Australian Wine Research Institute

Annual Report 2022

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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, and is a registered charity with the Australian Charities and Not-for-profits Commission.

The Constitution of The Australian Wine Research Institute Ltd (AWRI) sets out in broad terms the aims of the AWRI. The AWRI's activities are guided by its business and research, development and extension plans, and its stated mission, values and behaviours.

Mission

Supporting the Australian grape and wine industry through world-class research, practical solutions and knowledge transfer.

Values

Values provide guidance in how the AWRI will deliver on its mission. The AWRI's values are:

- Excellence
- Integrity
- Passion

Behaviours

The behaviours that support our values are:

Excellence

- Outcomes focused, delivering results
- Personal mastery – being the best one can be
- Asking and answering the right questions
- Relevant to industry
- Collaborating to achieve faster, better or cheaper outcomes

Integrity

- Accountability to stakeholders
- Dealing honestly, impartially and consistently
- Scientific and professional rigour

Passion

- Enthusiasm for our people, our industry and our products
- Spirit of creativity
- Enjoying work and celebrating achievements
- Desire to do better
- Pursuing knowledge and understanding

Location

The AWRI's laboratories and offices are housed in the Wine Innovation Central Building within an internationally renowned research cluster on the Waite Research Precinct at Urrbrae in the Adelaide foothills. Grape and wine scientists from other organisations are co-located with the AWRI in the Wine Innovation Central Building.

The Waite Research Precinct is also home to other research and teaching organisations including: Australian Centre for Plant Functional Genomics (ACPFG), Australian Genome Research Facility (AGRF), Australian Grain Technologies (AGT), Australian Plant Phenomics Facility, CSIRO, South Australian Research and Development Institute (SARDI), the University of Adelaide's School of Agriculture, Food and Wine and the Waite Research Institute.

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68th Annual Report - 30 June 2022
Presented to the Australian grape and wine community

AWRI

Chair and Managing Director's report

The Australian grape and wine industry is continuing to face challenging conditions, with global factors affecting exports and a range of significant pressures on profitability. Nevertheless, our community took the opportunity to come together in a very positive way at the 18th AWITC and WineTech in June 2022, launching honest discussions about the current state of the sector and opportunities to bounce back. At the AWRI, 2021/22 has been a year focused on implementing strategic changes across a range of key areas, with the goal of ensuring a sustainable future for our organisation and our ability to continue to support the Australian grape and wine community for many years to come.

New business strategy, rebranding and launch of Affinity Labs

This year we began implementing our new strategy, developed over the previous year in consultation with stakeholders and guided by external consultants. The strategy includes five key pillars to be addressed to transform the AWRI ensure that it has a sustainable future:

- Tune in to industry
- Push scientific boundaries
- Transfer the knowledge
- Secure our future
- Unlock commercial potential.

Initial actions have focused on the fifth pillar, unlocking the AWRI's commercial potential, with the implementation of a new business strategy for the AWRI's commercial activities. A significant focus of this has been the rebranding of AWRI Commercial Services to Affinity Labs, an identity which provides increased flexibility to work across a range of segments and markets. The AWRI master brand also underwent a refresh at the same time, ensuring ongoing alignment between the two brands. Other actions under this pillar have included the appointment of a Marketing Lead and the development of a standalone website for Affinity Labs, both key steps in taking a more customer-centric approach to our commercial activities.

Sustainability

Sustainable Winegrowing Australia saw significant membership growth in 2021/22, reaching 933 members, up from 479 in 2019/20 and 631 in 2020/21. There was also high demand for certification training, with training delivered to almost 700 participants across Australia. The demand for membership and certification is primarily being driven by the supply chain and a desire by members to obtain and use the certification trust mark. During the year WIC Winemaking Services (a joint venture between the AWRI and University of Adelaide, operating on the Waite Campus) achieved certified member status. The AWRI Board also commenced its journey of thinking and reporting through the lens of ESG (Environmental, Social, Governance), with further developments anticipated over the next year.

Completion of five-year portfolio of Wine Australia projects

This financial year saw the completion of a portfolio of research, development, extension and adoption projects funded by Wine Australia under a five-year agreement. The projects section of this report provides updates on the majority of those projects, apart from those that were completed in an earlier year. Final Reports will be developed early in 2022/23 and made available through the Wine Australia website.

New Investment Agreement and work towards strategic partnership with University of Adelaide

In June 2022 the AWRI signed a four-year investment agreement with Wine Australia. The signing of this agreement was the culmination of many months of work across the organisation, developing new project plans, consulting with stakeholders and negotiating contractual arrangements. The projects in this new agreement fall into three categories – 'extension and adoption', 'insights' and 'impact'. While the first two categories are similar to the project types in previous agreements, the third is new and involves a comprehensive co-design process with industry and Wine Australia, led by an external consultant, to develop project plans. While this new approach will require some changes in approach and some new techniques to be learned, it is expected to result in projects with closer industry involvement, leveraging of co-investment, and a deeper understanding of the segments which stand to benefit most from them.

Productive discussions have also been continuing towards signing a non-exclusive strategic partnership agreement with the University of Adelaide. This partnership would provide a framework for our two organisations to work more closely together, for mutual benefit, advancing each organisation's research agenda, supporting critical mass in key capabilities, creating an affiliate relationship at the institutional level, exploring adjunct or joint appointments and helping to secure long-term sustainable investment. Such an agreement would open up a range of possibilities for collaboration and investment that have not previously been open to the AWRI.

Constitutional changes to Board composition and appointment processes

Following a consultation period in late 2021, the AWRI finalised a range of constitutional changes that adjust the AWRI Board's composition and appointment processes. These changes will ensure best-practice corporate governance and see the organisation continue to evolve to meet the needs of the Australian grape and wine industry. The proposed changes were approved by the AWRI Board in February 2022 and included:

- The introduction from January 2023 of a position elected by Grape Research Levy payers.
- Reducing the number of positions elected by levy payers from six to four, of which one position is nominated and elected by each of the small, medium and large category Wine Grapes Levy payers and one position is nominated and elected by Grape Research Levy payers.
- Increasing the maximum number of Appointed Director positions from four to six, to ensure an appropriate balance of skills and diversity (including geography).
- Introducing a nominations committee to assist in the selection and reappointment of Appointed Directors via an open recruitment process, that seeks expressions of interest to address identified gaps in the Board's skills and diversity.
- Introducing a gender diversity quota for non-executive Director positions, specifying a minimum of at least four Directors of either gender.

A nominations committee has been formed, and will conduct the process of selecting the next two Appointed Directors between June and September 2022, with nominations and an election for vacant elected positions to follow later in 2022.

18th AWITC and WineTech

After some significant uncertainty due to the COVID-19 pandemic, it was a major achievement to be able to hold the 18th AWITC and WineTech as originally planned in Adelaide in June 2022, in partnership with ASVO. This is always a significant event for AWRI staff, with contributions across all aspects including administration, communication, finance, workshops, the plenary program and the poster display. Key highlights included the close integration between the technical conference presentations and the trade exhibition, the overall positive vibe from all attendees and the strong program content. An event like this is only possible due to collaborations with a wide range of organisations and people. The ASVO Board, and particularly members of the AWITC Executive Committee, are thanked for their contributions to the success of the event. The Outlook sessions on day 1 were presented in conjunction with Australian Grape & Wine. The WineTech trade show, which is such an integral part of the overall event, is the result of a partnership with WISA and Expertise Events. Working with the Calabria, Medich and McWilliam families, we were able to align new Australian Wine Industry Awards with the AWITC, supporting the launch of this new awards format. For the first time, the AWITC also partnered with DrinkWise, to ensure messages about healthier and safer drinking practices were included at AWITC social events. The AWITC team are now looking to July 2025, when we will stage the 19th AWITC and WineTech in Adelaide.

New no- and low-alcohol (NOLO) wine facility

It is clear that consumers across the world are increasingly interested in no- and low-alcohol beverages, with the beer and spirits industries some way ahead of wine in producing beverages that mimic the sensory attributes of the full-alcohol product equivalents. Following completion of a two-year Wine Australia-funded NOLO project that sought to define the desirable sensory attributes of existing NOLO beverages, NOLO research at the AWRI will continue as one of the three impact project themes under the new investment agreement

with Wine Australia. In addition, the AWRI and the University of Adelaide have received a grant from PIRSA for a research-scale spinning cone facility to be installed at the Hickinbotham-Roseworthy Wine Science Laboratory on the Waite Campus. This is a major step forward for the development of NOLO wine products, as researchers and producers will be able to use this equipment to create trial product batches at a much smaller scale than has previously been available to our industry.

Smoke taint baseline data and new understanding of chemistry/sensory links

Some significant outcomes were achieved in smoke taint research during the year. A comprehensive study on the baseline concentrations of smoke-related phenols and their glycosides in non-smoke-exposed grapes (and wines made from them) was published as an open access article in the *Australian Journal of Grape and Wine Research*. This dataset can be used to help determine the likelihood of smoke exposure when analysing potentially smoke-affected grapes or wines.

In addition, some major leaps forward were achieved in understanding the links between chemical analysis of grapes and the risk of smoke sensory effects in wine, based on data from wines produced from grapes with varied smoke exposure from the 2019/20 Australian bushfires. A decision tool has been developed, to help support growers and winemakers to understand their options and make informed decisions when confronted with potentially smoke-affected grapes, with the goal of minimising the risk of producing wine with smoke flavour, while avoiding unnecessary crop losses. It is expected that this tool will be tested with industry and undergo optimisation based on feedback before being made widely available.

Citizen science

During the year the citizen science projects on pear and apple by-products, conducted in conjunction with Maggie and Colin Beer, concluded. A second citizen science project, known as 'Yeast Catchers,' funded by a Citizen Science grant from the Australian Government Department of Science, Industry and Resources, made excellent progress in its first year. The Yeast Catchers project aims to isolate yeasts endemic to Australia, while introducing real-world scientific research into Australian schools. In the first year of the project, eight schools participated, and 90 positive cultures were re-cultured and arrayed on agar plates to obtain yeast isolates. A total of 958 isolates were typed to species-level using ITS profiling. Homology analysis indicated at least 37 different species of yeast across the dataset, with some species present in more than one sample. Draft whole genome sequencing was performed for 96 isolates that represent the breadth of predicted species and site diversity, with positive identification established for 63 isolates. At least 29 schools are expected to participate in year two of the project, inspiring the next generation of scientists.

Metabolomics SA

The SA node of Metabolomics Australia at the AWRI, funded by NCRIS/Bioplatforms Australia and the South Australian Government, continues to be a critical component of our chemistry and bioinformatics capabilities. The node has eight staff (analytical chemists, food scientists, a bioinformatician and a data engineer) and supports a range of up-to-date analytical equipment, including GC, LC, GCMS, mass spectrometers and a 400 MHz NMR. Services are provided across the food and beverage, agriculture, plant, environmental and livestock sectors, with more than 10,000 analyses performed annually. The node also provides a back-up to Affinity Labs in cases of instrument failure or when there is high demand due to an industry emergency, as well as supporting method development.

International partnerships

After a hiatus caused by the COVID-19 pandemic, it has been pleasing to see collaborative activities with international partner organisations resume. AWRI scientists have participated in international conferences and regulatory forums in recent months, with more international activity on the medium-term horizon. We also expect to soon see visits of international scientists to the AWRI recommence, with enormous benefits to be gained from the sharing of knowledge and expertise. Alliances such as BAG and OENOVITI play an important role in facilitating this type of collaboration, ensuring Australian wine science stays in touch with what is happening on the international stage.

Staff development

Staff development remains a high priority at the AWRI to ensure we continue to attract and retain the best possible staff and build our capabilities to support the Australian grape and wine industry. A second intake into our two-year internal Leadership Development Program occurred this year, with two staff joining the initial cohort of four. The program provides a range of individual and group development and education opportunities. In addition, group training was delivered to staff on dealing with the media, writing, presentation skills and poster design, largely aimed at preparing staff for the 18th AWITC.

Wine Steering Group

The Wine Steering Group (coordinated by the University of Adelaide) has been recently revised and expanded to include representatives from all Wine Innovation Cluster partners and industry representatives. In recent meetings, the group has discussed a proposal on futureproofing the Australian wine industry against a changing climate developed by the AWRI and the University of Adelaide in collaboration with industry. This proposal discusses the core needs under challenging future climate projections, the establishment of a global vineyard network with other key grape and wine research institutes overseas and the establishment of a world-class teaching, research and fermentation hub at the Waite Campus. The group is now seeking to finalise this proposal into a clear vision and business case for government investment.

Changes underway at Australian Grape & Wine

It was announced at the AWITC in June that Tony Battaglene would be stepping down as CEO of Australian Grape & Wine. Tony has been a passionate supporter of grape and wine R&D throughout his tenure and we thank him for his ongoing support and loyal service to the Australian grape and wine community. We wish him the very best for his future endeavours and look forward to working with his successor.

