprehensive income for the period** | **4,717** | **4,191** | **3,504** | **(6,656)** | **2,668** | **2,771** | **3,814** | **(1,314)** |

**STATEMENTS OF FINANCIAL POSITION**

| **As at 30 June 2012** | **2012** | **2011** | **2012** | **2011** | **2012** | **2011** | **2012** | **2011** |
|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | |
| Cash at bank | – | 2 | – | 1,010 | – | – | – | 500 |
| Investments | 121,298 | 115,171 | 100,259 | 94,493 | 79,216 | 75,679 | 107,637 | 102,013 |
| Receivables | 363 | 1,221 | 300 | 1,002 | 237 | 556 | 322 | 1,082 |
| **Total current assets** | 121,661 | 116,394 | 100,559 | 96,505 | 79,453 | 76,235 | 107,959 | 103,595 |
| Investments | – | – | – | – | – | – | – | – |
| **Total non-current assets** | – | – | – | – | – | – | – | – |
| **Total assets** | 121,661 | 116,394 | 100,559 | 96,505 | 79,453 | 76,235 | 107,959 | 103,595 |
| **Liabilities** | | | | | | | | |
| Sundry creditors | 1,100 | 550 | 1,100 | 550 | 1,100 | 550 | 1,100 | 550 |
| **Total current liabilities** | 1,100 | 550 | 1,100 | 550 | 1,100 | 550 | 1,100 | 550 |
| **Net assets** | 120,561 | 115,844 | 99,459 | 95,955 | 78,353 | 75,685 | 106,859 | 103,045 |
| **Trust funds** | | | | | | | | |
| Settled sum | 12,785 | 12,785 | 50 | 50 | 20,000 | 20,000 | 50 | 50 |
| Founders donation | – | – | 25,000 | 25,000 | – | – | – | – |
| | 12,785 | 12,785 | 25,050 | 25,050 | 20,000 | 20,000 | 50 | 50 |
| **Accumulated surplus** | | | | | | | | |
| Opening balance | 103,059 | 98,868 | 70,905 | 77,561 | 55,685 | 52,914 | 102,995 | 104,309 |
| Surplus for the year | 4,717 | 4,191 | 3,504 | (6,656) | 2,668 | 2,771 | 3,814 | (1,314) |
| Closing balance | 107,776 | 103,059 | 74,409 | 70,905 | 58,353 | 55,685 | 106,809 | 102,995 |
| **Total trust funds** | **120,561** | **115,844** | **99,459** | **95,955** | **78,353** | **75,685** | **106,859** | **103,045** |

## Independent auditor's report to the trustee of:

THE JOHN FORNACHON MEMORIAL LIBRARY ENDOWMENT FUND

THE THOMAS WALTER HARDY MEMORIAL TRUST FUND

THE H. R. HASSELGROVE MEMORIAL TRUST FUND

THE STEPHEN HICKINBOTHAM RESEARCH MEMORIAL TRUST

**Report on the Financial Reports**

We have audited the accompanying financial reports, being special purpose financial reports of The John Fornachon Memorial Library Endowment Fund, The Thomas Walter Hardy Memorial Trust Fund, The H.R. Hasselgrove Memorial Trust Fund and The Stephen Hickinbotham Research Memorial Trust, which comprise the statements of financial position as at 30 June 2012 and the statements of comprehensive income, notes comprising a summary of significant accounting policies and other explanatory information, and the statement by directors of the trustee company.

*Trustee's Responsibility for the Financial Report*

The directors of the trustee company are responsible for the preparation of the financial reports and have determined that the basis of preparation described in Note 2 to the financial report is appropriate to meet the requirements of the trustee company.

The directors of the trustee company's responsibility also includes such internal controls as the directors determine is necessary to enable the preparation of financial reports that are free from material misstatement, whether due to fraud or error.

*Auditor's Responsibility*

Our responsibility is to express an opinion on the financial reports based on our audits. We have conducted our audits in accordance with Australian Auditing Standards. Those standards require that we comply with relevant ethical requirements relating to audit engagements and plan and perform the audits to obtain reasonable assurance whether the financial reports are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial reports. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial reports, whether due to fraud or error. In making those risk assessments, the auditor considers internal controls relevant to the funds' preparation and fair presentation of financial reports in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the funds' internal controls. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by the directors of the trustee company, as well as evaluating the overall presentation of the financial reports.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

*Opinion*

In our opinion the financial reports of The John Fornachon Memorial Library Endowment Fund, The Thomas Walter Hardy Memorial Trust Fund, The H.R. Hasselgrove Memorial Trust Fund and The Stephen Hickinbotham Research Memorial Trust:

(i) present fairly the memorial funds' financial positions as at 30 June 2012 and their performance for the year ended on that date; and

(ii) comply with Australian Accounting Standards to the extent described in Note 2.

**Basis of Accounting**

Without modifying our opinion, we draw attention to Note 2 to the financial report, which describes the basis of accounting. The financial report has been prepared for the purpose of fulfilling the directors' of the company's financial reporting responsibilities for the memorial funds. As a result, the financial report may not be suitable for another purpose.