Technical trends from the AWRI helpdesk

As in previous years, the queries received by the AWRI helpdesk reflected technical issues encountered during the year and were strongly influenced by weather conditions during the growing season and vintage. Winter rainfall in 2021 was above average across much of Australia and for the second year running a La Niña system was declared by the Bureau of Meteorology. These conditions resulted in queries on the control of fungal diseases, including powdery and downy mildews. Packaged information produced in the 2021 season during similar conditions was redistributed early in the season, with extra resources developed on phosphorous acid, managing unruly canopies and getting the most out of copper sprays.

Hail events affected regions across multiple Australian states between October 2021 and January 2022. In response, the AWRI helpdesk produced several *eBulletins* and delivered webinars to provide growers with advice on dealing with hail damage. Several affected regions and sites were visited to assess damage, consult with vineyard management teams and provide direct information about hail recovery strategies. Follow-up assessments of vines towards the end of the season were conducted to learn lessons about recovery from hail.

The wetter winter, generally mild seasonal conditions, and a warmer than average autumn resulted in a slow ripening season that has seen producers report exceptional fruit quality in many regions. Fruit ripeness occurred at lower sugar concentrations with a higher natural acidity, albeit with lower yields in some cases. Wine Australia's national vintage survey estimated an Australian wine-grape crush of 1.73 million tonnes, 2 per cent below the 10-year average and 13.5 per cent below last year's record crush of 2.01 million tonnes.

Vineyard pests

Vineyard scale was a concern in several regions this season and a number of investigations were conducted to confirm the types of scale present in four regions. The wetter season also resulted in higher than average numbers of queries about pests and diseases, their control in the vineyard, their impact on MOG levels during harvest and their ability to cause taints in wine. Pests observed this year included slugs, snails, caterpillars, grasshoppers, moths, millipedes, native stink bugs and aromatic weeds.

Bushfires and planned burns

Smoke taint remained a concern for some regions in WA, with the drier conditions contributing to a number of early-season bushfires around Dunsborough, Denmark and Margaret River. Fires were also reported in the south-east of SA and in Tasmania. Many were short-period grass fires with minimal impact on fruit. Several states again brought forward prescribed burns into early autumn, which caused concern for some growers whose fruit remained on the vine due to the delayed season. The AWRI worked with state and regional bodies to provide accurate information on controlled burns and their impact on viticulture to support communications with organisations conducting prescribed burns.

Winemaking practices

During the vintage, winemakers raised a number of queries about different winemaking practices, including fortification, vinegar production and variations to tank method sparkling wine production. Questions were also received about production techniques for low- and no-alcohol wines, as companies begin to enter this emerging production space and market. Winemakers also raised questions about yeast inoculation, yeast scale-up and nutrient supplementation practices for fermentations, possibly relating to increases in price and concerns about availability of diammonium phosphate (DAP).

Looking towards vintage 2023

Unusually, the La Niña system continued well into winter 2022 and this, along with a negative Indian Ocean Dipole, resulted in warmer than average waters around northern Australia. This and other localised drivers indicated that winter and spring rainfall were very likely to remain higher than average for much of mainland Australia, but lower for Western Australian regions and south-western Tasmania (BOM Climate Outlook July-September 2022).

We acknowledge that many in our industry are currently facing a very challenging supply/demand situation and significant pressures on profitability. The AWRI is committed to supporting producers through these difficult market conditions.

Expressing our thanks

Every year the AWRI works closely with grape and wine producers across Australia, provides services to a wide range of clients and investment partners and operates more than 100 active research collaborations. We gratefully acknowledge these partners, who all contribute to the success and sustainability of the Australian grape and wine industry.

Wine Australia is thanked for both its financial support and the trust it places in the AWRI, as the Australian grape and wine industry's dedicated research, development, extension and adoption organisation. The strategic relationship between the AWRI and Wine Australia is critically important in maximising benefits from the investment of levies into new techniques and technologies that support our industry's position as a global innovation leader. This helps ensure that Australian producers can compete effectively on the global stage, supporting productivity, sustainability and profitability.

Australian Grape & Wine is thanked for providing essential strategic guidance and support to the AWRI and to our industry more broadly. Members of the AWRI Board are acknowledged for their dedication and enthusiasm during the year. And finally, the committed, talented and resilient AWRI staff are thanked for their continuing efforts in support of our industry.

Louisa Rose
Chair

Dr Mark Krstic
Managing Director

Vale Randell Taylor

The AWRI family was devastated to lose one of its longest-serving members, Randell Taylor, in November 2021, following a tragic cycling accident.

Randell was Manager of the AWRI's Trace Analysis Laboratory and had worked at the AWRI since 1996. He was an expert in the analysis of agricultural residues in grape and wine and had provided support to countless members of our industry across his career. Randell was so much more than his work achievements – he was the most enthusiastic and positive person, known for his infectious smile and incredible zest for life. He was also a highly talented and valued member of the South Australian running, cycling, rogaining, geocaching and triathlon communities and a much-loved husband, father, brother and son.

We are currently working on several ways to remember and pay tribute to Randell's life, including a memorial picnic table on the Yurrebilla Trail in the Waite Conservation Reserve above the AWRI (one of Randell's favourite trails) and a traineeship program to support undergraduate science students.

Board members

Ms L.E. Rose
BAppSc (Oen), BSc, GAICD
Chair – Elected under Clause 25.2 (c) of the Constitution
(Levy Payer elected Director)

Mr T.J. Bekkers
BAppSc (Ag) (Hons), Grad Cert (Mgt), GAICD
Elected under Clause 25.2 (c) of the Constitution
(Levy Payer elected Director)

Ms P. Giannini
BEc, GradDipAcc, ICAA
Appointed under Clause 25.2(b) of the Constitution
(Appointed Director)

Prof. K.D. Kirk
BSc (Hons), PhD, DPhil
Appointed under Clause 25.2 (b) of the Constitution
(Appointed Director)

Dr M.P. Krstic
BAgSc (Hons), PhD, MBA, GAICD
Ex officio under Clause 25.2 (a) of the Constitution as Managing Director of the AWRI

Mr B.M. McClen
BAgSc (Hons), MBA
Elected under Clause 25.2 (c) of the Constitution
(Levy Payer elected Director)

Ms C.L. Ribbons
BCom, CPA, GAICD
Appointed under Clause 27.4 of the Constitution (from 1 September 2021)
(Levy Payer elected Director)

Ms E.A. Riley
BAppSc (Wine Science), GAICD
Appointed under Clause 25.2 (b) of the Constitution
(Appointed Director)

Mr T.N. Sneyd MW
BAppSc (Wine Science), DNO, MBA
Elected under Clause 25.2 (c) of the Constitution
(Levy Payer elected Director)

Ms C.N. Wright
BCom, BAgSc (Oen)
Elected under Clause 25.2 (c) of the Constitution
(Levy Payer elected Director)

Pictured left to right: *Brett McClen, Liz Riley, Courtney Ribbons, Trish Giannini, Kiaran Kirk, Mark Krstic, Louisa Rose, Toby Bekkers, Corrina Wright, Nigel Sneyd*

Board notes

Chair

Ms L.E. Rose

Audit committee

Ms P. Giannini (Chair), Ms C.L. Ribbons, Mr B.M. McClen

Personnel committee

Ms L.E. Rose (Chair), Prof. K.D. Kirk, Mr T.N. Sneyd

Nominations committee

Dr J.S. Harvey (Independent Chair), Ms N. Palun (Independent member), Mr T.J. Bekkers, Ms E.A. Riley

Meetings

Ordinary General Meeting

The 67th Ordinary (Annual) General Meeting was held on 16 November 2021.

Extraordinary General Meeting

An Extraordinary General Meeting was held on 22 February 2022.

Board

The Board of the AWRI met on the following dates: 29 and 30 September 2021; 16 November 2021; 22 February 2022; 30 and 31 May 2022.

Investment

The Board of the AWRI acknowledges the continuing financial support of Wine Australia; the Governments of South Australia and Victoria; Landscape South Australia; the Australian Government Department of Agriculture, Fisheries and Forestry; the Australian Government Department of Industry, Science and Resources; and Bioplatforms Australia, along with a large number of confidential commercial clients. The AWRI is committed to investing the funding it receives from Wine Australia in accordance with the performance principles for Research and Development Corporations set out by the Australian Government.

Appreciation

The AWRI benefits greatly from collaborations with individuals and organisations from the following countries: Australia, Bulgaria, Canada, China, France, Germany, Indonesia, Italy, South Africa, UK and USA. The assistance and cooperation provided by these partners across the globe are gratefully acknowledged.

Launch of Affinity Labs and refreshed AWRI branding
A new identity for the AWRI's commercial activities, Affinity Labs, was launched in June at the 18th AWITC.

Understanding the properties of no- and low-alcohol (NOLO) beverages
Comprehensive sensory and chemical profiling were completed on sparkling, white, rosé and red NOLO wines as well as NOLO beers, ciders and spirits.

New podcast
A new podcast 'AWRI decanted' was launched, with the first series focusing on wine flavour. Uptake of the podcast was strong, with an average of 435 listens per episode.

Blending with proline-rich wines improves flavour and mouthfeel
Research on the grape-derived amino acid, proline, which persists through fermentation, demonstrated its flavour properties in wine.

Highlights of the year

Customers, consumers and markets

OIV appointment

Markus Herderich (AWRI Group Manager – Research) was elected by the Science and Technology Commission as Vice-President of the OIV. The OIV (International Organisation for Vine and Wine) is an intergovernmental peak body, which aims to inform, assist, harmonise, standardise and support the grape and wine sector through a network of more than 1,000 experts from 49 member countries.

Consumer response to smoke flavour

Three consumer studies established a strong negative link between overall liking and smoke flavour in smoke-affected Chardonnay, Pinot Noir rosé and unoaked Shiraz wines. Some consumers were surprisingly responsive, disliking wines with only a low level of smoke flavour.

Smoke analysis ring test

A ring test comparing results from laboratories in Australia, Europe, South America and the United States found significantly higher variation between results from hydrolysis-based methods for measuring bound smoke compounds in wine than from the direct LCMS method developed at and used by the AWRI.

Recommended approach for including energy values on wine labels

Work continued on developing a uniform approach to the description of the dietary energy content of wines. Analysis of data from Affinity Labs led to a recommendation for standard declarations for energy content based on wine style rather than calculating energy for each individual wine. This approach easily stayed within the label tolerances required in Europe and North America while giving meaningful information to consumers and reducing costs for producers. This work will form part of an industry submission to Food Standards Australia New Zealand on the requirement for nutritional and energy labelling.

Assessments of new agrochemicals

The Agvet Chemical Program was used for the first time to fund an assessment of eight agrochemicals that could benefit the grape and wine industry. This process identified the information that would be required to have the active constituents registered for use in wine-grape production. The program assists participating chemical companies to assess the viability of making new agrochemicals available.

Extension, adoption and education

18th AWITC

The 18th Australian Wine Industry Conference and WineTech trade exhibition was held in Adelaide in June, presented by the AWRI and ASVO in partnership with Expertise Events, WISA and Australian Grape & Wine. The event included 11 plenary sessions featuring 49 presentations, 29 technical workshops, 8 business workshops, a technical poster display and a student forum.

Return to face-to-face events

Six roadshow seminars and 14 workshops were presented in 2021/22 to a total of 725 attendees. The majority of events were able to be held face-to-face, as COVID-19 travel restrictions eased.

Webinars

Twenty-two webinars were presented to a total of 2,502 attendees, an increase from the previous year's attendance of 2,199, and equating to an average of 114 per webinar. There were also more than 17,700 views of this year's webinar recordings via YouTube.

Website

More than 223,715 visitors accessed the AWRI website during the year (an increase of 22% compared to the previous year) with more than 645,775 page-views. New content was added on topics including non-chemical weed control, water management, aeration of ferments and amelioration of smoke taint in juice and wine.

Videos

Three new demonstration videos were produced, covering the practice change themes of irrigation and aeration of ferments. In addition, the number of subscribers to the AWRI's YouTube channel grew from 2,442 in 2020/21 to more than 4,100 in 2021/22 and the channel attracted more than 271,920 views, up by more than 200% from the previous year.

Launch of 'AWRI decanted' podcast

A new podcast 'AWRI decanted' was launched, with the first series focusing on wine flavour. Uptake of the podcast was strong, with an average of 435 listens per episode. A second series was initiated in early 2022, with a theme of current viticulture research and the practitioners who are adopting it.

Helpdesk support

During 2021/22, the AWRI helpdesk responded to 1,609 wine and viticulture enquiries and conducted 126 investigations. There were approximately double the typical number of viticulture queries, mainly due to the cool, wet conditions in many regions, hail and other climatic events.

Library services

In 2021/22 the library responded to 1,966 reference and information requests, an increase of 85% compared to the previous year. Of these, the number of requests for resources from information packs increased from 299 in 2020/21 to 840 in 2021/22. Thirty-two new information packs were added to the AWRI website during the year. Library staff also performed 56 specialised literature searches, an increase of 26 compared to the previous year.

Resources on practice change priorities

A variety of new resources were developed to support the adoption of best-practice irrigation and aeration of ferments. These included podcast episodes, demonstration videos, webinars, fact sheets, industry articles and workshops at the 18th AWITC.

New digital tools

A new decision tool was developed to help growers decide which non-chemical weed control options are best suited to their vineyard environment and to develop a weed management plan for effective non-chemical weed control. A spreadsheet-based water budgeting tool developed by SARDI was updated into an online tool that includes direct links to weather data from the Bureau of Meteorology. This tool is designed to assist growers in managing irrigation water resources to optimise productivity, particularly in years where irrigation water is restricted.

ShowRunner

Thirty-nine shows with approximately 13,000 entries used the ShowRunner platform in 2021/22 (almost back to pre-COVID levels). ShowRunner also now offers the ability to include international entries, with international Geographical Indications available to be chosen when wines are entered into the system.

Performance, products and processes

Savoury flavour target

The amino acid glutamic acid was found to give a savoury/umami taste to red wine when added at concentrations found in commercially produced wines, providing a target for controlling savoury flavour in wines. In related work, a winemaking study identified higher fermentation temperature as a factor in enhancing glutamic acid concentration in red wine. Additionally, glutamic acid concentrations in pressings wines were found to be on average 5.5 times greater than in free-run wine, suggesting an additional way to enhance this character in red wine.

Blending with proline-rich wines improves flavour and mouthfeel

Research on the grape-derived amino acid, proline, which persists through fermentation, demonstrated its flavour properties in wine. In a blending study using inland Cabernet Sauvignon wines, optimal blends were found to include a high proportion of wine with elevated proline levels, which increased sweetness, viscosity and fruit flavour, while lowering astringency and bitterness. This approach of identifying proline-rich blending components opens a new avenue for improving 'thin' red wines.

Commercial trial of foliar spraying to increase 'tropical' characters in white wine

The use of foliar applications of sulfur and nitrogen for modulating 'tropical' thiols in wines was shown to be easily adopted within commercial vineyard operations, and was selected as a practice change priority for future extension activities.

Surprising result for suspected bitterant

A glycosylated form of coumaric acid that had been previously suspected to be a bitterant in white wine was subjected to formal sensory analysis. Surprisingly, it was found to suppress bitterness in model wine. This result suggests that the presence of glycosylated forms of hydroxycinnamates may positively contribute to the taste of white wine by reducing bitterness.

Sensory effects of flotation

A study investigating the effects of three different juice clarification practices on the composition, taste and mouthfeel of white wine showed that clarification via flotation resulted in wines with very similar properties to those made using typical cold settling/racking practices. This result should provide winemakers with increased confidence in using the more efficient and cost-effective flotation method for white juice clarification.

Success in trials of alternative heat and cold stabilisation techniques

Successful proof-of-principle studies demonstrated the potential of alternative cold stabilisation strategies based on zeolites and plasma-modified surfaces. Using zeolites and coated surfaces with carefully designed chemical functionalities could induce cold stabilisation without a need for cold storage of wine, reducing energy costs.

Implementation options for aeration of ferments

To support the adoption of ferment aeration, experiments were conducted to determine whether gas flow rate, sparger surface area, or both, should scale with ferment size when aerating static white fermentations. For a given airflow rate there was little evidence that an increase in sparger surface area or a change in the distribution of spargers within the vessel had any effect on total change in redox potential. The main effect was derived from increases in gas flow rate. These results suggest that for the low flow rates advised for aeration of white ferments, complex sparger arrangements may not be necessary for effective aeration, especially for longer duration treatments.

Understanding the properties of no- and low-alcohol (NOLO) beverages

Comprehensive sensory and chemical profiling were completed on sparkling, white, rosé and red NOLO wines as well as NOLO beers, ciders and spirits. Results highlighted the effects of the alcohol removal process on chemical composition and identified sensory characteristics that are best suited to these products. Sensory evaluations were also completed on possible additives that may improve the flavour and texture of NOLO products.

Potential role for marc-derived extracts in NOLO products

Marc-derived glycoside extracts were found to be useful in NOLO wines, whether by addition leading to direct in-mouth production of flavour, or through the generation of odour-active monoterpenes during subsequent bottle storage. The knowledge previously gained on the role of glycosides in wine flavour appears to also be directly applicable to NOLO products.

Genetic basis of low-acetate-producing wine yeast hybrid identified

Genetic analysis of a previously developed *Saccharomyces cerevisiae*-*Saccharomyces uvarum* hybrid yeast with a trait of producing low concentrations of acetic acid identified four key areas of interest within the chromosome earlier associated with the trait. Deletion of individual genes identified a known negative regulator of glycerol production as a critical factor in the loss of the low acetic acid trait. This work suggests that there is a level of interplay between *S. cerevisiae* and *S. uvarum* genomes within the hybrid, improving its ability to adapt to high sugar concentrations and lowering its production of acetic acid.

New strains of *Oenococcus oeni* isolated

Two novel strains of *O. oeni*, originally isolated from wild ferments, were identified as having potential as commercial starter cultures. These strains exhibit superior pH and ethanol tolerance, favourable MLF performance and similar impacts on alcoholic fermentation and acetic acid production to existing commercial strains.

Understanding interactions between non-*Saccharomyces* yeast and *Saccharomyces cerevisiae*

Progress was made in understanding potential causes of negative interactions between non-*Saccharomyces* yeast and *S. cerevisiae*, relevant to winemakers who wish to use non-*Saccharomyces* starter cultures. While previous work had suggested that that inhibition of *S. cerevisiae* by *Torulaspora delbrueckii* was related to the depletion of specific amino acids, this was demonstrated not to be the case. It now appears increasingly likely that the inhibition results from vitamin and elemental nutrient sequestration. In parallel, experimental work showed that iron sequestration was not responsible for the inhibition of fermentation by *Metschnikowia pulcherrima*, as had previously been suspected.

Industry-endorsed standard procedures for grape assessment

In response to recommendations from the ACCC, industry-endorsed standard procedures were developed for the measurement of total soluble solids, pH, titratable acidity and colour, and for the validation of secondary methods. A range of supporting documents were also created, to help ensure grape assessment practices are as accurate and reliable as possible. This work was guided and reviewed by a project reference group of representatives from key industry bodies.

Assessing SO_2-tolerant strains of *Brettanomyces*

Industry isolates of *Brettanomyces* were screened for the ability consume *p*-coumaric acid, the precursor of the wine spoilage compound, 4-ethylphenol. There was no significant difference in the ability of SO_2-tolerant strains to consume coumaric acid compared to their SO_2-susceptible counterparts. This indicates that the SO_2-tolerant strains retain the potential to spoil wine at a level similar to susceptible strains. The SO_2-tolerant strains were also tested for susceptibility to the antimicrobial agents dimethyl dicarbonate and chitosan. Both agents demonstrated effectiveness against these isolates.

New understanding of the formation and preservation of 'flint' character in wine

A range of experiments assessed factors influencing the formation and preservation of phenylmethanethiol (PMT), a compound associated with 'flint' character in wine. A link was established between juice nitrogen status and the amount of PMT produced during winemaking. The preservation of PMT in wines was detrimentally affected by copper and iron, as well as high residual concentrations of H_2S and SO_2.

Contribution of non-*Saccharomyces* yeast to 'flint' aromas and their precursors

The ability of non-*Saccharomyces* yeast to produce aroma compounds benzaldehyde ('almond') and benzyl alcohol ('chocolate', 'fig' and 'tobacco') was investigated. Benzaldehyde is also known to be one of the precursors of PMT ('flint'). Nine *Hanseniaspora vineae* and *Hanseniaspora osmophila* strains were evaluated. The *H. vineae* strains produced higher levels of benzaldehyde and benzyl alcohol, but this did not result in an increase in the formation of PMT. *H. osmophila* strains produced high levels of PMT. This study demonstrated the potential for non-*Saccharomyces* yeast to be used in the modulation of 'flint' aromas in wine.

Novel smart surfaces successfully remove 'reductive' aroma compounds from wine

The effectiveness of smart surfaces in removing 'free' H_2S, methanethiol (MeSH), and ethanethiol (EtSH) from wines was compared with the common practice of copper fining. The concentrations of H_2S, MeSH and EtSH were significantly decreased after treatment with the smart surfaces. The treatment was as effective or more effective than copper fining for white wines. In addition, SO_2 did not interfere with the ability of the smart surfaces to remove H_2S and the treatment did not remove 'tropical' thiols.

Minimising the risk of 'reductive' characters in canned wines

Wine compositional factors including pH, free SO_2, copper, oxygen, chloride and elevated temperatures have been shown to influence the migration of aluminium into canned wines and the subsequent formation of H_2S. Trials with a consortium of canned wine producers showed that the risk of reductive characters in canned wines can be minimised if wines with a low-risk compositional profile are pre-selected. This can be combined with treatment using a commercial cross-linked polymer prior to canning to decrease the risk of aluminium migration into the wines and the subsequent formation of H_2S.

Key smoke markers confirmed

A set of smoke markers including several volatile phenols and glycosides in grapes and wine were found to be strongly related to smoke flavour in wine. Different models were required to predict smoky flavour in Chardonnay, Pinot Noir and Shiraz wines from grape data. The AWRI can now provide better guidance to producers on smoke marker concentrations in grapes and wine that are likely to result in smoky wines.

Background database of smoke marker compounds

A comprehensive dataset from more than 1,000 non-smoke-exposed grape and wine samples across 12 major varieties was published in an open-access peer-reviewed article. These values are used routinely for interpretation of smoke analysis results and the identification of grapes not exposed to smoke.

Environment, sustainability and natural capital

Sustainable Winegrowing Australia membership, certification and trust mark use

In 2021/22, membership increased from 631 to 933, with certified members representing 24% of total members. The Sustainable Winegrowing Australia trust mark, which is available for use by certified members, grew in visibility during the year, appearing on more than 100 wine labels, 100 farm gate signs and in the marketing and promotions of a range of certified members.

WIC Winemaking Services achieves Sustainable Winegrowing Australia certification

WIC Winemaking Services attained certified member status with Sustainable Winegrowing Australia. This certification reflects the facility's commitment to sustainable practices and continuous improvement.

Sequencing Australian grapevine clones

Whole genome sequencing was completed on almost 400 grapevine samples, featuring clones of Chardonnay, Shiraz, Pinot Noir and Riesling. This sample set represents the majority of clones from the main suppliers of grapevine germplasm in Australia. For the first time, genetic fingerprints were established for clonal variants in these important varieties.

Impact of temperature on wild ferments

The effect of different temperatures (12°C, 22°C and 28°C) on uninoculated Chardonnay and Shiraz fermentations was investigated. Increasing temperature increased fermentation rate, as expected, resulting in shorter fermentation times. Total yeast cell counts were higher at higher temperatures, although some differences were found depending on grape variety. In Chardonnay, higher temperatures promoted the growth of *S. cerevisiae*, decreasing the abundance of *Hanseniaspora* and *Torulaspora* species. In Shiraz, relative abundance of *S. cerevisiae* and *Starmerella* species increased with higher temperature, while the abundance of *Metschnikowia* and *Lachancea* species decreased. Differences in chemical composition were also found in the final wines.

Non-*Saccharomyces* yeast strains show promise

Three strains of non-*Saccharomyces* were identified as having potential as commercial starter cultures. After an initial selection based on enzyme activities that can release important flavour compounds, pilot-scale trials were performed in Riesling. Sensory analysis revealed that all non-*Saccharomyces* wines were different from the control wines, with *Metschnikowia* wines associated with 'tropical fruit' attributes and *Torulaspora* wines associated with 'stone fruit' and 'citrus' flavours. These findings demonstrate the potential for non-*Saccharomyces* starter cultures to shape wine flavour and aroma and suggest it would be worthwhile to evaluate them in other grape varieties.

Fungicide resistance in powdery mildew investigated

Whole genome sequencing was used as a new approach to investigating population structure and resistance status of powdery mildew, providing more information than previous PCR-based testing.

Autonomous vineyard vehicles demonstrated

An autonomy kit was fitted to a tractor and it was successfully run with under-vine weeding and other vineyard implements, including a canopy sprayer and a mulcher. A demonstration day was held for growers to share initial experiences with the equipment.

Foundational data and support services

Changes to Board appointments

Following an extensive review of its composition and appointment processes, the AWRI Board implemented a range of substantive changes including the introduction of a position elected by Grape Research Levy payers, a reduction in Elected Directors from six to four, an increase in Appointed Directors from four to six, an open recruitment process for Appointed Directors and the introduction of diversity quotas. These changes ensure the AWRI remains well placed to meet the evolving needs of the Australian grape and wine industry and demonstrates contemporary governance principles.

Completion of five-year portfolio of projects

This financial year saw the completion of a portfolio of research, development, extension and adoption projects funded by Wine Australia under a five-year agreement. Final Reports will be completed early in 2022/23 and made available through the Wine Australia website.