PKF
Chartered Accountants

Ian J. Painter
Partner

Signed in Adelaide on 18th September 2012

# Appendix 1 – External presentations and talks

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| P.C. Osidacz | Consumer testing: what do consumers want? | Amateur Winemakers and Brewers Club, Adelaide, SA | 5 Jul 2011 |
| M. Marangon, E.J. Waters | Recent advances on the study of protein instability in white wines | 7th Symposium In Vino Analytica Scientia, Graz, Austria | 21 Jul 2011 |
| R.A. Muhlack | AWRI Riverina Node Report | Riverina Winemakers Association AGM, Griffith, NSW | 3 Aug 2011 |
| C.S. Stockley | Wine in our society | Premium Wine Brands, Barossa Valley, SA | 4 Aug 2011 |
| G.D. Cowey | Sensory evaluation. Wine aromas, flavours, faults and taints and Australian Wine Show judging | | |
| M.J. Herderich | The AWRI and Australian wine industry | Zhejiang Academy of Agricultural Science, Hangzhou, Zhejiang, PR China | |
| P.W. Godden | What Style of PinotG are you? Helping consumers understand the styles of wine made from Pinot Grigio and Pinot Gris | Zilzie Wines, Karadoc, Vic | 9 Aug 2011 |
| I.L. Francis | Leather, lime and lychee: the chemistry of wine flavour | AusBiotech meeting, AWRI, Glen Osmond, SA | 10 Aug 2011 |
| I.S. Pretorius | The art of wine and the science of yeast a magic blend | The University of Sydney, Sydney, NSW | 16 Sep 2011 |
| G.D. Cowey | Heat stability | AWRI Packaging Workshop, Century Inn, Traralgon, Gippsland, Vic | 17 Aug 2011 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| M. Essling | Knowing your chemicals | Presented via Webinar at the AWRI, Glen Osmond, SA | 19 Aug 2011 |
| G.D. Cowey | Heat stability | AWRI Packaging Workshop, Vintara Winery, Rutherglen, Vic | |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| P.A. Henschke, M. Ugliano, C. Varela, S. Schmidt, I.L. Francis, S.-J. Bell, R. Kolouchova | Did you know that DAP can strongly affect the flavour profile and style of wine? | AWRI Roadshow, Vintara Winery, Rutherglen, Vic | 23 Aug 2011 |
| I.L. Francis | Protein haze in white wines: new solutions to an old problem | | |
| V.J. O'Brien | Winery cost reduction strategies | | |
| C.A. Simos | What options do you have in cold stabilising your wines? | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| R.A. Muhlack | Doing more with less: sustainable process solutions for profitability | AWRI Roadshow, Vintara Winery, Rutherglen, Vic | 23 Aug 2011 |
| V.J. O'Brien | How to significantly reduce your carbon footprint without spending any money | | |
| M. Essling | It's getting hotter – what does this mean for our vineyard management strategies? | | |
| E.N. Wilkes | Which new AWRI technologies can add value to your business? | | |
| C.A. Simos | Features of the AWRI website | | |
| C.A. Simos | What options do you have in cold stabilising your wines? | AWRI Roadshow, Bendigo Regional Institute of TAFE, Bendigo, Vic | 24 Aug 2011 |
| P.J. Costello, P.A. Henschke, E.J. Bartowsky | Using the timing of MLF inoculation to optimise your winemaking | | |
| C. Varela, D. Kutyna, A.D. Coulter, K.A. Bindon, R. Gawel, C.S. Stockley, R.A. Muhlack, P.R. Dry, I.L. Francis, M.J. Herderich, I.S. Pretorius, P.A. Henschke, P.J. Chambers | Strategies for reducing alcohol levels in wine | | |
| R.A. Muhlack | Doing more with less: sustainable process solutions for profitability | | |
| E.N. Wilkes | Which new AWRI technologies can add value to your business? | | |
| I.L. Francis | What sensory properties of red wine drive consumer preferences? | | |
| I.L. Francis | The origin of eucalyptol and minty flavour in red wines | | |
| V.J. O'Brien | Winery cost reduction strategies | | |
| M. Essling | Why do we need new varieties for the future? | | |
| C.A. Simos | Features of the AWRI website | | |
| M.L. Longbottom | Climate in the Limestone Coast and emerging varieties | GWRDC Climate change workshop, Penola Sports Club, Penola, SA | 25 Aug 2011 |
| M.J. Herderich | Metabolomics and the quest for understanding quality in flavor chemistry and wine science | Recent Advances in Analysis of Food and Flavors, National Meeting of the American Chemical Society, Denver, USA | 28 Aug 2011 |
| P.J. Chambers | Systems Biology: a new paradigm for wine yeast strain development | 2011 Winter School in Mathematical and Computational Biology, The University of Queensland, Qld | 29 Aug 2011 |
| G.D. Cowey | Heat stability | Packaging Workshop, Stanthorpe, Qld | 30 Aug 2011 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post bottling transport | | |
| P.W. Godden | Which new AWRI technologies can add value to your business? | AWRI Roadshow, McLaren Vale and Fleurieu Visitor Centre, McLaren Vale, SA | 31 Aug 2011 |
| M.L. Longbottom | Why do we need new varieties for the future? | | |
| K.A. Bindon | Viticultural management of grape and wine phenolics | | |
| E.N. Wilkes | Energy for the future: moving towards onsite renewable biomass and solar technology | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| E.J. Bartowsky | Using MLF to accentuate wine aroma and flavour | AWRI Roadshow, McLaren Vale and Fleurieu Visitor Centre, McLaren Vale, SA | 31 Aug 2011 |
| C.A. Varela | Wild ferments – what are the alternatives? | | |
| P.C. Osidacz | What sensory properties of red wine drive consumer preferences? | | |
| K.A. Bindon | Tannin from grape to wine: new insights on a complex system | | |
| C.A. Simos | Features of the AWRI website | | |
| M. Essling, P.R. Dry | Knowing your chemicals | Mildura Vine Spring Health Field Day, Mildura, Vic | |
| M.L. Longbottom | Viticulture at the AWRI | St Hallett grapegrowers, Barossa Valley, SA | 2 Sep 2011 |
| P.R. Dry | Management strategies to reduce bunch temperature in Australian vineyards | 17th GiESCO symposium, Asti/Alba, Italy | 2 Sept 2011 |
| E.N. Wilkes | Preliminary results Wynns Cabernet clonal trial | Treasury Wines, winemakers and viticulturists, Wynns, Coonawarra, SA | 19 Sep 2011 |
| M. Essling, P.R. Dry | MRL issues in key export markets | 8th Australian Table Grapes Conference, Grand Hotel, Mildura, Vic | 23 Sep 2011 |
| P.C. Osidacz | What sensory properties of red wines drive consumer preferences? | AWRI Webinar | 27 Sep 2011 |
| K.A. Bindon, C.A. Varela, H. Holt, P.C. Osidacz, I.L. Francis, J.A. Kennedy, M.J. Herderich | A multi-disciplinary approach to determine relationships between grape maturity, wine chemistry and wine sensory properties | Crush 2011 The Grape and Wine Science Symposium, Adelaide, SA | 28 Sep 2011 |
| W.U. Cynkar | Simultaneous measurements of compositional parameters in grape juice and grape homogenate using mid-infrared spectroscopy | Crush 2011 The Grape and Wine Science Symposium, Adelaide, SA | 29 Sep 2011 |
| P.W. Godden | Development of the PinotG Style Spectrum –a tool which objectively measures and communicates wine style to consumers | | |
| R.A. Muhlack | Engineering cost reductions through predictive simulation of wine fermentation | | |
| R.G. Dambergs | Maximising red wine quality with the vinification process – a case study with Pinot Noir | | |
| P.C. Osidacz, I.L. Francis, B.R. Bramley, M. Stevens[7] | The effect of short-term exposure and education on the stability of red wine consumer preferences | | |
| H. Holt, J.A. Kennedy, P.J. Chambers, C.D. Curtin | The influences of yeast strain on Shiraz wine quality indicators | | |
| Y. Hayasaka, G.A. Baldock, M. Parker, P.C. Osidacz, K.H. Pardon, C.A. Black, D.W. Jeffery, A.D. Coulter, C.A. Simos, I.L. Francis, M.J. Herderich | When the smoke clears, will it end up in the bottle? | | |
| M. Parker, P.C. Osidacz, G.A. Baldock, Y. Hayasaka, C.A. Black, K.H. Pardon, D.W. Jeffery, J.S. Geue, C. Mayr, M.J Herderich, I.L Francis | Understanding the chemical basis of bushfire smoke flavour in affected wines | | |
| J.M. McRae, S. Kassara, P.A. Smith | Understanding tannin structures and red wine astringency | | |
| J.M. McRae, P.A. Smith | Impact of tannin structure on protein interactions and implications for wine astringency | | |
| K.A. Bindon, J.A. Kennedy, A. Bacic[1] | Grape cell wall-tannin interactions are modified by grape ripening | | |
| R. Gawel, A. Schulkin, M.P. Day, E.J. Waters[2], P.A. Smith | The role of phenolic composition, pH, polysaccharides and alcohol level on the in-mouth texture of white wine | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| E.J. Bartowsky, A.R. Borneman, P.J. Costello, C. Abrahamse, C. Ting | Unravelling the mysteries of malolactic fermentation: from microbiology to frontier technology | Crush 2011 The Grape and Wine Science Symposium, Adelaide, SA | 30 Sept 2011 |
| A.G. Cordente | Development of wine yeast strains with enhanced aroma and flavour profiles | | |
| C.A. Varela, S.A. Schmidt, A.R. Borneman, P.J. Chambers and Australian Wine Yeast Systems Biology Consortium | Systems Biology: a new approach to industrial yeast strain development | | |
| P.A. Henschke C.A. Varela, M. Ugliano, D. Torrea, T.E. Siebert, R. Kolouchova, G. Winter, B. Travis, B.R. Bramley, S.A. Schmidt, C.D. Curtin, S.-J. Bell, I.L. Francis | Inorganic nitrogen (DAP): a double-edged winemaking sword | | |
| C.D. Curtin, A.R. Borneman, P.A. Henschke, P.W. Godden, P.J. Chambers, I.S. Pretorius | *Brettanomyces* in Australian wine: genome sequencing of AWRI 1499 | | |
| C.D. Curtin, G. Winter, P. Higgins[11], P.A. Henschke, M. Ugliano | From smelly wine to Alzheimer's: formation of $H_2S$ from organic sulfur sources | | |
| S.A. Schmidt, S. Dillon[10], R. Kolouchova, P.A. Henschke, P.J. Chambers | Impacts of variations in elemental nutrient concentration of Chardonnay musts on *Saccharomyces cerevisiae* fermentation kinetics and wine composition | | |
| D.L. Capone, M.A. Sefton[3], D.W. Jeffery[3] | Studies on 3-mercaptohexan-1-ol and its conjugates in Sauvignon Blanc juice and wine | | |
| T.E. Siebert, G.A. Logan[4], M.R. Solomon | Spicing up Shiraz: viticultural and winemaking influences on the peppery aroma compound, rotundone | | |
| C.A. Varela, D. Kutyna, P.A. Henschke, P.J. Chambers | Generating wine yeasts for the production of low alcohol wines | | |
| S.-J. Bell, P.A. Henschke, T.E. Siebert, M.R. Solomon, D.L. Capone, B.R. Bramley, B. Travis, I.L. Francis. | The effect of vineyard nitrogen addition on Shiraz wine sensory properties and chemical composition | | |
| M.D. Mercurio, C.D. Curtin, P. Mercurio, N.S. Watson-Haigh, W. Hines, J. Hack | Evaluating the impact of wine fermentation practices on volatile aroma compounds through targeted metabolite analyses and non-targeted metabolomic analyses | | |