Renewed funding agreement with Wine Australia

Renewed arrangements for the funding received by the AWRI from Wine Australia were developed in conjunction with a new portfolio of research, development, extension and adoption projects, which incorporate a high degree of ongoing stakeholder engagement through an embedded co-innovation process. This agreement will be effective from July 2022 to June 2026.

Launch of Affinity Labs and refreshed AWRI branding

A new identity for the AWRI's commercial activities, Affinity Labs, was launched in June at the 18th AWITC. The launch followed significant strategy development and stakeholder consultation. The new identity will support growth in non-traditional industries, while also drawing on the strengths of the AWRI. Refreshed AWRI branding was developed in parallel, to ensure the two brands can work closely together.

Service delivery and customer growth

In 2021/22 Affinity Labs processed 26,226 samples, slightly lower than the 2019 to 2021 average of 26,704 but in keeping with typical year-on-year variation. Customer numbers grew by 113, demonstrating continued demand for the services provided.

Citizen science project engaging school students

The AWRI is working with school students around Australia on a citizen science project, funded by the Australian Government Department of Industry, Science and Resources, that is looking for undiscovered Australian fungal species. In the project's first year, eight schools participated and 90 positive cultures were re-cultured to obtain yeast isolates. At least 37 different species of yeast were found, with some species present in more than one sample.

Metabolomics capability increased

Metabolomics SA has increased its capability and can now profile more than 400 non-volatile metabolites in plants, biofluids, microorganisms, foods and beverages. The facility launched a new website (metabolomics.awri.com.au) to promote the analytical technologies, services and expertise it offers to researchers and industry.

Staff

The number of AWRI staff employed in a full-time, part-time and casual capacity as at 30 June 2022 was 145 (106.3 full-time equivalents). When the number of AWRI-based students (both from Australia and overseas) and visiting researchers is added, the total increases to 146. Of these, approximately 61.5% were funded by Wine Australia in 2021/22.

Office of the Managing Director

Mark Krstic, BAgSc (Hons), PhD *UniTas*, MBA *MelbBusSchool*, GAICD, Managing Director

Shiralee Dodd, BA, LLB (Hons), GradDip (Legal Prac) *UniAdel*, Company Secretary

Mardi Longbottom, BAgSc (Vitic Sci), MVit, PhD *UniAdel*, Manager – Sustainability and Viticulture

Ella Robinson, BA, BSc (Hons) *UniAdel,* Communication Manager

Tony Robinson, BSc (Hons) (Hort and Vitic) *UniWA* and *UniAdel,* PhD *Murdoch*, Business Development Manager

Natalie Burgan, Cert IV (Bus Admin) *National Group Training,* Dip (Proj Mgt) *SG Learning and Development,* Executive Officer

Kate Hardy, BA, LLB (Hons), GradDip (Legal Prac) *UniAdel,* GAICD, Legal Advisor

Liz Pitcher, BAgSc (Hons) *UniAdel,* BAppSc (Vitic) *CSU,* Cert IV (Training and Assessment) *Harrison Training Group,* Sustainability and Viticulture Specialist

Kyla Schmidt, Dip (WineMktg) *Uni Adel,* Marketing Lead (started 21 March 2022)

Corporate Services

Chris Day, BAgSc (Hons) (Oen), MBA *UniAdel,* GradCert Chartered Accounting Foundations *Deakin,* CA, GAICD, Group Manager – Corporate Services

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

Kate Beames, Cert IV (Small Bus Mgt) *Adelaide New Enterprise Training Services,* AWITC Conference Manager (concluded 7 January 2022)

Adam Holland, Cert IV (IT) *NTUni,* IT Manager

Alfons Cuijvers, MLaw *UniAntwerp,* Human Resources Manager

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

Fang Tang, Undergrad (Foreign Econ) *RenminUniChina,* GradDip (Fin Mgt), MCom *UniNewEng,* Finance Officer

Pauline Jorgensen, Cert III (Bus Admin) *TAFE SA,* Finance Officer

Kylee Watson, Cert III (Fin Services) *TAFE SA,* Finance Officer

Alex Hennig, Cert IV IT (Networking) *TAFE SA,* Microsoft Office Associate, IT Support Officer (started 16 May 2022)

Josephine Giorgio-Ion, Receptionist

Jennifer O'Mahony, Receptionist

Research

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

Keren Bindon, BSc (Hons) (Biol) *UniNatal,* MSc (Plant Biotechnol) *Stellenbosch,* PhD (Vitic) *UniAdel,* Research Manager

Anthony Borneman, BSc (Hons), PhD *UniMelb,* Research Manager – Molecular Biology

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

Simon Schmidt, BSc (Hons), PhD *Flinders,* Research Manager – Biosciences

Paul Henschke, BSc (Hons), PhD *UniAdel,* Emeritus Fellow

Cristian Varela, BSc (Biochem), MSc (Biochem), PhD (Chem Eng and Bioprocesses) *CatholicUniChile,* Principal Research Scientist

Marlize Bekker, BSc (Ind Chem), BSc (Hons), MSc (Chem), PhD (Chem) *Stellenbosch,* Senior Research Scientist

Agnieszka Mierczynska-Vasilev, MSc (Chem), PhD *UniLodz,* Senior Research Scientist

Jenny Bellon, BSc (Biochem and Genet), PhD *UniAdel,* Research Scientist

Toni Garcia Cordente, BSc (Chem), BSc (Biochem), PhD (Biochem and Mol Biol) *UniBarcelona,* Research Scientist

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

Julie Culbert, BSc (Hons), PhD *UniAdel,* Research Scientist

Richard Gawel, BSc, GradDip (Ed) *UniAdel,* GradDip (Oen) *Roseworthy,* PhD *Deakin,* Cert IV (Workplace Training/Assessment) *TAFE SA,* Research Scientist

Josh Hixson, BTech, BSc (Hons) *Flinders,* PhD *UniAdel,* Research Scientist

Darek Kutyna, MSc *AgUniPoland,* PhD *Victoria,* Research Scientist

Cristobal Onetto, MSc, PhD *UniAdel,* Research Scientist

Mango Parker, BSc (Chem) *Flinders,* PhD *UniSA,* Research Scientist

Wes Pearson, BSc (Wine Biochem) *UniBritishColumbia,* GradCert (Appl Sensory Sci and Consumer Testing) *UC Davis,* PhD *CSU,* Research Scientist

Tracey Siebert, ScTechCert (Chem) *SAIT,* BSc (Org Chem and Pharmacol) *UniAdel,* PhD *UniSA,* Research Scientist

Chris Ward, BSc (Hons) (Genet and Evol), PhD *UniAdel,* Research Scientist

Alicia Jouin, BSc, MSc, PhD *ISVV,* Post Doctoral Research Scientist (concluded 31 January 2022)

Sheridan Barter, BTech (Foren and Analyt Chem), BSc (Hons) *Flinders,* Senior Scientist

Damian Espinase Nandorfy, BSc (Hons) (Oen and Vitic) *Brock,* GradCert (Appl Sensory and Consumer Sci) *UC Davis,* Senior Scientist

Stella Kassara, BSc (Hons) *UniAdel,* Senior Scientist

Mark Solomon, BSc (Hons) (Med Chem) *Flinders,* Senior Scientist

Eleanor Bilogrevic, BSc (Nutr and Food Sci) *UniSA,* GradCert (Appl Sensory and Consumer Sci) *UC Davis,* Scientist

Simon Dillon, BSc (Hons) (Microbiol and Molec Biol) *Flinders,* Cert IV (Leadership and Management) *LMA,* Scientist

Yevgeniya Grebneva, DipFoodChem *TechUniDresden,* PhD *HochschuleGeisenheimUni,* Scientist (concluded 31 December 2021)

WenWen Jiang, BBioeng *DalianPolytech,* MOenVitic *UniAdel,* Scientist

Charlotte Jordans, BSc (Biochem), MSc (Agron) *UniCopenhagen,* Scientist

Allie Kulcsar, BSc (Foren and Analyt Sci) (Hons) *Flinders,* Scientist

Alex Schulkin, BSc *Bar-Ilan,* GradDip (Oen) *UniAdel,* Scientist

Flynn Watson, BSc (Hons) (Double Chem) *UniAdel,* Scientist

Kate Cuijvers, BSc (Hons) (Genet) *UniAdel,* Cert II (Medical Service First Response) *StJohn,* Technical Officer

Laura Hale, BSc (Genet), BSc(Hons) (Evol and Paleobiol) *UniAdel,* Technical Officer

Radka Kolouchova, AssocDip *TechCollFoodTech,* Technical Officer (concluded 23 July 2021)

Renata Kucera, BSc (Hons) (Foren and Analyt Chem) *Flinders,* Technical Officer (concluded 10 June 2022)

Deanna Langone, BSc (Hons) (Foren and Analyt Sc) *Flinders,* Technical Officer (started 4 April 2022)

Desireé Likos, BSc (Biochem and Microbiol) *UniAdel,* GradCert (Appl Sensory and Consumer Sci) *UC Davis,* Technical Officer

Jane McCarthy, Cert (Anim Hand), Cert (Vet Nurs) *TAFE SA,* AdvCert (Med Lab Sc) *UniSA,* Technical Officer

Lisa Pisaniello, BSc (Foren and Analyt Sci) *Flinders,* Technical Officer

Song Qi, BSc (Molec and Drug Design) *UniAdel,* Technical Officer

Tim Reilly, BSc (Hons) (Nanotech) *Flinders,* Technical Officer

Steven Van Den Heuvel, BSc (Hons) (Molec Biol) *Flinders,* Technical Officer

Jelena Jovanovic, Purchasing Officer

June Robinson, Laboratory Assistant

Metabolomics South Australia

Natoiya Lloyd, BSc (Hons) *Flinders,* PhD UniAdel, Node Manager Metabolomics SA

Luca Nicolotti, M (Chem and Pharmaceut Technol), PhD *UniTurin,* Research Scientist

Maryam Taraji, BSc (Appl Chem) *UniGuilan,* MSc (Analyt Chem) *Al-Zahra,* PhD *UniTas,* Research Scientist

Don Teng, PostGradDip (Math and Stat), MSc (Bioinform) *UniMelb,* Bioinformatician

Vilma Hysenaj, BSc, M (Pharm Chem), PhD (Food Chem) *UniGenova,* Post Doctoral Research Scientist

Georgia Davidson, BSc (Hons) (Foren and Analyt Chem) *Flinders,* Technical Officer

Casual sensory panel

Nina Blake, Junko Blaney, Amy Cantor, Allison Cox, Amanda Dalton-Winks, Sara Davis, Penelope Elliot, David Evans, Penelope Fox, Josephine Giorgio-Ion, Philippa Hall, Sonya Henderson, Mary-Jane Hendry, Carrie Hill, Gurinder Khera, Mary Likos, Beverley Kiil, Susan Lincoln, Wai (Patrick) Liu, Rosemary McCarron, Dimple Melwani, Kerin Montgomerie, Liam O'Mahony, Virginia Phillips, Pierre Rafini, Sue Robinson, Jane Schapel, Makiko Sheehy, Heather Smith, Corey Spencer, Jacqueline Stone, Volker Trede, Susan Zabrowarny, Matthew Zdenkowski

Industry Development and Support

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

Peter Dry, BAgSc, MAgSc, PhD *UniAdel,* Emeritus Fellow

Yoji Hayasaka, DipEng (Ind Chem) *Tokyo IT,* MPharm *Victorian College of Pharmacy Monash,* PhD *Yamanashi,* Honorary Fellow

Linda Bevin, BBus (Info Mgt), GradDip (Lib and Info Stud) *QUT,* Information and Knowledge Manager

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

Geoff Cowey, Dip *WSET,* BAppSc (WineSc) *CSU,* BSc (Hons) *UniAdel,* Senior Oenologist

Matt Holdstock, BSc *Flinders,* GradDip (Oen) *UniAdel,* Senior Oenologist

Robyn Dixon, BSc, GradDip (Vitic) *UniAdel,* MAppSc *Lincoln*, Senior Viticulturist

Marcel Essling, BBus *Victoria,* BAgSc *UniAdel,* Senior Viticulturist

Chris Penfold, MAppSci (Ag) *UniAdel,* Senior Viticulturist

Christa Schwarz, BViticOen *UniAdel,* Technical Officer – Viticulture (started 22 November 2021)

Ben Cordingley, BSc (Hons) (Biotechnol) *UniNSW,* BWineSc *CSU,* Oenologist

John Gledhill, BAppSc (WineSc), BAppSc (Vitic) *CSU,* Winemaker

Francesca Blefari, BBus *UniEdithCowan,* Project Manager

Anne Lord, GradDip (Info Stud) *UniSA,* Librarian

Rosanne Dunne, BA (Info Stud) (Public and Corp Info Mgt) *UniSA,* AALIA, Library Coordinator (started 23 August 2021)

Russell Desmond, BViticOen UniAdel, Assistant Winemaker (started 29 November 2021)

Lieke van der Hulst, BSc *Leiden,* MSc *TechUniDelft,* PhD *UniAdel,* Assistant Winemaker (concluded 14 September 2021)

Will McSorley, Dip EventMgt *TAFE SA,* Project/Conference Coordinator (started 30 August 2021)