| A.R. Borneman | Characterisation of intra-specific genome diversity in industrial yeasts by whole-genome next-generation sequencing | | |
| R.G. Dambergs | Maximising red wine quality with the vinification process – a case study with Pinot Noir | | |
| P.W. Godden | Development of the PinotG Style Spectrum – a tool which objectively measures and communicates wine style to consumers | | |
| M. Marangon, T. Doco[5], P. Williams[5], P.A. Smith , E.J. Waters[2], A. Vernhet[5] | Factors involved in the thermal aggregation of grape pathogenesis-related proteins | | |
| K.K. Forsyth | Electrodialysis: adding a spark to sustainability | | |
| V.J. O'Brien | Sustainable winery operations | | |
| M. Essling | Know your chemicals | AWRI Webinar | 4 Oct 2011 |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| E.N. Wilkes | Which new AWRI technologies can add value to your business? | AWRI Roadshow, The Valleys Lifestyle Centre, Upstairs Sports Club, Clare Valley, SA | 5 Oct 2011 |
| P.A. Henschke | Did you know that DAP can strongly affect the flavour profile and style of wine? | | |
| P.J. Costello | Using the timing of MLF inoculation to optimise your winemaking | | |
| E.N. Wilkes | Practical management of *Brett* in the winery | | |
| M.L. Longbottom | Why do we need new varieties for the future? | | |
| C.A. Simos | Winemaking management strategies for *Botrytis* and Powdery Mildew | | |
| K.A. Bindon | Grape ripeness and wine composition (Cabernet Sauvignon) | | |
| C.A. Simos | What options to you have for cold stabilisation of your wines? | | |
| C.A. Simos | Features of the AWRI website | | |
| V.J. O'Brien | Winery cost reduction strategies | AWRI Webinar | 11 Oct 2011 |
| P.W. Godden | The Pinot G Style Spectrum presentation and tasting | Brown Brothers Wines, Kew, Vic | 12 Oct 2011 |
| P.W. Godden | The Pinot G Style Spectrum presentation and tasting | Zilzie Wines, South Yarra, Vic | |
| C.S. Stockley | An investigation into the effects of a red wine containing a high versus a low concentration of resveratrol on biomarkers for colorectal cancer- preliminary results | 5th International Conference on Polyphenols and Health, Sitges, Spain | 16 Oct 2011 |
| I.S. Pretorius | Wine yeast: Searching for novel answers in As, Cs, Gs and Ts | AusBiotech 2011, Adelaide, SA | 18 Oct 2011 |
| P.C. Osidacz | Consumers, sensory science, and the influence of human genetics on sensory perception of wine: why we like what we like | | |
| M.L. Longbottom | It's getting hotter, what does this mean for our vineyard management strategies? | AWRI Webinar | |
| C.D. Curtin | Towards nutritional management of fermentation outcomes | Lallemand Seminar, Stanthorpe, Qld | 25 Oct 2011 |
| K.A. Bindon | Tannin from grape to wine: new insights on a complex system | AWRI Webinar | |
| C.S. Stockley | Wine – its bioactive compounds and health | Food for a Healthy Planet 2, Melbourne University, Melbourne Vic | |
| C.D. Curtin | The vacuole is where it's all happening! Release of 3MH from its GSH conjugate and formation of $H_2S$ from organic S sources | SB2 Annual Review, Hanmer Springs, New Zealand | 27 Oct 2011 |
| C.S. Stockley | Making better wine for better health | AWRI Roadshow, Jacobs Creek Visitor Centre, Barossa Valley, SA | 2 Nov 2011 |
| C.A. Varela | Wild ferments – what are the alternatives? | | |
| K.A. Bindon | Tannin from grape to wine: new insights on a complex system | | |
| V.J. O'Brien | Are you selecting the best packaging for your wines? | | |
| C.A. Varela | Strategies for reducing alcohol levels in wine | | |
| M.L. Longbottom | Great wine from grafted vines | | |
| P.R. Muhlack | Doing more with less: sustainable process solutions for profitability | | |
| P.W. Godden | Which new AWRI technologies can add value to your business? | | |
| C.A. Simos | Features of the AWRI website | | |
| I.S. Pretorius | Wine bugs: From ancient wisdom to opening new vistas with frontier yeast science | Anchor Yeast Seminar, Lanzarac, Stellenbosch, South Africa | 3 Nov 2011 |
| | | Sixteenth Congress of the South African Society for Microbiology, Cape Town, South Africa | 6 Nov 2011 |
| R.A. Muhlack | Doing more with less: sustainable process solutions for profitability | AWRI Webinar | 8 Nov 2011 |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| C.D. Curtin | Towards nutritional management of fermentation outcomes | Lallemand Seminar, Coonawarra, SA | 9 Nov 2011 |
| P.W. Godden | The Pinot G Style Spectrum presentation and tasting | Rosemount and Lindemans Wines, South Bank, Vic | |
| P.C. Osidacz, I.L. Francis | What sensory properties of wines drive consumer preferences? Overview of some recent AWRI studies | Department of Viticulture and Oenology, University of Stellenbosch, South Africa | |
| P.W. Godden | Proctase: a potential enzymatic alternative to bentonite for removing heat-unstable protein from wine | Treasury Wine Estates technical meeting, Magill, SA | 10 Nov 2011 |
| R. Gawel | What sensory properties of red wine drive consumer preferences? | AWRI Roadshow, Struan House, Limestone Coast, SA | |
| E.M.C. Robinson | Which new AWRI technologies can add value to your business? | | |
| P.R. Dry | Viticultural management of grape and wine phenolics | | |
| K.A. Bindon | Tannin from grape to wine: new insights on a complex system | | |
| R. Gawel | Putting the texture back into white wine – the role of white wine phenolics | | |
| K.A. Bindon | Grape ripeness and wine composition (Cabernet Sauvignon) | | |
| P.R. Dry | Why do bunches get hot - and what does it mean for wine quality? | | |
| C.A. Simos | Features of the AWRI website | | |
| P.C. Osidacz, I.L. Francis | Do consumer preferences change as a result of increased wine experience? | 33rd Conference of the South African Society for Enology and Viticulture (SASEV), Stellenbosch, South Africa | |
| P.C. Osidacz, I.L. Francis | What sensory properties of wines drive consumer preferences? Overview of some recent AWRI studies | | |
| P.C. Osidacz, I.L. Francis | Revealing Chinese consumers' red wine preferences: a cross-cultural study | | |
| R.G. Dambergs | Optimising phenolic extraction in Pinot Noir *Part 1: Understanding phenolics* | South Gippsland Wine Industry Association, Kardella South, Vic | 11 Nov 2011 |
| R.G. Dambergs | Optimising phenolic extraction in Pinot Noir *Part 2: Manipulating Pinot Noir vinification* | | |
| I.S. Pretorius | Advances in wine science provide integrated solutions to industry problems | 33rd Conference of the South African Society for Enology and Viticulture (SASEV), Stellenbosch, South Africa | |
| I.S. Pretorius | Why is *Brett* so hard to control? Searching for answers in As, Cs, Gs and Ts. | | |
| D.L. Capone | The origin of eucalyptol and minty flavour in red wine | AWRI Webinar | 15 Nov 2011 |
| P.R. Dry | It's getting hotter - what does this mean for our vineyard management strategies? | AWRI Roadshow, Comfort Inn Gemini Hotel, Griffith, NSW | |
| I.L. Francis, P.C. Osidacz | What sensory properties of red wine drive consumer preferences? | | |
| C.A. Simos | What options do you have for cold stabilisation of your wines? | | |
| I.L. Francis, T. Siebert, G. Logan[4], M. Solomon | Pepper and spice in Shiraz: What influences Rotundone levels in wines? | | |
| P.W. Godden | Protein haze in white wines: new solutions to an old problem | | |
| P.W. Godden | Managing $H_2S$ during fermentation - latest research | | |
| C.A. Simos | Features of the AWRI website | AWRI Roadshow, Comfort Inn Gemini Hotel, Griffith, NSW | 15 Nov 2011 |
| P.W. Godden | Which new AWRI technologies can add value to your business? | AWRI Roadshow, Orange Agricultural Institute, Orange NSW | 16 Nov 2011 |
| P.W. Godden | Practical management of *Brett* in the winery | | |
| R.A. Muhlack | Energy of the future - moving towards onsite renewable biomass and solar energy | | |
| P.R. Dry | It's getting hotter - what does this mean for our vineyard management strategies? | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| I.L. Francis, P.C. Osidacz | What sensory properties of red wine drive consumer preferences? | AWRI Roadshow, Orange Agricultural Institute, Orange NSW | 16 Nov 2011 |
| P.R. Dry | Viticultural management of grape and wine phenols | | |
| I.L. Francis, P.C. Osidacz, E. King | What are the desirable levels of tropical fruit, cat pee and green flavours in Sauvignon Blanc? | | |
| C.A. Simos | Features of the AWRI website | | |
| P.R. Dry | It's getting hotter – what does this mean for our vineyard management strategies? | AWRI Roadshow, Lark Hill Winery Restaurant, Canberra, ACT | 17 Nov 2011 |
| R.A. Muhlack | Energy of the future – moving towards onsite renewable biomass and solar energy | | |
| K.A. Bindon | Viticultural management of phenolics | | |
| I.L. Francis, P.C. Osidacz | Do elevated levels of phenolics in commercial whites affect consumer preferences? | | |
| K.A. Bindon | Tannin from grape to wine: new insights on a complex system | | |
| P.W. Godden | Which new AWRI technologies can add value to your business? | | |
| C.A. Simos | Features of the AWRI website | | |
| R.G. Dambergs | Pinot Noir and sparkling wine research | Wine Tasmania Field Day, Milton Vineyard, Cranbrook, Tas | 18 Nov 2011 |
| C.A. Simos | Making the best out of difficult vintages: managing sub-optimal fruit in the winery | Australian Society for Viticulture and Oenology (ASVO) Seminar, SARDI Plant Research Centre Auditorium, Urrbrae, SA | 22 Nov 2011 |
| G.D. Cowey | Viticulture and winemaking strategies for processing ripe fruit and managing alcohol | 13th Congreso LatinoAmericano de Viticultura y Enologia, University of Chile, Santiago, Chile | |
| G.D. Cowey | The impact of closure choice on wine development<br>- sulfide development<br>- $SO_2$ levels and shelf life | 13th Congreso LatinoAmericano de Viticultura y Enologia, University of Chile, Santiago, Chile | 23 Nov 2011 |
| R.A. Muhlack | Is anaerobic digestion a viable option for processing winery effluent and generating energy? | Organic Force 'Managing Winery Residues' Seminar and Field Day, D'Arenberg Winery, McLaren Vale, SA | 24 Nov 2011 |
| R.A. Muhlack | Using grape marc for energy generation | | |
| M.G. Holdstock | Heat stability | AWRI Packaging Workshop, Comfort Inn Gemini Hotel, Griffith, NSW | |
| G.A. West | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| M.G. Holdstock | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| G.A. West | Line sanitation and filtration | | |
| M.G. Holdstock | Packaging operation | | |
| M.G. Holdstock | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| G.A. West | Post-bottling transport | | |
| C.A. Simos | Winemaking management strategies for Botrytis | AGM of The Interwinery Analysis Group (IWAG), Serafino's, McLaren Vale, SA | 25 Nov 2011 |
| E.J. Bartowsky | Management of yeast and bacteria cultures during vintage | | |
| S.A. Schmidt | YAN: nitrogen in the balance | | |
| P.R. Dry | Terroir - separating fact from fiction | AWRI Webinar | 29 Nov 2011 |
| M.G. Holdstock | Bulk shipping of wine | The Institute of Masters of Wine, AWRI, Urrbrae, SA | 30 Nov 2011 |
| M.G. Holdstock | *Botrytis* - what we heard, what we saw, how we responded | | |
| K.K. Forsyth | Making every drop count – cleaner production strategies | AWRI Webinar | 6 Dec 2011 |
| H.E. Holt | Salt and wine flavour | Riverland Wine Industry Development Council, Barmera, SA | 16 Dec 2012 |
| A. Schulkin | Wine research in the AWRI: selected insights | Agricultural Faculty, Hebrew University, Israel | 13 Jan 2012 |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| R.G. Dambergs, A. Sparrow[6], A. Carew[6] | The influence of maceration techniques on Pinot Noir tannin and pigment profiles | Eighth International Cool Climate Symposium, Hobart, Tas | 1 Feb 2012 |
| P.R. Dry | Alternative varieties for a cool climate | | |
| R.G. Dambergs | Understanding and controlling Pinot Noir phenolics | Workshop: Taming the Pinot Noir terroir. Eighth International Cool Climate Symposium, Hobart, Tas | 2 Feb 2012 |
| K.K. Forsyth | Balancing the carbon ledger in the wine sector | Eighth International Cool Climate Symposium, Hobart, Tas | |
| J.R. Bellon, P.A. Henschke, P.J. Chambers | Taming the terroir with non-conventional yeast | | |
| R.G. Dambergs | Manipulating Pinot Noir red wine quality in the winery | Workshop: Can we produce better Pinot Noir and sparkling wine? Eighth International Cool Climate Symposium, Hobart, Tas | 3 Feb 2012 |
| R.G. Dambergs | Monitoring sparkling tirage | | |
| C.A. Varela | Systems Biology: a new approach to industrial yeast strain development | 17th Lorne Proteomics Symposium, Lorne, Vic | |
| G.D. Cowey | Sensory evaluation. Wine aromas, flavours, faults and taints and Australian Wine Show judging | Premium Wine Brands, Barossa Valley, SA | 7 Feb 2012 |
| M. Marangon | Protein instability in white wines: mechanism and solutions | Thomas Worm and Hanne Thulstrup, CPKelco R&D department, Lille Skensved, Denmark | 9 Feb 2012 |
| P.R. Dry | Australian viticulture | Visiting CalPoly students, University of Adelaide, North Terrace Campus, Adelaide, SA | 14 Feb 2012 |
| G.D. Cowey | Simulated flavours, faults, taints and mouth-feel tasting | Limestone Coast Wine Industry Association, Chardonnay Lodge, Coonawarra, SA | |
| A.D. Coulter | A taste of flavour research | International Masters of Wine, Napa Valley, California, USA | |
| A.D. Coulter | Simulated tainted and faulty wine tasting | | 15 Feb 2012 |
| C.S. Stockley | Summary and outcomes of the informal OIV allergen working group | OIV Food Safety Expert Group, Paris, France | 9 Mar 2012 |
| C.S. Stockley | Evaluation of safety of an additive approved for food and for oral use, but not approved for vine products | OIV Food Safety Expert Group, Paris, France | |
| C.A. Simos and M.P. Krstic | Q&A interactive session | Rosevears Vineyard, Tamar Valley, Tas | 15 Mar 2012 |
| D.L. Johnson | The future of the Australian wine industry will be based on technology, not tradition | Debate@The Waite, Waite Campus, Urrbrae, SA | |
| C.A. Simos and M.P. Krstic | Q&A interactive session | Meadowbank Vineyard, Coal River Valley, Tas | 16 Mar 2012 |
| D.L. Capone, M.A. Sefton[3], I.L. Francis, D. Jeffery[3] | The origin of 1,8 cineole (eucalyptol) in wine | American Chemical Society Spring National Meeting, San Diego, California, USA | 26 Mar 2012 |
| A.R. Borneman, E.J. Bartowsky, J.P. Affourtit[9], I.S. Pretorius, M. Egholm[9], P.J. Chambers | Characterisation of intra-specific genomic diversity in industrial microorganisms by whole-genome sequencing | CSIRO seminar, CISRO, Waite, Campus, Urrbrae, SA | 3 Apr 2012 |
| E.J. Bartowsky, C. Abrahamse, P.J. Costello, J. McCarthy, A.R. Borneman | Lactic acid bacteria research | Universitat Rovira i Virgili, Oenological Biotechnology Research Group, Tarragona, Spain | 24 Apr 2012 |
| R.A. Muhlack | Winery energy efficiency | McWilliam's National Technical Manager, McWilliam's Hanwood Winery, NSW | 1 May 2012 |
| G.D. Cowey | Heat stability | Packaging Workshop, Hunter Valley, NSW | 16 May 2012 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| M.P. Krstic | Cost of production benchmarking in viticulture | Yarra Valley Seminar, Yarra Valley, Vic | 17 May 2012 |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| P.R. Dry | Does soil and vine nutrient status affect wine quality? | AWRI Roadshow Seminar, Renmark Hotel Function Centre, Renmark, SA | 23 May 2012 |
| I.L. Francis | What sensory properties of red wines drive consumer preferences? | | |
| P.A. Henschke | Wild ferments – what are the alternatives? | | |
| C.A. Varela | Strategies for reducing alcohol levels in wine | | |
| P.R. Dry | Great wine from grafted vines | | |
| G.D. Cowey | Heat stability | Packaging Workshop, Renmark Hotel Function Centre, Renmark, SA | 24 May 2012 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| P.C. Williamson | Describing wine aromas and flavours | 31st Advanced Wine Assessment Course Adelaide Showground, Adelaide, SA | 5 Jun 2012 |
| D.L. Capone, M.A. Sefton[3], I.L. Francis, D. Jeffery[3] | The origin of 1,8 cineole (eucalyptol) in wine | University of Melbourne, Melbourne, Vic | 7 Jun 2012 |
| T.E. Siebert, G. Logan[4], M.R. Solomon | Spicing up Shiraz: viticultural and winemaking influences on the peppery aroma compound, rotundone | University of Melbourne, Melbourne, Vic | |
| R.A. Muhlack | Australian wine industry overview—careers in science and technology in the wine industry | School Groups from Griffith High School, Marian College, and Barellan, Hillston, Ardlethan & Ariah Park Central Schools – in conjunction with DeBortoli, McWilliam's and Riverina TAFE, Riverina area, NSW | 7, 19, 20 Jun 2012 |
| M.P. Krstic | Update on smoke taint detections and management | Western Victorian Winegrowers' Seminar, Ararat, Vic | 8 Jun 2012 |
| D. Capone, M.A. Sefton[3], I.L. Francis, D. Jeffery[3] | The origin of 1,8 cineole (eucalyptol) in wine | | |
| T.E. Siebert, G. Logan[4], M.R. Solomon | Spicing up Shiraz: viticultural and winemaking influences on the peppery aroma compound, rotundone | | |
| C.D. Curtin, A.R. Borneman, P.A. Henschke, P.J. Chambers, I.S. Pretorius | Genomics of the wine spoilage yeast *Dekkera (Brettanomyces) bruxellensis* | Macrowine 2012, Universite Bordeaux 1, Bordeaux, France | 19 Jun 2012 |
| H.E. Holt, K.A. Bindon, C.A. Varela | A multi-disciplinary approach to determine relationships among grape maturity, wine chemistry and wine sensory properties | | 20 Jun 2012 |
| R. Gawel, M. Day, A. Schulkin, S.C. van Sluyter[8], E.J. Waters[2], P.A. Smith | Putting the texture back into white wines. The role of phenolics, polysaccharides, alcohol and pH in white wine structure and style | 63rd Meeting of the American Society of Enology and Viticulture, Portland Oregon, USA | |
| M.J. Herderich | Advances in analytical procedures to assess the likelihood of smoke taint compounds ending up in final wine | 2012 Smoke Taint Symposium, Melbourne, Vic | 20 Jun 2012 |
| C. Mayr | Understanding the chemical and sensorial basis of bushfire smoke flavour in affected wines | | |
| C.A. Simos | Responding to an industry smoke taint crisis | | |
| I.L. Francis, P.O. Williamson | What do consumers like? | Winery Engineering Association National Conference, Nuriootpa, SA | |
| A.D. Coulter, P.A. Henschke | Microbiological instabilities and control of unwanted microbial growth during winemaking | Blackwood Winemakers and Brewers Club Inc., Blackwood, SA | |
| V.J. O'Brien | Building customer value | WineEng 2012, Nuriootpa, SA | |
| P.R. Dry | Vine balance – how does it affect yield and quality? | AWRI Roadshow, MONA, Hobart, Tas | 21 Jun 2012 |
| P.A. Smith | Viticultural management of grape and wine phenolics | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| M. Essling | How can irrigation management strategies be used to manipulate wine quality? | AWRI Roadshow, MONA, Hobart, Tas | 21 Jun 2012 |
| P.R. Dry | How can cultural practices be used to improve fruit set? | | |
| M. Essling | I have Botrytis bunch rot, what can I do about it? | | |
| P.R. Dry | Terroir – separating fact from fiction | | |
| R.G. Dambergs | Measuring tannin to add value to your business | | |
| P.A. Smith | Tannin from grape to wine: new insights on a complex system | | |
| C.A. Simos | Features of the AWRI website | | |
| S.J. Nordestgaard | Musical chairs: moving product around large wineries | WineEng 2012, Nuriootpa, SA | |
| P.R. Dry | Vine balance – how does it affect yield and quality? | AWRI Roadshow, Elmslie Estate, Launceston, Tas | 22 Jun 2012 |
| P.A. Smith | Viticultural management of grape and wine phenolics | | |
| M. Essling | How can irrigation management strategies be used to manipulate wine quality? | | |
| P.R. Dry | How can cultural practices be used to improve fruit set? | | |
| M. Essling | I have Botrytis bunch rot, what can I do about it? | | |
| P.R. Dry | Terroir - separating fact from fiction | | |
| R.G. Dambergs | Measuring tannin to add value to your business | | |
| P.A. Smith | Tannin from grape to wine: new insights on a complex system | | |
| C.A. Simos | Features of the AWRI website | | |
| G.D. Cowey | Heat stability | Packaging Workshop, Avoca/Pyrenees, Vic | 26 Jun 2012 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | | |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| R. Gawel, M. Day, E.J. Waters[2] P.A. Smith | Wine astringency: fact or friction? | University of California, Davis, USA | |
| G.D. Cowey | Heat stability | Packaging Workshop, Bendigo, Vic | 27 Jun 2012 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |
| G.D. Cowey | Real wine tasting | Packaging Workshop, Bendigo, Vic | 27 Jun 2012 |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| G.D. Cowey | Heat stability | Packaging Workshop, Geelong, Vic | 28 Jun 2012 |
| M.G. Holdstock | Cold stability | | |
| A.D. Coulter | Sulfide treatment and wine fining practical | | |
| G.D. Cowey | Packaging preparation | | |
| A.D. Coulter | Controlling microbiological activity | | |
| M.G. Holdstock | Line sanitation and filtration | | |
| G.D. Cowey | Packaging operation | | |