Elli-Marie Panagis, BBus (Tourism and Event Mgt) *UniSA,* Project Coordinator

Jessica Scudds, BCA (Fashion Design and Tech) *Flinders,* Project Coordinator

Affinity Labs

Eric Wilkes, BSc (Hons) (Chem), PhD *UniNewcastle,* General Manager – Affinity Labs

Neil Scrimgeour, BSc (Hons) (App Chem) *Wolverhampton,* Business Development Manager

Leanne Hoxey, BSc *UniAdel,* Operational Support Manager

Randell Taylor, BSc (Hons) *UniAdel,* Manager Trace Laboratory (deceased 27 November 2021)

Alan Little, BSc (Hons) (Biochem), PhD *UniAdel,* Manager Applied Biosciences (concluded 31 December 2021)

Amy Rinaldo, BBiotech (Hons) *Flinders,* PhD *UniAdel,* Manager Applied Biosciences

Nuredin Habili, BAgSc (Hons), PhD *UniAdel,* Senior Research Scientist (concluded 31 December 2021), Emeritus Fellow

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

Bryan Newell, BAppSc (Chem and Physics) *UniSA,* Team Leader – Analytical Laboratory

Pamela Solomon, BTech (Foren and Analyt Chem), BInnovationEnterprise (Sci and Tech) *Flinders,* Manager – Trace Laboratory

Susanne Copeland, MBiochemEng *MannheimUniApplSci,* Germany, Quality Assurance Coordinator (started 17 January 2022)

Kieran Hirlam, BE (Hons) (Chem), BFin *UniAdel,* Project Team Manager

Marco Schoeman, BSc (Biotechnol) *UniAdel,* Customer Service Manager (started 17 January 2022)

Wen-Hsiang (Denny) Hsieh, BChemEng *TatungUni,* MChemMatEng *NationalCentralUniTaiwan*, MViticOen UniAdel, Project Engineer

Caroline Bartel, BSc (Hons) (Biotech) *UniAdel,* Scientist

Laura Bey, BSc (Foren and Analyt Chem), GradCert (Bus Admin) *Flinders,* Scientist

Thomas Hensel, BTech (Foren and Analyt Chem), BSc (Hons), MSc (Chem) *Flinders,* Scientist

Heather Tosen, BSc *UniAdel,* Scientist

Simone Madaras, BSc (Hons) (Foren and Analyt Chem), PhD *Flinders,* Project Technician

Manreet Bansal, BSc (Nanotech) *Flinders,* Laboratory Technician (concluded 3 September 2021)

Ida Batiancila, Laboratory Technician

Zung Do, BFoodSc, MFoodSc *HanoiUniSciTechnol,* PhD *UniAdel,* Laboratory Technician

Kerri Duncan, BSc (AnimalSc) *UniAdel,* Laboratory Technician (concluded 3 September 2021)

Jesse Hall, BSc (Foren and Analyt Sci) *Flinders,* Laboratory Technician

Joshua Lennon, BSc (Chem), BMathCompSci *UniAdel,* Laboratory Technician (started 6 June 2022)

Jacinta McAskill, Cert III (Lab Operations) *Sunraysia TAFE,* Laboratory Technician

Emily Milsom, BSc (Hons) (Chem) *UniAdel,* Laboratory Technician (started 23 May 2022)

Emma Muehlberg, BTech (Foren and Analyt Chem), BSc (Hons), PhD *Flinders,* Laboratory Technician (started 8 November 2021)

Kara Paxton, BPharmSc, BBiomedRes (Hons) *UniSA,* Laboratory Technician (concluded 20 May 2022)

Jessica Schrapel, BSc (Hons) (Foren and Analyt Sc) *Flinders,* Laboratory Technician (started 21 February 2022)

Dean Smiley, Laboratory Technician

Caitlin Wellman, Cert III (Laboratory Skills) *TAFE SA,* Laboratory Technician (concluded 24 June 2022)

Matthew Wheal, BSc (Hons) (Biol), PhD *UniAdel,* Laboratory Technician

Qi Wu, BPlantProtection *SouthChinaAgric,* MPlantHealthBiosecurity *UniAdel,* Laboratory Technician

Sara Zhan, BViticOen *UniAdel,* Laboratory Technician (started 30 August 2021)

Rachel West, BTech (Foren and Analyt Chem), BSc (Hons) (Foren and Analyt Chem), PhD *Flinders,* Operational Support Technician

Yihe (Eva) Sui, MViticOen, PhD *UniAdel,* Project Technician (started 20 June 2022)

Brigitte Lynch, Dip (Bus Admin) *Careers Australia,* MBA *AustInstBus,* Customer Relations Supervisor (concluded 29 November 2021)

Robyn Gleeson, Customer Service Officer

Jillian Lee, Customer Service Officer

Gina Sellars, Laboratory Assistant

Paul Witt, Courier

Students

Jana Hildebrandt, *UniSA,* PhD student

Bryce Polley, QUT, MPhil student

Staff activities

Kate Beames was a member of the Australian Wine Industry Technical Conference Planning Committee (to December 2021).

Anthony Borneman is an Affiliate Associate Professor at the University of Adelaide.

Natalie Burgan is a member of the Australian Wine Industry Technical Conference Planning Committee, Executive Officer for the Wine Innovation Cluster Leadership and Research Committees and a member of the planning committee for Crush – the grape and wine science symposium.

Chris Day is a Chartered Accountant and a Director, Treasurer and Public Officer of the Australian Wine Industry Technical Conference.

Simon Dillon is a member of the SA Biobank Technical Reference Group. He is also a member of the quality group for The International Society for Biological and Environmental Repositories' (ISBER) Best Practice 5th Edition Development Team.

Robyn Dixon is a member of Barossa Vine Improvement Committee, Riverland Grape and Wine Technology Group, Biodiversity McLaren Vale Group and Riverina Vineyard Technical Group.

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

Damian Espinase Nandorfy is a National Science Week SA coordinating committee member.

Angus Forgan is a member of the South Australian Institutional Biosafety Committee Network Forum and a member of the SA Biobank Technical Reference Group.

Leigh Francis is an Associate Editor of the *Australian Journal of Grape and Wine Research*; a member of the Editorial Board of the *Journal of the Science of Food and Agriculture*; an Affiliate Associate Professor at the University of Adelaide; and an Adjunct Associate Professor at the University of South Australia.

Paul Henschke is an Associate Editor of the *Australian Journal of Grape and Wine Research*; an Affiliate Professor at the University of Adelaide; and Fellow of the Australian Society of Viticulture and Oenology.

Markus Herderich is an Affiliate Professor at the University of Adelaide; Director of the Australian Wine Industry Technical Conference; and member of the Metabolomics Australia Executive Management Group. He is also Vice President of the Organisation Internationale de la Vigne et du Vin (OIV) and the Subcommission for Analytical Methods (SCMA) and expert in OIV's Commission-II (Oenology); a member of the Wine Industry Technical Advisory Committee; a member of the Wine Innovation Cluster Research Group; an Associated Editor of *OenoOne* and member of the Journal Advisory Committee of the *Australian Journal of Grape and Wine Research*.

Kieran Hirlam is a member of Australian Grape & Wine's Packaging Committee. He is also a member of the Independent Brewers Association Sustainability Group.

Mark Krstic is an Adjunct Professor at Macquarie University; Chair of the Australian Wine Industry Technical Conference; member of the Advisory Board for the South Australian Genomics Centre; Director of the National Wine Foundation; member of Hort Innovation's Table Grape Strategic Investment Advisory Panel; member of the Waite Strategic Leadership Group; member of the OENOVITI and BAG International Executive Committee; member of Australian Grape & Wine's Sustainability Advisory Committee; Associate Editor of *Wine & Viticulture Journal*; Honorary Senior Fellow at the University of Melbourne; and a graduate of the Australian Wine Industry Future Leaders Program.

Natoiya Lloyd is a member of the Metabolomics Australia Executive Management Group, the Metabolomics Australia Analytical group and the Royal Australian Chemical Institute.

Mardi Longbottom was a Director of the Australian Society of Viticulture and Oenology until November 2021. She is a member of the Australian Grape & Wine's Sustainability Advisory Committee; member of the Environmental Technical Committee of Freshcare Ltd; Fellow of the Governor's Leadership Foundation Program; and a member of the Australian Wine Industry Technical Conference Planning Committee.

Brigitte Lynch was Secretariat for the Interwinery Analysis Group committee (to November 2021).

Agnieszka Mierczynska-Vasilev is a member of Australian Near Infrared Spectroscopy Group. She is also an Adjunct Senior Lecturer at Flinders University.

Bryan Newell is Samples Coordinator for the Interwinery Analysis Group.

Simon Nordestgaard is Conference Program Coordinator for the Winery Engineering Association.

Wes Pearson is a committee member of the McLaren Vale Districts Group and a graduate of the Australian Wine Industry Future Leaders Program and the Len Evans Tutorial.

Amy Rinaldo is a member of the Wine Industry Suppliers Association Viticulture Working Group.

Ella Robinson is a member of the Australian Wine Industry Technical Conference Planning Committee.

Tony Robinson was Treasurer and Director of the Australian Society of Viticulture and Oenology until November 2021. He is an *ex officio* Councillor of the Royal Agricultural and Horticultural Society of South Australia and a member of the Wine Show Sectional Committee; a member of the Australian Wine Industry Technical Conference Planning Committee; an alumni of the Australian-American Fulbright Program; a graduate of the Australian Wine Industry Future Leaders Program; and an MBA Candidate and Aspiring Leaders Scholarship recipient at the University of Adelaide Business School.

Neil Scrimgeour is a member of Australian Grape & Wine's Packaging Committee.

Con Simos is a member of the Australian Wine Industry Technical Conference Planning Committee; a member of the WA Wine Industry Association R&D Committee; and a graduate of the Australian Wine Industry Future Leaders Program.

Cristian Varela is a member of the Editorial Board of the journals *Applied and Environmental Microbiology*, *International Journal of Food Microbiology*, *Food Microbiology* and *FEMS Yeast Research*. He is also Affiliate Senior Lecturer at the University of Adelaide and member of the Australian Society of Viticulture and Oenology.

Rachel West is Samples Coordinator for the Interwinery Analysis Group.

Matthew Wheal is the Secretary and South Australian representative of the Australasian Plant and Soil Analysis Council.

Eric Wilkes is a member of the Interwinery Analysis Group committee; a member of the expert panel of the Subcommission for Analytical Methods in OIV's Commission-II (Oenology); a member of the Wine Industry Technical Advisory Committee; Treasurer of the SA branch of the Royal Australian Chemical Institute; Co-chair of the FIVS (International Federation of Wines and Spirits) Scientific and Technical Committee; Chair of the FIVS working group on fire impacts; and a member of the Wine Industry Suppliers Association (WISA) committee.

Project Reports

Customers, consumers and markets

The Australian wine industry depends on producing wines that consumers value, trust and are able to access in both domestic and international markets. Projects under this theme take a scientific approach to providing technical guidance on agrochemical use to meet export market requirements; helping to preserve the integrity and quality of Australian wine; and contributing technical expertise to national and international forums on wine regulation.

Staff

Marcel Essling, Prof. Markus Herderich, Anne Lord, Christa Schwarz (from 22 November 2021), Dr Eric Wilkes.

Collaborators

Accolade Wines (Jonathan Breach); agrochemical manufacturers, suppliers and consultants; Agrochemicals Reference Group; Australian Grape & Wine (Tony Battaglene, Damien Griffante); Australian Pesticides and Veterinary Medicines Authority (APVMA) (James Deller); CropLife Australia (Gregory Sekulic); Department of Agriculture, Fisheries and Forestry (Nigel Pinto); E. & J. Gallo Winery, USA (Steve Tallman); ETS Laboratories, USA (Gordon Burns); FIVS (Bennett Caplan); Food Standards Australia New Zealand (FSANZ) (Dr Mark FitzRoy); GrapeLink (Graeme Forsythe); Grapeweb (Okhi Oktanio, Mark Riddell); Homologa (Olivier Flandre); Organisation International de la Vigne et du Vin (OIV), France (Pau Roca, Dr Jean-Claude Ruf); South Australian Research and Development Institute (SARDI) (Dr Ismail Ismail, Dr Mark Sosnowski); Pernod Ricard Winemakers (Philip Deverell); Treasury Wine Estates (Dr Kerry DeGaris); Wine Australia (Steve Guy, Laura Jewell, Rachel Triggs); Wine Institute, USA (Katherine Bedard).

Supporting market access, safety and regulation

Background

Maintaining market access and opening markets for Australian wine are facilitated by managing and reducing current and potential barriers to trade. The Australian wine industry needs to anticipate, facilitate and influence regulation of wine composition, production, labelling and marketing. This project provides regulatory-related scientific and technical advice and assistance to key industry stakeholders. In addition, it supports representation at national and international industry forums in order to raise awareness of matters of concern to the Australian wine industry.