| Staff | Title of talk | Presented to and where | Date |
|---|---|---|---|
| G.D. Cowey | Real wine tasting | Packaging Workshop, Geelong, Vic | 28 Jun 2012 |
| A.D. Coulter | Closure choice and post-bottling storage | | |
| M.G. Holdstock | Post-bottling transport | | |
| M. Marangon | How to predict and prevent the protein instability of white wines | Webinar at Wine stability workshop, Bari, Italy | 29 Jun 2012 |

1. University of Melbourne, 2. Now GWRDC, 3. Now University of Adelaide, 4. University of Auckland, 5. Sciences for Enology, INRA/Montpellier SupAgro/UMI, France, 6. University of Tasmania PhD student, 7. Sensory Insights Pty Ltd, 8. Now Macquarie University, 9. 454 Life Sciences, A Roche Company, 10. The Yalumba Wine Company, 11. University of Western Sydney

## Workshops organised by AWRI Staff

| Conducted by | Title of workshop | Held | Date |
|---|---|---|---|
| P.R. Dry | Research to Practice: Alternative Varieties | Treasury Wine Estates, Nuriootpa, SA | 1 Jul 2011 |
| | | Longview Vineyards, Macclesfield, SA | 5 Jul 2011 |
| | | The Wine House, Langhorne Creek, SA | 7 Jul 2011 |
| | | Dowie Doole, Tatachilla, SA | 21 Jul 2011 |
| C.A. Simos, F. Blefari | AWRI Advanced Wine Assessment Course | Hunter Valley Gardens, Pokolbin, NSW | 10 Aug 2011 |
| A.D. Coulter, G.D. Cowey, M.G. Holdstock | A guide to trouble-free packaging for winemakers | Century Inn, Traralgon, Gippsland, Vic | 17 Aug 2011 |
| | | Vintara Winery, Rutherglen, Vic | 19 Aug 2011 |
| | | Ballandean Hall, Ballandean, (Stanthorpe) Qld | 30 Aug 2011 |
| P.W. Godden, E.N. Wilkes, W.U. Cynkar, R.A. Muhlack, R.G. Dambergs | AWRI hands-on and practical new technologies workshop | Riverina TAFE, Griffith, NSW | 11 Oct 2011 |
| | | Hunter Valley Gardens, Pokolbin, NSW | 20 Oct 2011 |
| | | New Grange Meeting and Function Centre, Campbell Town, Tas | 2 Nov 2011 |
| P.R. Dry | Research to Practice: Alternative Varieties | Taylors Winery, Clare Valley, SA | 24 Nov 2011 |
| A.D. Coulter, M.G. Holdstock, G.A. West | A guide to trouble-free packaging | Comfort Inn Gemini Hotel, Griffith, NSW | 24 Nov 2011 |
| S.J. Nordestgaard, K.K. Forsyth | Winery operations workshop (refrigeration and wastewater) | Hunter Valley Gardens, Pokolbin, NSW | 8 Dec 2011 |
| C.A. Simos, F. Blefari, V.F. Phillips, M.G. Holdstock, E.L. Kennedy | Wines of France (session 1) | AWRI, Urrbrae, SA | 8 Dec 2011 |
| C.A. Simos, F. Blefari, V.F. Phillips, M.G. Holdstock, E.L. Kennedy | Wines of France (session 2) | AWRI, Urrbrae, SA | 9 Dec 2011 |
| J.R. Bellon | Taming the Pinot Noir terroir | Eighth International Cool Climate Symposium, Hobart, Tas | 2 Feb 2012 |
| R.G. Dambergs, R. Smart[1] | Can we produce better Pinot Noir and sparkling wine? | | 3 Feb 2012 |
| G.D. Cowey, A.D. Coulter, M.G. Holdstock | A guide to trouble-free packaging | Mercure Resort Hunter Valley Gardens, Pokolbin, NSW | 16 May 2012 |
| | | Renmark Hotel Function Centre, Renmark, SA | 24 May 2012 |
| P.R. Dry | Research to Practice: Alternative Varieties workshop | AWRI, Urrbrae, SA | 12 Jun 2012 |
| G.D. Cowey, A.D. Coulter, M.G. Holdstock | A guide to trouble-free packaging | Avoca Hotel, Avoca, Vic | 26 Jun 2012 |
| | | Bendigo TAFE, Bendigo, Vic | 27 Jun 2012 |
| | | The Geelong Club, Geelong, Vic | 28 Jun 2012 |

1. Smart Viticulture

# Posters

| Author(s) | Title of poster | Presented at | Date |
|---|---|---|---|
| H.E. Holt, C.D. Curtin, P.J. Chambers | Choice of yeast strain and its influences on Shiraz wine quality indicators | In Vino Analytica Scientia 2011, Graz, Austria | 21-23 Jul 2011 |
| P.C. Osidacz, I.L. Francis, B.R. Bramley, M. Stevens[1] | The effect of short-term exposure and education on the stability of red wine consumer preferences | 9th Pangborn Sensory Science Symposium, Toronto, Canada | 4-8 Sep 2011 |
| P. Mercurio, M. Mercurio, M.R. Solomon | Marine research in South Australia and the role of metabolomics | Australian Marine Sciences Association 2011 - The Great Australian Bight: Ecosystem and Resource Management, SA Water, Adelaide, SA | 7 Sep 2011 |
| S.A. Schmidt, S. Dillon[2], R. Kolouchova, P.A. Henschke, P.J. Chambers | Interactions between pH, $K^+$ and *Saccharomyces cerevisiae* strain can negatively impact fermentation kinetics and wine composition of Chardonnay musts | Eighth International Cool Climate Symposium, Hobart, Tas | 31 Jan-4 Feb 12 |
| C.A. Varela, D. Torrea[3], S.A. Schmidt, C. Ancin-Azpilicueta[3], P.J. Chambers, P.A. Henschke | Effect of the fermentation stimulants oxygen and lipids on volatile and non-volatile composition of Chardonnay wine | | |
| P.A. Henschke, C.A. Varela, S.A. Schmidt, D. Torrea[3], M. Vilanova[4], T.E. Siebert, R. Kalouchova, M. Ugliano[5], C. Ancin-Azpilicueta[3], C.D. Curtin, I.L. Francis | DAP – a wine aroma and style tool: case studies with Albariño and Chardonnay, | | |
| R.G. Dambergs, A.L. Carew[6], A. Sparrow[6] | Comparison of tannin and pigment outcomes in Pinot Noir wine from eight maceration techniques | Eighth International Cool Climate Symposium, Hobart, Tas | 31 Jan-4 Feb 12 |
| R.G. Dambergs, R. Smart[7], A. Sparrow[6] | Would you like a short red, Sir? | | |
| R.G. Dambergs, N. Scrimgeour, E.M. Robinson, E.N. Wilkes, P.A. Smith, P.W. Godden | A web-based portal for the analysis of wine tannin and pigment | | |
| R.G. Dambergs, C. Claye[6], J.E. Jones[6], F.L. Kerslake[6] | Pruning to maximise vine reserves | | |
| J.E. Jones[6], F.L. Kerslake[6], R.G. Dambergs | Decision making for premium sparkling wine production in Tasmania | | |
| A. Sparrow[6], R.G. Dambergs | Seeing double, Pinot phenolics | | |
| A. Sparrow[6], R.G. Dambergs, D. Close[6] | Locating Pinot Noir tannins | | |
| A. Sparrow[6], R.G. Dambergs R. Smart[7] | Influence of skin maceration and seed removal on wine composition of Pinot Noir | | |
| R. Smart[7], A. Sparrow[6], R.G. Dambergs, J. Song[8], H. Wang[8], M. Qian[7] | The effect of Botrytis infection on wine flavours and composition | | |
| R. Smart[7], R.G. Dambergs, A. Sparrow[6] | A procedure of ultra-small scale vinification for use in viticulture and oenology research | Eighth International Cool Climate Symposium, Hobart, Tas | 31 Jan-4 Feb 12 |
| P. Smart[9], R.G. Dambergs | European wasps are not cool | | |
| P. Smart[9], R.G. Dambergs | Clonal and rootstock influences on Pinot noir grape maturation | | |
| K.A. Bindon, C.A. Varela, H.E. Holt, P.C. Osidacz, I.L. Francis, J.A. Kennedy[10], M.J. Herderich | A multi-disciplinary approach to determine relationships among grape maturity, wine chemistry and wine sensory properties | Macrowine 2012, Universite Bordeaux[1], Bordeaux, France | 18 -21 Jun 2012 |
| K.A. Bindon, R. F. Guerro[11], P.A. Smith | Fibers from processing wastes as novel fining agents for wine tannin | | |
| K.A. Bindon, A. Bacic[12], J.A. Kennedy | Grape cell wall-tannin interactions are modified by grape ripening | | |
| D. Gazzola[12], S.C. Van Sluyter[13], P. A. Smith[3], E.J. Waters[14], A. Curioni[12], M. Marangon | Wine thaumatin-like protein isoforms show different aggregation behaviours | | |

1. Sensory Insights Pty Ltd, 2. The Yalumba Wine Company, 3. Universidad Pública Navarra, Pamplona, Spain, 4. Misión Biológica de Galicia (CSIC), Spain, 5. Nomacorc SA, France, 6. Tasmanian Institute of Agriculture, 7. Smart Viticulture, 8. Department of Food Science & Technology, Oregon State University, 9. Pressing Matters, 10. California State University – Fresno, Department of Viticulture and Enology, 11. Centro IFAPA Rancho La Merced, Spain, 12. Department of Agronomy Food Natural Resources Animals and Environment, Università di Padova, Italy, 13. Department of Chemistry and Biomolecular Sciences, Macquarie University, Australia, 14. Grape and Wine Research and Development Corporation, Australia

# Appendix 2 – Teaching responsibilities (Lectures) of AWRI staff

| Institution | Subject number | Subject name | No of lectures | Staff member |
|---|---|---|---|---|
| University of Adelaide | 3046WT/7046WT | Fermentation Technology | 2 | I.L. Francis |
| University of Adelaide | 3046WT/7046WT | Fermentation Technology | 2 | P.A. Henschke |
| University of Adelaide | 3045WT/7048WT | Advances in Oenology | 3 | E.J. Bartowsky |
| University of Adelaide | 3045WT/7048WT | Advances in Oenology | 4 | P.A. Henschke |
| University of Adelaide | 3045WT/7048WT | Advances in Oenology | 1 | C.A. Simos |
| University of Adelaide | 3044WWT | Alternative varieties to viticultural methods and procedures | 1 | M.L. Longbottom |
| University of Adelaide | 3044WWT | Alternative varieties to viticultural methods and procedures | 1 | P.R. Dry |
| University of Adelaide | OEN 2500 | Vineyard and Winery Operations II | 4 | P.R. Dry |
| University of Adelaide | 105645 | Generating novel yeasts for the wine industry | 2 | P.J. Chambers |
| University of Adelaide | 3047/7047 | Winemaking at vintage | 2 | P.A. Henschke |
| University of Adelaide | N/A | EMBA; 13 o/seas students | 2 | M.J. Herderich |
| University of Adelaide | 2001WT | Wine in society | 2 | C.S. Stockley |
| University of Adelaide | 3005WT | Grape industry practice, policy and communication | 2 plus approx 50 hours planning and organisation | C.S. Stockley |
| University of Adelaide | 3500WT | Grape industry practice policy and communication | 1 | I.L. Francis |
| University of Adelaide | 3500WT | Grape industry practice, policy and communication | 1 | M.J. Herderich |
| University of Adelaide | Viticulture IIIB | Viticulture IIIB | 2 | P.R. Dry |
| University of Adelaide | 3007WT/7010WT | Stabilisation and Clarification III | 3 | A.D. Coulter |
| University of Tasmania | KLA256 | Microbes and man | 1 | R.G. Dambergs |
| University of Tasmania | KLA365 | Plant stress responses and product quality | 2 | R.G. Dambergs |
| University of Tasmania | KLA316 | Agricultural technology and innovation | 1 | R.G. Dambergs |

# Appendix 3 – Student supervision responsibilities of AWRI staff for 2011/2012

| Student | Supervisors | Source of funds |
|---|---|---|
| **PhD** | | |
| Jenny Bellon | P.J. Chambers, A.R. Borneman, C. Ford[1] | University of Adelaide |
| Anna Carew | D. Close[4], R.G. Dambergs, C.D. Curtin, R. Shellie[4] | University of Tasmania |
| Catherine Cox-Kidman | C. Collins[1], M. McCarthy[7], P.R. Dry | Self-funded |
| Gareth Hill | Kathy Evans[4], R. Beresford[5], R.G. Dambergs | University of Tasmania, NZ Plant and Food Res |
| Sam Rees | R. Doyle[4], M. Hardie[1], R.G. Dambergs | University of Tasmania |
| Angela Sparrow | R.G. Dambergs, D. Close[4] | University of Tasmania |
| Nick Warnock | S. Schmidt, E.J. Waters[8], P. Anderson[2] | Flinders University |
| Patricia Williamson | I.L. Francis, L. Lockshin[10], S. Mueller Loose[10,11], S. Bogomolova[10] | AWRI |
| Cynthia Yonker | C. Ford[1], N. Dokoozlian[6], S. Bastian[1], P.R. Dry | Self-funded |
| Pangzhen Zhang | M. Krstic, M. Herderich, N. Scarlett[12], S. Barlow[13], K. Howell[13] | University of Melbourne |
| **Hons** | | |
| Max Edgley | D. Close[9], R.G. Dambergs | University of Tasmania |
| Samantha White | J. Jones[9], R.G. Dambergs | University of Tasmania |

1. University of Adelaide, 2. Flinders University, 3. University of Western Sydney, 4. University of Tasmania, 5. New Zealand Plant and Food Research, 6. E&J Gallo, 7. SARDI, 8. GWRDC, 9. Tasmanian Institute of Agricultural Research, 10. University of South Australia, 11. Aarhus University, Denmark, 12. Mt Langi Ghiran, 13. University of Melbourne

## Theses completed

| Student | Hon/PhD | Title of Thesis | Supervisors |
|---|---|---|---|
| Ines Botscher | Hons equiv. | Untersuchung zur Biosynthese von Mono- und Sesquiterpenen in *Vitis vinifera* cv. *Shiraz* | M.J. Herderich, M. Wust[7] |
| Dimitra Capone | PhD | Application of novel analytical methods to the identification, formation and fate of two important wine aroma compounds | D. Jeffrey[4], M. Sefton[4], D. Taylor[4] |
| Josh Hixson | PhD | Chemistry of Hydroxycinnamic Esters and their role as precursors to *Dekkera* produced off-flavour in wine | C.D. Curtin, G. Elsey[4], D. Taylor[4] |
| Fiona Kerslake | PhD | Effect of vineyard management on Pinot Noir fruit and wine quality | S. Wilson[1], R. Smart[2], D. Close[1], J. Jones[1], R.G. Dambergs |
| Eric Mertes | Hons | Effect of mineral nutrient content on cherry fruit quality and phenolic chemistry during post-harvest storage | D. Close[1], R.G. Dambergs |
| Tina Tran | PhD | Identifying genes that confer ethanol tolerance in *Saccharomyces cerevisiae* | P.J. Chambers, S.A. Schmidt, A.R. Borneman and G. Stanley[5] |
| Reuben Wells | PhD | Vineyard stress and leaf health- links to fruit and wine quality | S. Wilson[1], R. Smart[2], D. Close[1], J. Jones[1], R.G. Dambergs |
| Lara Westaway | Hons | An investigation into the existence of a viable but non-culturable state of *Brettanomyces/Dekkera bruxellensis* | C.D. Curtin, A. Soden[3], P.R. Grbin[4] |
| Gal Winter | PhD | Central role of the vacuole in nutrient modulation of volatile sulphur compound formation during fermentation by *Saccharomyces cerevisiae* | C.D. Curtin, M. Ugliano, T. Bailey[6] |

1. University of Tasmania, 2. Smart Viticulture, 3. Treasury Wine Estates, 4. University of Adelaide, 5. University of Central Queensland, 6. University of Western Sydney, 7. University of Bonn, Germany