Technical aspects of supporting market access

Technical support for market access for Australian wine continued and the project team actively participated in international meetings including the International Wine Technical Summit, FIVS, World Wine Trade Group, the OIV and the APEC Wine Regulatory Forum. Support was also provided to Australian Grape & Wine's Wine Industry Technical Advisory Committee, with information delivered on changes to the international regulatory environment and opportunities to improve market access.

Key papers and presentations prepared during the year included:

- A comparison of the results from 18 international laboratories for smoke taint analysis, presented at the FIVS symposium in Belgium
- A paper on the challenges of producing and measuring regulatory information for no- and low-alcohol wines for the Australasian Wine Law Association
- A *Technical Review* article which presented aggregated analytical data describing the impacts of typical values for alcohol and other wine components on wine energy content and recommended the best approach for consistent information for consumers to be included on packaging at minimum cost to producers
- A presentation to postgraduate students at the Technical University of Munich, Germany on advances in wine authenticity and provenance testing, which provided a New World perspective
- Recommendations to the OIV on the classification of dimethyl decarbonate (DMDC) as a processing aid; amelioration of smoke-affected wine; appropriate use of total dry extract; use of DL-tartaric acid to treat calcium instabilities; opportunities for streamlining certificates of analysis; and assessment of water additions during winemaking
- Input into a review of the domestic organic regulatory framework and proposed amendments to the Australian National Standard for Organic and Bio-Dynamic Produce
- Briefings on opportunities from and labelling requirements associated with emerging genetic modification technologies for strain development and plant breeding
- A briefing on permitted concentrations of boron in wine.

The international ring test program managed by the AWRI in conjunction with the Interwinery Analysis Group continued with 19 laboratories from 10 countries in Asia, Australasia, North America,

Africa and South America. The project team, in conjunction with the FIVS Scientific and Technical Committee working group on smoke impacts, also continued to advocate for standardisation in the measurement of fire impacts in grapes and wine. This group commissioned a major ring test, managed by the AWRI, of laboratories offering smoke taint testing in Australia, Europe, South America and the United States. Each laboratory tested five different red and white wines with varying levels of smoke compounds (including blind duplicates). A major difference was found in the variability across different laboratories for the two methods commonly used to measure bound smoke compounds in wine (Figure 1). The more commonly used hydrolysis-based method gave significantly more variable results for all the bound smoke markers than the direct liquid chromatography-mass spectrometry (LCMS) method, as developed and used by the AWRI. These results suggest that it is not appropriate to use hydrolysis methods when comparing results between laboratories or when comparing studies on smoke mitigation technologies.

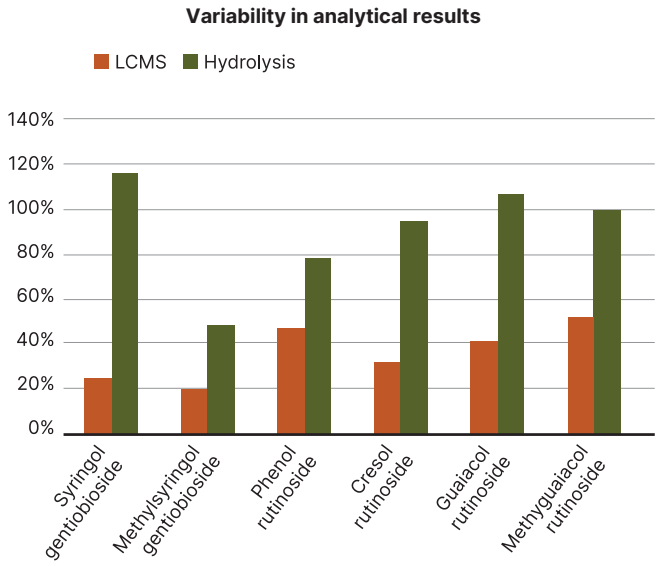

Figure 1. Average variability in analytical results (measured as % coefficient of variation) across 19 laboratories when measuring a range of bound smoke marker compounds in five wines using the two most common measurement techniques (LCMS, tan vs hydrolysis, green)

Work also continued on developing a uniform approach for the description of the dietary energy content of wines. Analysis of data from Affinity Labs' wine analysis databases led to a set of recommendations for standard declarations for energy content based on wine style rather than calculating energy for each individual wine. Such an approach easily stayed within the label tolerances required in Europe and North America while providing meaningful information to consumers and reducing costs to producers. These recommendations will be included in an industry submission to FSANZ on the requirement for nutritional and energy labelling.

Collecting and disseminating information on agrochemicals

Background

Governments around the world monitor residues of agrochemicals and set limits for the amounts that are legally allowed in foods, including grapes and wine. Up-to-date information on agrochemical management is needed to ensure that finished wines meet these limits and do not encounter trade barriers. This project aims to assist grape and wine producers to manage agrochemical residues in their products. This is achieved by collating and providing accurate and timely information on regulatory and technical aspects of chemicals registered for use in Australian viticulture and the maximum residue limit (MRL) requirements of those chemicals in domestic and key export markets.

Providing information and working for the sector

The project team reviewed the latest information on agrochemicals by liaising with regulators, chemical manufacturers, suppliers and end-users. Best-practice recommendations were then incorporated into a new version of the publication *Agrochemicals registered for use in Australian viticulture* (commonly known as the 'Dog book'). A total of 6,000 copies of the 2022/23 'Dog book' were produced in June 2022 for distribution in July 2022. Updates were made to the online search portal and the agrochemical app, and an electronic version of the 'Dog book' was made available through the AWRI website.

Four new active constituents (acetic acid, iron phosphate, iron powder and polyoxin D zinc salt) were registered for use in wine-grape production. Because the compounds had not previously been used in viticulture in Australia in circumstances where the active ingredients would contact the vines, data on fermentation impacts, sensory effects and residues were required to assess the suitability of these compounds for use in wine-grape production. Decisions about withholding periods to be included in the 'Dog book' were made by the Agrochemical Reference Group.

Information on agrochemicals or pest and disease issues was provided to stakeholders via four *eBulletins*, including one in October 2021 which discussed the effective use of sulfur in cool conditions. Project staff also worked with chemical company suppliers to identify active constituents that are not registered for use in viticulture, but which might be useful if registration could be obtained. This process resulted in three chemical companies using the Agvet Chemicals Program to identify the information that would be required to have eight new chemicals registered for the viticulture sector.

The importance of working together

The primary goals of this project were met through three key factors working harmoniously. Firstly, the regulatory environment was monitored by project staff. It is important that proposed changes are identified early and evaluated to determine their relevance to grape production practices and wine residues. Project staff actively scanned notifications of a sanitary and phytosanitary or technical barrier to trade nature that are issued through the World Trade Organisation facility, ePing. Reviewing these notifications identified more than 30 proposed or actual changes to MRLs, none of which ended up resulting in changes to 'Dog book' recommendations. Other resources were also accessed, including the USDA's Global Agriculture Information Network. Regular comparisons were made of the MRLs in the AWRI database with MRLs of key export markets to ensure that the database remained up to date.

The second important factor integral to the success of the project was Affinity Labs. This commercial arm of the AWRI contributed extensive expertise and data about agrochemical residues in grapes and wine. For example, when there was a change to the iprodione registration in the EU, Affinity Labs was able to provide data on the iprodione residues in grapes and wine from historical residue testing. This confirmed that a change to the 'Dog book' recommendation for this active constituent was not required. In situations where the presence of a novel analyte in wine is questioned, Affinity Labs staff are integral in discussions about the potential risk and how to test for the substance.

The agrochemical reference group was the third key factor. This group, made up of geographically diverse grape and wine stakeholders, performs the important function of determining the 'Dog book' recommendations for the following season. The willingness of group members to share information for the collective good of the industry was again demonstrated this season. Company representatives presented and discussed their residue trial results, including the testing of phosphorous acid residues in grapes and wine. This collaborative mindset is instrumental in this project's success. Reference group members are also responsible for bringing agrochemical issues to the AWRI's attention, including challenges in pest and disease control and market access.

Extension, adoption and education

The full value of research and development is only realised in industry when outcomes are effectively and efficiently implemented by practitioners. For this to occur, both extension and support for adoption are required. Projects under this theme apply a range of proven mechanisms to communicate research outcomes, solve industry problems, provide access to relevant technical resources, educate and train students, foster industry adoption and bridge gaps between research and practice.

Staff

Linda Bevin, Francesca Blefari, Ben Cordingley, Adrian Coulter, Geoff Cowey, Robyn Dixon, Rosanne Dunne (from 23 August 2021), Marcel Essling, Melissa Francis (to 31 August 2021), Dr Nuredin Habili (to 31 December 2021), Prof. Markus Herderich, Matt Holdstock, Dr Mark Krstic, Dr Mardi Longbottom, Anne Lord, Dr Simon Nordestgaard, Elli-Marie Panagis, William McSorley (from 30 August 2021), Liz Pitcher, Ella Robinson, Christa Schwarz (from 22 November 2021), Jessica Scudds, Con Simos, Randell Taylor (to 27 November 2021), Dr Eric Wilkes.

Collaborators

Accolade Wines (Vanessa Stockdale); Agriculture Victoria (Megan Hill); Australian Table Grapes Association Inc. (ATGA) (Jeff Scott); Barossa Grape & Wine Association (Nicki Robins); Brown Family Wine Group (Brett McClen); Hoddles Creek Estate (Franco D'Anna); Langhorne Creek Wine Region (Lian Jaensch); Mornington Peninsula Vignerons Association (Olivia Barrie, Tyson Lewis); Mount Langi Ghiran (Damien Sheehan); Murray Valley Winegrowers (Paul Derrico); OICCE Times-Rivista di Enologia, Italy (Dr Giusi Mainardi); Pernod Ricard Winemakers (Kate Lattey, Steven Scott); Practical Winery and Vineyard Journal, USA (Don Neel); Riverland Wine (Lyndall Rowe); state and regional wine industry associations; University of Adelaide (Dr Sue Bastian, Dr Christopher Ford); University of Melbourne (Prof. Snow Barlow, Dr Pangzhen Zhang); WBM (Anthony Madigan); Wine Australia (Hannah Bentley, Belinda Bramley, Drea Hall, Jo Hargreaves, Jacquie van Santen); Wine Communicators of Australia (WCA) (Prue Kline); Wine Network Consulting (Mark O'Callaghan, Rachel Sutcliffe); Wine Victoria (Angie Bradbury, Megan de Jong, Richard Howden, Damien Sheehan, Rachael Sweeney); Winetitles (Harrison Davies, Sonya Logan, Hans Mick); Yarra Valley Wine Growers Association (Caroline Evans); Yalumba Family Winemakers (Greg Nattrass, Luke Wilson, Matt Zadow).

Improving viticulture and oenology practice through extension and education

Background

The AWRI's extension program uses a range of platforms to facilitate early awareness of research findings, adoption of new technologies and practice change, all of which contribute to improvements in sustainability and competitiveness. Activities include the long-standing AWRI roadshow seminar program; practical workshops; webinars; the Research to Practice program; the Advanced Wine Assessment Course; and other tasting events. Education activities in areas not covered by levy-payer-funded extension are delivered under a user-pays model. Having a number of different platforms for the extension of technical information is important in the pathway to adoption, as it helps cater for diverse audiences and provides different ways for messages to be delivered. Events delivered by the AWRI in 2021/22 are summarised in Appendix 2.

Roadshow seminars and workshops

The AWRI roadshow program transitioned back to mostly face-to-face events this year with 6 seminars and 14 workshops being held in 2021/22 (see Appendix 2 for details). The roadshow seminars presented updates across a range of grape and wine science topics, while the workshops provided hands-on practical components for both winemaking and viticultural content. There were five Chardonnay winemaking treatment tastings, five non-chemical weed control and cover crops workshops, three irrigation efficiency workshops and one aeration of ferments workshop. Of these events, only five were run virtually due to COVID-19-related travel restrictions, while the remaining events were successfully held face-to-face. A total of 725 participants attended seminar and workshop events during the year, more than double the previous year's attendance (347).

Practice change projects

An increased focus on adoption and practice change continued during the year with a range of extension activities related to improving irrigation efficiency in warm inland regions and adoption of the use of oxygen (aeration) during fermentation.

Improving irrigation efficiency in warm inland regions

An irrigation efficiency practice change project commenced in October 2020 with a survey of 180 growers from the warm irrigated regions about their current and planned irrigation practices. The growers surveyed represented 12.2% of the total number of growers in the inland irrigated regions, 11.4% of the total planted area and 11.6% of the total tonnes harvested in vintage 2020. In response to the survey results, a plan to increase the adoption of best-practice irrigation monitoring and maintenance was developed in collaboration with Wine Australia and growers in the Murray Valley and Riverland regions. A new webpage was developed on the AWRI website to make it easier for industry to find resources related to water management. Two short 'how to' videos on irrigation monitoring and maintenance were produced in Mildura, which are available from the water management webpage and from the AWRI's YouTube channel. The videos were showcased at three irrigation practice change workshops held in Mildura, Loxton and Renmark, which had a total of 75 attendees. Two irrigation-related webinars and two podcasts were delivered to share information and encourage adoption of best-practice irrigation monitoring, maintenance and scheduling. A total of 165 people attended the two irrigation webinars and the podcasts received more than 475 listens. In addition, an irrigation scheduling workshop was delivered at the 18th AWITC with more than 30 participants.