# Appendix 4 – Media interviews during 2011/2012

| Date | Staff member | Discussed | Media |
|---|---|---|---|
| 24 Aug 2011 | K.A. Bindon | Researcher in profile | *Australian and New Zealand Grapegrower and Winemaker* |
| 29 Aug 2011 | K.A. Bindon | Sequential Harvest study | *Australian and New Zealand Grapegrower and Winemaker* |
| 23 Sep 2011 | P.C. Osidacz | Consumer testing | *The Advertiser* |
| 4 Oct 2011 | R.G. Dambergs | AWRI and Tasmanian wine research | *Edge Radio,* Hobart |
| 14 Nov 2011 | G.D. Cowey | AWRI wine education and support services | *Wine Spectator* |
| 17 Nov 2011 | R.A. Muhlack | Bioenergy Technology for the wine industry | ABC News Radio |
| 17 Nov 2011 | R.J. Blair | The AWRI's position on the use of genetically modified organisms in Australian wine | Frank Smith, freelance wine journalist |
| 22 Nov 2011 | I.S. Pretorius | Advancing the frontline against *Brettanomyces* – AWRI's breakthrough offers potential to transform the battle against Brett | Kim Robertson, ABC |
| 23 Nov 2011 | P.R. Dry | Alternative varieties and climate change | ABC Rural Radio |
| 23 Nov 2011 | C.D. Curtin | Brett genome sequencing | ABC |
| 5 Dec 2011 | C.S. Stockley | Sulfur dioxide in foods and wine | *The Australian* |
| 11 Dec 2011 | D.L. Capone | Tropical thiol precursors | *Australian & New Zealand Grapegrower & Winemaker* |
| 23 Dec 2011 | R.G. Dambergs | Tasmanian wine research and International Cool Climate Wine Symposium | ABC News |
| 19 Jan 2012 | D.L. Johnson | The Chardonnay project collaboration with the University of British Colombia | Emily Elias, CBC Radio News, Vancouver |
| 1 Feb 2012 | C.S. Stockley | Allergies | Max Allen |
| 9 Feb 2012 | C.A. Simos | Wine quality | Andrea Frost, *Wine Companion Magazine* |
| 13 Feb 2012 | M.P. Krstic | AWRI's Victorian node | Paul Le Lacheur, *National Grapegrowers and Vignerons* |
| 14 Feb 2012 | M.J. Herderich | Bubbles in Champagne | Leigh Drayton, *The Weekend Australian* |
| 15 Feb 2012 | P.A. Henschke | Mousy wines | Max Allen |
| 20 Feb 2012 | M.G. Holdstock | Maximum sodium levels in wine | Frank Smith, freelance journalist |
| 20 Feb 2012 | I.L. Francis | The role of sensory science in winemaking | Kellie Arbuckle, *Australian and New Zealand Grapegrower and Winemaker* |
| 24 Feb 2012 | M.P. Krstic | Making wine in changing climates | Cameron Wilson, ABC Radio |
| 16 Mar 2012 | C.A. Simos and M.P. Krstic | Smoke taint | Anna Vidot, ABC *Country Hour* Hobart, Tas |
| 22 Mar 2012 | D.L. Johnson | Round table discussion on the future of the Australian wine industry | Cameron Wilson, ABC Radio National |
| 23 May 2012 | P.R. Dry | Terroir | Rosemary Grant, ABC *Country Hour* |
| 13 Jun 2012 | C.S. Stockley | EU allergen labeling regulations | Frank Smith, Australian Wine Industry Writer |
| 19 Jun 2012 | G.D. Cowey | Terroir and wine faults. Sensory correlations with wine chemistry | Sam Harrop, Wine and Spirits Magazine |
| 29 Jun 2012 | G.D. Cowey | Colour in red and white wines | Jamie Goode, Wine Anorak |

# Appendix 5 – papers published by the AWRI staff recorded during 2011/2012

**1290** Schmidt, S.A., Dillon, S., Kolouchova, R., Henschke, P.A., Chambers, P.J. Impacts of variations in elemental nutrient concentration of Chardonnay musts on *Saccharomyces cerevisiae* fermentation kinetics and wine composition. *Appl. Microbiol. Biotechnol*. 91 (2) : 365–375; 2011.

**1291** Wilkinson, K.L., Ristic, R., Pinchbeck, K.A., Fudge, A.L., Singh, D.P., Pitt, K.M., Downey, M.O., Baldock, G.A., Hayasaka, Y., Parker, M., Herderich, M.J. Comparison of methods for the analysis of smoke related phenols and their conjugates in grapes and wine. *Aust. J. Grape Wine Res*. 17 (2) : 22–28; 2011.

**1292** Ristic, R., Osidacz, P., Pinchbeck, K.A., Hayasaka, Y., Fudge, A.L., Wilkinson, K.L. The effect of winemaking techniques on the intensity of smoke taint in wine. *Aust. J. Grape Wine Res*. 17 (2) : 29–40; 2011.

**1293** King, E.S., Osidacz, P., Curtin, C., Bastian, S.E.P., Francis, I.L. Assessing desirable levels of sensory properties in Sauvignon Blanc wines – consumer preferences and contribution of key aroma compounds. *Aust. J. Grape Wine Res*. 17 (2) : 169–180; 2011.

**1294** Pocock, K.F., Salazar, F.N., Waters, E.J. The effect of bentonite fining at different stages of white winemaking on protein stability. *Aust. J. Grape Wine Res*. 17 (2) : 280–284; 2011.

**1295** Winter, G., Van der Westhuizen, T., Higgins, V.J., Curtin, C., Ugliano, M. Contribution of cysteine and glutathione conjugates to the formation of the volatile thiols 3-mercaptohexan-1-ol (3MH) and 3-mercaptohexyl acetate (3MHA) during fermentation by *Saccharomyces cerevisiae*. *Aust. J. Grape Wine Res*. 17 (2) : 285–290; 2011.

**1296** Lloyd, N.D.R., Capone, D.L., Ugliano, M., Taylor, D.K., Skouroumounis, G.K., Sefton, M.A., Elsey, G.M. Formation of damascenone under both commercial and model fermentation conditions. *J. Agric. Food Chem*. 59 (4) : 1338–1343; 2011.

**1297** Schmidt, S.A., Tan, E.L., Brown, S., Nasution, U.J., Pettolino, F., Macintyre, O.J., Lopes, M.D.B., Waters, E.J., Anderson, P.A. Hpf2 glycan structure is critical for protection against protein haze formation in white wine. *J. Agric. Food Chem*. 57 (8) : 3308–3315; 2009.

**1298** McRae, J.M., Kennedy, J.A. Wine and grape tannin interactions with salivary proteins and their impact on astringency: a review of current research. *Molecules* 16 (3) : 2348–2364; 2011.

**1299** Bindon, K., Myburgh, P., Oberholster, A., Roux, K., Du Toit, C. Response of grape and wine phenolic composition in *Vitis vinifera* L. cv. Merlot to variation in grapevine water status. *S. Afr. J. Enol. Vitic*. 32 (1) : 71–88; 2011.

**1300** Curtin, C.D., Bellon, J.R., Bartowsky, E.J., Henschke, P.A., Chambers, P.J., Herderich, M.J., Pretorius, I.S. Harnessing AWRI's yeast and bacterial research to shape ' nextgen' Chardonnay part 2: infl uence of yeast, nutritional management and malolactic fermentation. *Wine Vitic. J. 26* (2) : 15–24; 2011.

**1301** Abrahamse, C.E., Bartowsky, E.J. Timing of malolactic fermentation inoculation in Shiraz grape must and wine: influence on chemical composition. *World J. Microbiol. Biotechnol*. DOI 10.1007/s11274-011-0814-3, 1–11; 2011.

**1302** King, E.S., Francis, I.L., Swiegers, J.H., Curtin, C. Yeast strain-derived sensory differences are retained in Sauvignon Blanc wines after extended bottle storage. *Am. J. Enol. Vitic*. 62 (3) : 366–370; 2011.

**1303** Holt, S., Cordente, A.G., Williams, S.J., Capone, D.L., Jitjaroen, W., Menz, I.R., Curtin, C., Anderson, P.A. Engineering *Saccharomyces cerevisiae* to release 3- mercaptohexan-1-ol during fermentation through overexpression of an *S. cerevisiae* gene, STR3, for improvement of wine aroma. *Appl. Environ. Microbiol.* 77 (11) : 3626–3632; 2011.

**1304** Bellon, J.R., Eglinton, J.M., Siebert, T.E., Pollnitz, A.P., Rose, L., de Barros Lopes, M., Chambers, P.J. Newly generated interspecific wine yeast hybrids introduce flavour and aroma diversity to wines. *Appl. Microbiol. Biotechnol.* 91 (3) : 603–612; 2011.

**1305** Bartowsky, E.J., Borneman, A.R. Genomic variations of *Oenococcus oeni* strains and the potential to impact on malolactic fermentation and aroma compounds in wine. *Appl. Microbiol. Biotechnol.* DOI 10.1007/s00253-011-3546-2 : 1–7; 2011.

**1306** Essling, M. 'Dog Book' queries collared. *Aust. N.Z. Grapegrower Winemaker* (570) : 48–48; 2011.

**1307** Majewski, P., Barbalet, A., Waters, E. $1 billion hidden cost of bentonite fining. *Aust. N.Z. Grapegrower Winemaker* (569) : 58–62; 2011.

**1308** Pretorius, I.S. 2010 AWRI Report. *Aust. N.Z. Grapegrower Winemaker* (562) : 74–77; 2010.

**1309** Cordente, A.G., Heinrich, A., Pretorius, I.S., Curtin, C., Swiegers, J.H. Isolation of sulfite reductase variants of a commercial wine yeast with significantly reduced hydrogen sulfide production. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 196–200; 2011.