Use of aeration during fermentation

Leading up to vintage 2022 a range of extension materials were developed for winemakers interested in aerating their ferments. These included podcast episodes, a designated webpage on the AWRI website, webinars, fact sheets and case studies. An online workshop was presented to more than 200 attendees in November, which brought together a range of presenters including researchers and winemakers with experience in using aeration during fermentation. The workshop focused on practical aspects including simple pieces of equipment that can be used on various tank sizes. After vintage 2022 a workshop was presented at the 18th AWITC with 45 participants. Education and extension activities will continue in the lead-up to vintage 2023, with more face-to-face workshops incorporating regional experts and early adopters.

Foliar sprays to increase flavour potential

An extension and adoption plan for the use of foliar sprays to increase flavour potential in grapes was developed in conjunction with Wine Australia. Delivery of activities will commence early in 2022/23.

Webinars

Twenty-two webinars were presented to a total of 2,502 attendees in 2021/22, an increase from the previous year's attendance of 2,199. Webinars covered a wide spectrum of topics across winemaking and viticultural research, as well as seasonal technical topics, updates on Sustainable Winegrowing Australia, the 2021 National Vintage Report and climate outlooks. The portfolio of presenters remained diverse, with more than 70% of the sessions presented by non-AWRI staff. The most popular webinar during the year (with 280 attendees) was titled 'Winter pruning to increase the longevity of vines' and was presented by Dr Mark Sosnowski (SARDI) and Mia Fischer (Simonit and Sirch). There were more than 17,700 views of this year's webinar recordings via YouTube in 2021/22, and the webinar with the single highest number of online views was also the winter pruning webinar, which received 5,207 views during the year after its upload in July 2021.

Podcast launch

A new podcast 'AWRI decanted' was launched during the year, with episodes of the first series released fortnightly from September to December 2021. This series focused on wine flavour, with topics including 'pepper', 'eucalyptus' and 'stone fruit' characters in wine, as well as the potential flavour in grape glycosides and the positive impacts of aeration of red ferments. Uptake of the podcast was strong, with an average of 435 listens per episode. Following the success of the first series, a second series was initiated in early 2022, with a theme centring on current viticulture research and the practitioners who are adopting it. Two episodes were released in June 2022, with the remainder of the series to be made available from July to September 2022.

Educational courses and events

The AWRI delivered one Advanced Wine Assessment Course (AWAC 54) in November 2021 and one Advanced Viticulture Course in October 2021.

Support for Wine Communicators of Australia

The AWRI provided technical support and hosting of the WCA webinar program and continued to enhance and support the WCA website.

Communication with stakeholders

Background

Communication with the Australian grape and wine community is an essential aspect of the AWRI's activities, helping to maximise benefits from investments in research, development and extension by promoting awareness and adoption. This project develops new content and manages the delivery of information and knowledge to Australian grape and wine producers in formats designed for easy understanding and practical adoption. Communication outlets include the AWRI website, industry journals, the AWRI Annual Report, *Technical Review*, electronic newsletters and social media.

AWRI website

The AWRI website is a major platform for communicating with stakeholders including grape and wine producers, students, potential employees and the general public. More than 223,715 visitors (an increase of 22% from the previous year) accessed the AWRI website during the year with more than 645,775 page-views. Updates to content included detailed resources on non-chemical weed control, incorporating a new decision tool; a new page on water management and best-practice irrigation; a page collating resources on aeration of ferments; new fact sheets on techniques for ameliorating smoke characters in juice and wine; and research updates on all projects conducted under the AWRI's *2017-2025 RD&E plan*. The website was also used to communicate with levy payers about changes to the AWRI Board's election and nomination procedures and to promote events including seminars, workshops, podcasts, tastings and webinars.

eBulletins and *eNews*

Nineteen *eBulletins* were delivered to approximately 3,250 subscribers during the year, providing timely information on technical issues, agrochemical updates, the release of issues of *Technical Review* and the webinar program (Table 1). Five issues of the AWRI's electronic newsletter, *eNews*, were distributed to an audience of more than 3,530 subscribers. This publication provides a range of information to AWRI stakeholders, including on upcoming events, recently published research, new information resources and sustainability updates.

Table 1. *eBulletins* issued during 2021/22

Date	Topic
9 Aug 2021	Time to spring into the next five webinars
11 Aug 2021	*Technical Review* August 2021 issue available online
8 Oct 2021	The seasonal outlook is coming and so are the next five AWRI webinars
12 Oct 2021	Opportunity to provide feedback on proposed changes to AWRI Board composition and appointment processes
13 Oct 2021	Agrochemical update October 2021 – Using sulfur to protect vines
14 Oct 2021	*Technical Review* October 2021 issue available online
29 Oct 2021	Advice for growers dealing with hail damage
9 Nov 2021	Managing vines after hail – webinar and key resources
12 Nov 2021	Managing disease in wet conditions
18 Nov 2021	Vintage is approaching fast and so are the next four AWRI webinars
18 Nov 2021	Downy mildew update
16 Dec 2021	*Technical Review* December 2021 issue available online
20 Dec 2021	Christmas closure and support available during the break
17 Feb 2022	*Technical Review* February 2022 issue available online
7 Apr 2022	*Technical Review* April 2022 issue available online
8 Jun 2022	*Technical Review* June 2022 issue available online
15 Jun 2022	Agrochemical update June 2022
21 Jun 2022	AWRI Board seeking new Chair under revised composition and appointment processes
27 Jun 2022	Launching Affinity Labs – a new identity for our commercial activities

Social media and video content

The AWRI's Twitter account reached approximately 4,030 followers, around 90 more than the previous year. The AWRI's Facebook presence grew by more than 330 likes during the year to reach 2,206. The AWRI's YouTube channel offers AWRI webinar recordings and other AWRI video content. The number of subscribers grew from 2,442 in 2020/21 to more than 4,100 in 2021/22 and the channel attracted more than 271,920 views, up by more than 200% from the previous year.

Three new demonstration videos were produced and uploaded during the year, with content relating to the two current practice change themes of best-practice irrigation and aeration of ferments. The two irrigation videos (on monitoring and maintenance) were posted in May 2022 and each received more than 400 views between their release and the end of June. The aeration video was posted in June and received more than 300 views in less than a month.

Annual report

For the past 67 years, the AWRI has produced a printed annual report as its formal report to Australian winemakers and grapegrowers. Since 1999, the annual reports have also been made available on the AWRI's website. The AWRI publishes a summary of the annual report in the *Australian & New Zealand Grapegrower & Winemaker* and offers to deliver an annual presentation to the board or executive of each major state-based winemaking body. This formal activity complements the wide range of other extension and communication activities undertaken by AWRI staff members throughout the year (see Appendices).

Technical Review

The AWRI's bi-monthly publication, *Technical Review*, publishes abstracts of recently published grape and wine science literature and technical articles authored by AWRI staff. *Technical Review* is provided to grape and wine producers via the AWRI website or a small number of hard copies. A total of 2,941 articles featured in the *Technical Review* Current Literature section were accessed online or provided to readers by library staff during the year. A significant amount of work was conducted to convert *Technical Review* to a purely online publication, built using the library catalogue software. The June 2022 issue was the last hard copy version of *Technical Review*, with the fully online version to be launched in August.

Editorial support

The AWRI contributes regular articles to *Wine & Viticulture Journal* and *Australian & New Zealand Grapegrower & Winemaker*, while also contributing to other Australian and international industry journals. Details of the articles published are included in Appendix 7.

Media liaison

The AWRI is regularly approached by national and international media for comment on technical issues related to wine. Four media releases and one statement were prepared and distributed, with 31 media interviews conducted during the year (Appendix 6).

Development of digital extension tools and software

Background

The AWRI provides a range of online databases and mobile apps to support Australian grape and wine producers. The uptake of these technologies is high and the demand for technology to improve productivity or promote efficient processes is continuing to increase. This project ensures there is a planned and coordinated approach to the development, delivery and maintenance of innovative and collaborative digital tools.

Mobile apps

The agrochemical and MRL databases form the core capability behind the 'Dog book', agrochemical and MRL online search functions and agrochemical mobile apps. The agrochemical and MRL online search portal attracted more than 2,635 users during the year and 699 users downloaded the new mobile app. There were more than 1,380 active users of the mobile app this year.

The winemaking calculators app is one of the AWRI's most popular tools. It helps winemakers conduct a range of calculations needed during wine production, including conversions, additions and label requirements. This year, 781 new users downloaded the winemaking calculator app.

Non-chemical control weed tool

In a project funded by the National Landcare Program, resources including a decision tool were developed to help growers decide which non-chemical weed control options are best suited to their vineyard environment and develop a plan for effective non-chemical weed control. The decision tool is designed to provide growers with information to help narrow down the list of options they could consider, rather than provide them with a single recommendation. Factors such as soil type and condition, slope, rainfall, water availability, weed pressure, vine age, vine vigour, fruit end-use targets, weather conditions and compatibility with existing infrastructure and equipment should all be considered by growers when choosing weed control methods. To complement the tool, three non-chemical weed control case studies were developed as well as webpages related to 11 non-chemical weed control tools used in vineyards and 14 common vineyard weeds. Four workshops were held in regions across Australia to educate growers about non-chemical weed control and the new digital tool.

Water irrigation budget tool

A spreadsheet-based water budgeting tool developed by SARDI was updated into an online tool that includes direct links to weather data from the Bureau of Meteorology. The tool is designed to assist growers in making decisions about how to manage irrigation water resources to optimise productivity, particularly in years where irrigation water is restricted. Workshops were held in Greater Victoria to educate growers on the importance of water budgeting for improved productivity and to demonstrate the new water budgeting tool.

Online helpdesk

The helpdesk and investigative service is managed using a desktop application MySQL database developed in 2011, enhanced in 2018, which contains helpdesk queries from 1991 onwards. A project commenced this year to develop an online helpdesk service where grapegrowers and winemakers can ask the helpdesk questions online rather than emailing or calling with enquiries. This project is expected to be completed in June 2023.

ShowRunner

Background

ShowRunner is an all-in-one show management software system developed at the AWRI, which covers all aspects of a wine show from online entries to electronic scoring and production of results. The software began as a tailored solution for the Advanced Wine Assessment Course and has been adapted to the processes and practices of the Australian wine show system and expanded to support other applications including classification tastings.

Shows returning

In total, 39 shows with approximately 13,000 entries used the ShowRunner platform in 2021/22, almost back to pre-COVID levels. The COVID-19 pandemic resulted in some changes to the longer-term plans for the software, with the need to bring some development activities forward. The system now operates as a web-based platform and the team has dramatically changed the software offering to allow for ease of access and remote support. This has allowed clients to run events remotely in a cost-effective manner. ShowRunner also now offers the ability for international entries, with international Geographical Indications available to be chosen when wines are entered into the system.

Regional engagement – Victorian Viticulture and Wine Innovation Program

Background

The AWRI delivers high-quality extension and practice change services to Victorian wine-grape growers and wineries through a partnership with Wine Victoria and Wine Australia. Project activities are overseen by Wine Victoria, which agrees on an annual workplan of activities under funding from Wine Australia's Regional Program.

Events delivered

Extension activities in 2021/22 included sustainability workshops; the ongoing evaluation of a rootstock demonstration trial in the Mornington Peninsula in collaboration with the University of Melbourne; planned burn coordination meetings with the Department of Environment, Land, Water and Planning; and four workshops on building resilience to drought and a water-constrained future.

AWRI helpdesk

Background

The AWRI's technical helpdesk plays an important role supporting grapegrowers and winemakers across Australia. The helpdesk provides rapid, confidential, technical support on topics across packaging, winemaking, viticulture and sustainability, delivered by an experienced, multi-disciplinary team.

Helpdesk enquiries

During 2021/22, 4,671 enquiries were received (Table 2). Of these, 1,609 were wine and viticulture enquiries and 3,062 were sustainability-related enquiries (discussed separately under the report for Sustainable Winegrowing Australia). There were approximately double the typical number of viticulture queries, mainly due to the cool, wet conditions experienced in many regions, as well as hail and other climatic events. The majority of wine and viticulture enquiries were from grape and wine companies and suppliers actively aligned with the wine industry, with a small number coming from government organisations, students, legal practitioners and journalists. Figure 2 shows that the sources of enquiries were broadly in line with the proportional volume of grapes crushed in each state/territory, with fewer queries than expected from NSW given the production volume in that state and the wet conditions across NSW this year.