**1310** Forsyth, K.K., O'Brien, V.T. Technology: empowering your inner artisan. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 80–81; 2011.

**1311** Francis, I.L., Osidacz, P.C., Bramley, B.R., King, E.S., O'Brien, V.T., Curtin, C.D., Waters, E.J., Jeffery, D.W., Herderich, M.J., Pretorius, I.S. Linking wine flavour components, sensory properties and consumer quality perceptions. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 48–52; 2011.

**1312** Godden, P.W. Shining some light on wine innovation: developing decision support tools that aid creative winemaking. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 92–97; 2011.

**1313** Kennedy, J.A. ,Jeffery, D.W., Francis, I.L., Herderich, M.J. Importance of chemical interactions for winemaking and wine sensory perception. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 43–47; 2011.

**1314** Liccioli, T., Schmidt, S.A., Schmid, F., Chambers, P.J., Jiranek, V., Improving fructose utilisation in wine yeast. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 190–195; 2011.

**1315** Mueller, S., Osidacz, P., Francis, I.L., Lockshin, L. Filling the gap – how do sensory and marketing attributes interact in consumer choice? Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 53–59; 2011.

**1316** Osidacz, P., Francis, I.L., Bramley, B., Stevens, M. The effect of repeated wine exposure on consumer preferences. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia 223–225; 2011.

**1317** Roget, W.K., Macintyre, O.J., O'Brien, V.T. In-bottle measurement of closure oxygen transmission rates. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia 204–207; 2011.

**1318** Tyerman, S., Bei, R.D., Fuentes, S., Vandeleur, R., Shelden, M., Sullivan, W., Pech, J., Edwards, E., Wilkinson, C., Cozzolino, D., Cynkar, W., Dambergs, R., Loveys, B., McCarthy, M. The future of irrigation scheduling: emerging technologies linked to vine physiology. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia 120–124; 2011.

**1319** Varela, C., Kutyna, D., Henschke, P.A., Stanley, G.A., Chambers, P.J. Generating wine yeasts that reduce alcohol content in wines. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia 201–203; 2011.

**1320** Waters, E.J., Ugliano, M., Kwiatkowski, M., Day, M., Bramley, B., Francis, I.L., Jung, R., Dimkou, E., Dieval, J.-B., Aagaard, O., Nygaard, M., Vidal, S. Oxygen management: winemaking in the bottle. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 71–74; 2011.

**1321** Wilkinson, K.L., Ristic, R., Dungey, K.A., Baldock, G.A., Hasayaka, Y. Assessing smoke taint in grapes and wine. Blair, R.J.; Lee, T.H.; Pretorius, I.S. (eds) The 14th Australian Wine Industry Technical Conference: Adelaide, South Australia 3–8 July 2010: Australian Wine Industry Technical Conference Inc., Adelaide, South Australia; 162–164; 2011.

**1322** Mueller, S., Osidacz, P., Francis, I.L., Lockshin, L. Filling the gap – how do sensory and marketing attributes interact in consumers' wine choice? *Internet J. Enol. Vitic.* 2 (1) : 1–7; 2011.

**1323** Kassara, S., Kennedy, J.A. Relationship between red wine grade and phenolics. 2. Tannin composition and size. *J. Agric. Food Chem.* 59 (15) : 8409–8412; 2011.

**1324** Riovanto, R., Cynkar, W.U., Berzaghi, P., Cozzolino, D. Discrimination between Shiraz wines from different Australian regions: the role of spectroscopy and chemometrics. *J. Agric. Food Chem.* dx.doi.org/10.1021/jf202578f : 1–5; 2011.

**1325** Cozzolino, D., Cynkar, W.U., Shah, N. The economics of implementing near infrared analysis in the grape and wine industries. *NIR News* 22 (5) : 10–11; 2011.

**1326** Herderich, M.J., Francis, I.L., Ugliano, M., Siebert, T.E., Jeffery, D.W. Analysis and formation of key sulfur aroma compounds in wine. Qian, M.C.; Fan, X.; Mahattanatawee, K. *Vol. Sulf. Comp. Food*. doi: 10.1021/bk-2011-1068.ch014 : 267–286; 2011.

**1327** Cordente, A.G., Curtin, C.D., Henschke, P.A., Chambers, P.J., Herderich, M.J., Pretorius, I.S. Taking the stink out of fermentation. *Wine Vitic. J.* 26 (3) : 12–15; 2011.

**1328** Schmidt, S.A., Dillon, S., Kolouchova, R., Henschke, P.A., Borneman, A.R., Forgan, A., Chambers, P.J., Pretorius, I.S. Grape juice and wine yeast: happy marriages and how to avoid getting stuck with the wrong partner. *Wine Vitic. J.* 26 (3) : 30–34; 2011.

**1329** Cowey, G. Botrytis – implications in wine development. *Aust. N.Z. Grapegrower Winemaker* 571, 78–78; 2011.

**1330** Essling, M., Dry, P. Natural balance critical to mealybug control. *Aust. N.Z. Grapegrower Winemaker* 572, 56–57; 2011.

**1331** Robinson, E., Francis, L., Cozzolino, D., Smith, P., Godden, P. Cutting through the confusion around Pinot G. *Aust. N.Z. Grapegrower Winemaker* 567, 48–54; 2011.

**1332** Capone, D.L., Pardon, K.H., Cordente, A.G., Jeffery, D.W. Identification and quantitation of 3-S-cysteinylglycinehexan-1-ol (cysgly-3-MH) in Sauvignon Blanc grape juice by HPLC-MS/MS. *J. Agric. Food Chem*. 59(20), 11204–11210; 2011.

**1333** Schmidt, S.A., Dillon, S., Kolouchova, R., Henschke, P.A., Borneman, A.R., Forgan, A., Chambers, P.J., Pretorius, I.S. Grape juice and wine yeast: happy marriages and how to avoid getting stuck with the wrong partner. *Wine Vitic. J.* 26(4), 30–34; 2011.

**1134** Ugliano, M., Kwiatkowski, M., Capone, D., Siebert, T., Dieval, J.-B., Aagaard, O., Waters, E.J., Vidal, S. Effect of wine composition, oxygen exposure and closure-derived oxygen on Sauvignon Blanc key sulfur aroma compounds. *Prog. Agric. Vitic.* 128(6), 109–113; 2011.

**1335** Hayasaka, Y., Baldock, G., Parker, M., Herderich, M., Pretorius, I. Seeing through the haze: the discovery of chemical markers for smoke exposure. *Wine Vitic. J.* 26(5), 26–31; 2011.

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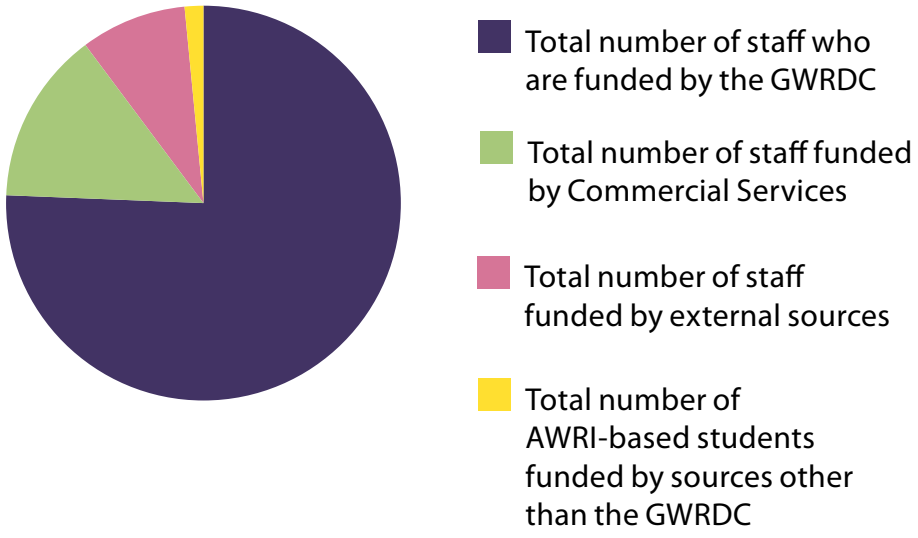


*Figure 33. Funding of the AWRI staff, excluding overseas students and visiting researchers*

# Staff of The Australian Wine Research Institute

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2 Leigh Francis
3 Peter Godden
4 Eric Wilkes
5 Mardi Longbottom
6 Matteo Marangon
7 Anthony Borneman
8 Paul Smith
9 Patricia Williamson
10 Cory Black
11 Alfons Cuijvers
12 Vince O'Brien
13 Linda Halse
14 Markus Herderich
15 Dan Johnson
16 Rae Blair
17 Nathan Watson-Haigh
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63 Alex Schulkin
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74 Michael Downie
75 Dimitra Capone
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79 Catherine Borneman
80 Richard Gawel
81 Wade Hines
82 Matthew Cream
83 Daniel Tynan
84 Cristian Varela
85 Virginia Phillips
86 Josh Hixson
87 Francesca Blefari
88 Slavko Bekavac
89 Tadro Abbott
90 Kevin Pardon
91 Darek Kutyna

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Sam Anderson
Jenny Bellon
Sam Connew
Chris Curtin
Bob Dambergs
Martin Day
Robyn Gleeson
Jeremy Hack
Stella Kassara
Mark Krstic
Anne Lord
Richard Muhlack
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