Table 2. Enquiries received by the AWRI helpdesk in 2021/22

Topic	Number of enquiries
Sustainability	3,062
Winemaking	971
Viticulture	638
Total	**4,671**

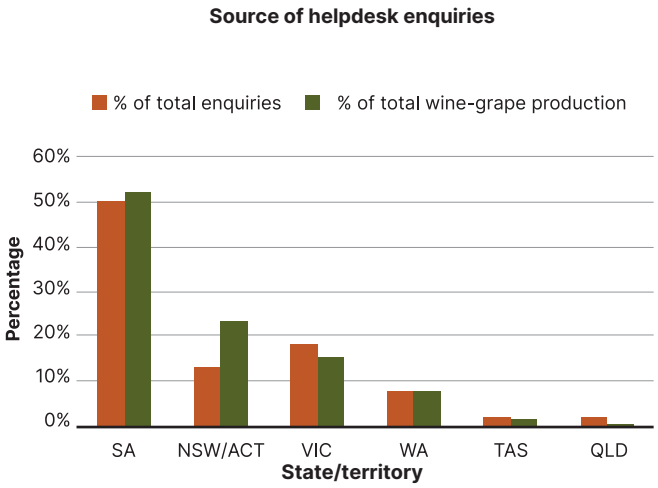

Figure 2. Enquiries received by the AWRI helpdesk in 2021/22 by state/territory compared to wine-grape production in 2022 (Wine Australia National Vintage Report 2022)

Wine and viticulture helpdesk enquiries are classified using 20 subject keywords. The number of enquiries received under each keyword is compared to monthly historical data collected over more than 20 years, to help identify national, state and regional trends. This allows for prompt responses to emerging issues and timely provision of relevant information. Figure 3 shows the wine and viticulture enquiries from 2021/22 arranged in order from most to least used keyword, highlighting key events or issues of interest during the year.

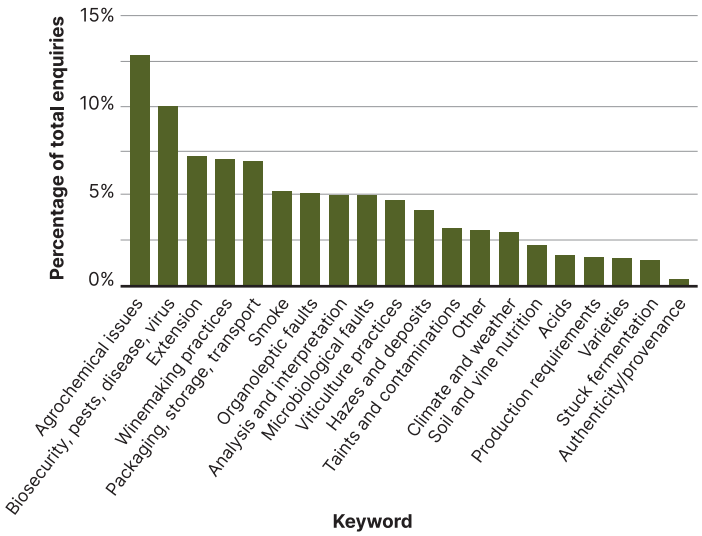

Figure 3. Winemaking and viticulture enquiries received by the AWRI helpdesk in 2021/22, organised by keywords. Enquiry numbers are represented as a percentage of total national wine and viticulture enquiries, where the total number was 1,609.

Viticulture enquiries

During the year, the viticulture team responded to 638 enquiries. Queries assigned to the keywords 'Agrochemical issues' and 'Biosecurity, pests, disease and virus', were the most common this year. The wet winter and spring and late La Niña event for summer resulted in queries on options for control of pests and fungal diseases, including powdery and downy mildews. Packaged information produced in the 2021 season during similar conditions was redistributed through an *eBulletin* early in the season. A reminder that phosphorous acid should not be applied to fruit destined for export wines was communicated and a new webpage on this chemical was created. The cooler spring and summer also saw some concerns about the efficacy of sulfur sprays under such conditions, as the vapour activity of sulfur is reduced at lower temperatures (15°C and below). An 'Ask the AWRI' column was published on how to best manage unruly canopies to prevent fungal diseases and a second was produced on how to get the most out of copper sprays.

Vineyard scale insects caused concern in several regions. An industry meeting was conducted with representatives from each affected region to identify key issues and knowledge gaps. Samples were taken from 10 vineyards across South Australia to determine if DNA sequencing is a viable option for identifying scale species in samples containing numerous scale insects collected from individual vines.

In a year where weather was particularly variable, a cost-benefit analysis was conducted of the value of using additional regional weather station networks in NSW compared to using existing regional Bureau of Meteorology (BOM) weather data. The exercise showed that BOM weather stations provide adequate coverage in most regions. However, some regions have vineyards located more than 50 km away from the nearest BOM weather station. In these regions, additional weather stations would be beneficial, and the additional costs for maintaining these stations justified.

Severe hailstorms affected several regions, often on multiple occasions, this season. After the first hail event, the AWRI helpdesk

produced several AWRI *eBulletins* and delivered webinars to provide growers with advice on dealing with hail damage. Several affected regions and sites were visited to assess damage, consult with vineyard management teams and provide direct information about the implications of different hail recovery strategies. Follow-up assessments of the vines towards the end of the season were conducted to learn lessons about recovery from hail. Regional associations, researchers and industry leaders were consulted to develop region-specific best management practices for hail recovery and the AWRI fact sheet 'Managing grapevines after hail damage' was updated. Updated resources on hail are located on the AWRI's 'Climate and weather tools' webpage.

Winemaking enquiries

During the year, the winemaking team responded to 971 enquiries. Winemakers raised a number of queries about different winemaking practices, such as fortification, vinegar production, variations to tank method sparkling wine production and treatment of wines affected by pinking. Questions were also received about production techniques for no- and low-alcohol (NOLO) wines, as companies begin to enter this newer production space and market. These questions covered not only how to produce NOLO wines, but also how to manage some of the technical challenges associated with them, such as haze prevention, product stabilisation, colour stability, oxidation control, product shelf life and microbial spoilage, including mousiness. Winemakers also appeared to be reviewing their yeast inoculation, yeast scale-up, and nutrient supplementation practices for fermentations, possibly as a consequence of diammonium phosphate (DAP) increasing in price and/or becoming more difficult to source. There were also questions about yeast assimilable nitrogen (YAN) analysis, which may now become a more cost-effective option rather than standard DAP additions, and about aeration of ferments in response to practice change activities conducted during the year.

The number of 'Packaging, storage and transport' queries also increased this year, with a focus on sulfur dioxide (SO_2) usage, removal, effectiveness, yeast tolerance and alternatives. Information on several of these topics was summarised in three 'Ask the AWRI' articles to provide greater industry awareness. The COVID-19 pandemic, trade restrictions with China and the Ukraine war collectively prompted queries about supply chain difficulties and increased costs for additives, dry goods and equipment, as well as export delays. Labour availability and/or skills shortages in the vineyard and winery also continued to put pressure on grape and wine businesses.

Smoke taint remained a concern in WA, with the drier conditions contributing to a number of early-season bushfires around Dunsborough, Denmark and Margaret River. Fires were also reported in Wrattonbully and Lucindale in SA and Pipers River in Tasmania. Fortunately, many of these were short-period grass fires with minimal impact on fruit. Due to the generally wetter year and additional vegetative growth, several states again brought forward prescribed burns into early autumn, which caused concern for some growers whose fruit remained on the vine. The AWRI worked with state and regional bodies to provide accurate information on prescribed burns and their impact on viticulture to support communications with organisations conducting such burns.

Winemaking and viticulture problem-solving investigations

This year 13% of winemaking enquiries resulted in investigations, where samples were required for analysis to identify the problem and recommend a solution. The helpdesk team conducted 126 problem-solving investigations on 896 samples (Table 3). This was approximately 70 fewer investigations than most years. As with enquiries, use of the problem-solving investigative service was mostly in line with the proportional volume of wine-grape plantings for each state or territory, with fewer investigations from NSW than expected given the wetter season in that state (Figure 4).

Table 3. Winemaking investigations conducted and samples analysed by the AWRI helpdesk in 2021/22

Type of investigation	2021/22
Hazes and deposits	32
Microbiological issues	16
Sensory investigations	16
Taints and contaminations	24
Other investigative analyses	34
Closure-related investigations	4
Total number of investigations	**126**
Total number of samples analysed	**896**

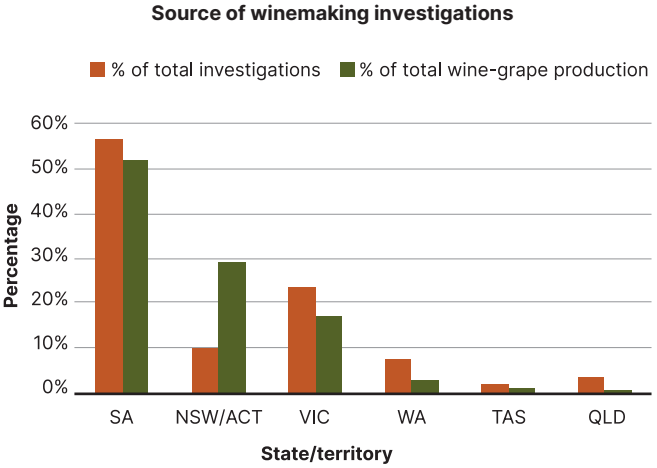

Figure 4. Winemaking investigations undertaken by the AWRI helpdesk in 2021/22 by state/territory, compared to wine-grape production in 2022 (Wine Australia National Vintage Report 2022)

Winemaking investigations are assigned to five main categories: hazes and deposits; sensory investigations; microbiological issues; taints and contaminations; and other. The proportion of investigations in each category has remained relatively consistent over the last ten years, with approximately 20% in each category (Figure 5). Closures is an additional category where investigations were common in the past; however, investigations in this category are now relatively rare because of the widespread uptake in Australia of non-cork-based closures.

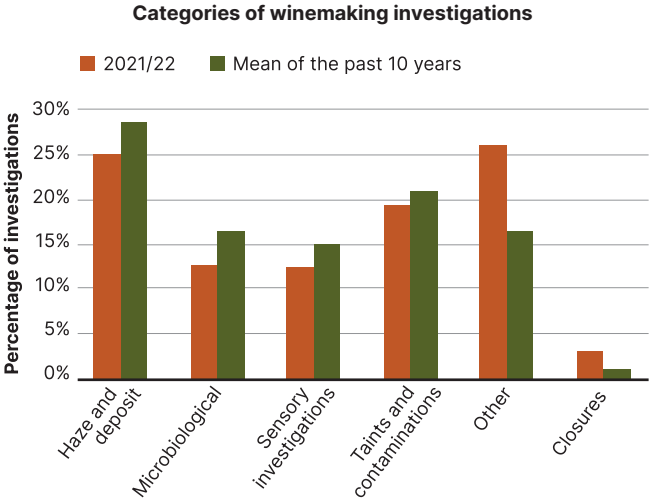

Figure 5. Distribution of winemaking investigations across five main categories (plus closures). For 2021/22 the total number of investigations was 126.

Hazes and deposits

While the proportion of haze and deposit investigations this year was similar to previous years (Figure 6), the actual number of haze and deposit investigations was about half the mean number typically conducted. On a positive note, this was driven by fewer post-packaging heat and cold instabilities. In contrast, the number of investigations of post-packaging microbiological hazes was fairly typical, with these consisting mainly of biofilm residues and yeast. Other deposits noted in packaged wines included nylon, rubber, an o-ring, fragments of dry goods material and hazes caused by increased aluminium concentrations extracted into products packaged in cans. Instability issues in NOLO wines and wine products were also observed as more producers enter this market and work through how to produce these products, which can behave quite differently from traditional table wine. Colour instability in rosé wine post-packaging was a concern for several producers, with one investigation trialling different ascorbic acid concentrations at bottling to determine the best option for colour retention.

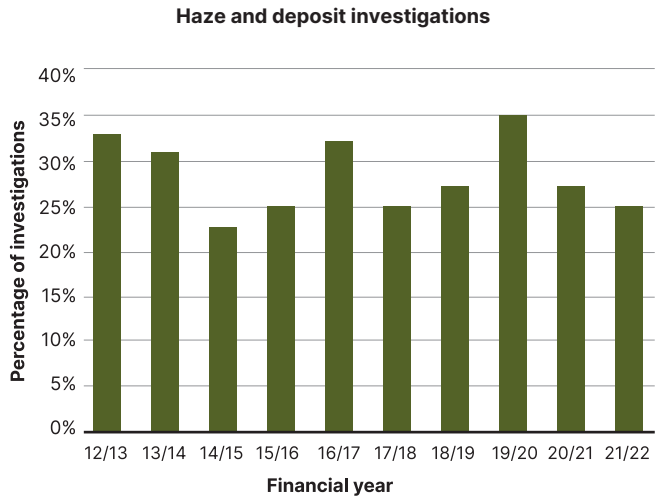

Figure 6. Haze and deposit investigations conducted by the AWRI helpdesk from 2012/13 to 2021/22

Microbiological issues

The proportion of microbiological investigations was similar to previous years (Figure 7), although the investigations themselves were less varied, being dominated by *Brettanomyces* spoilage, acetic acid production and yeast refermentation in bottle.

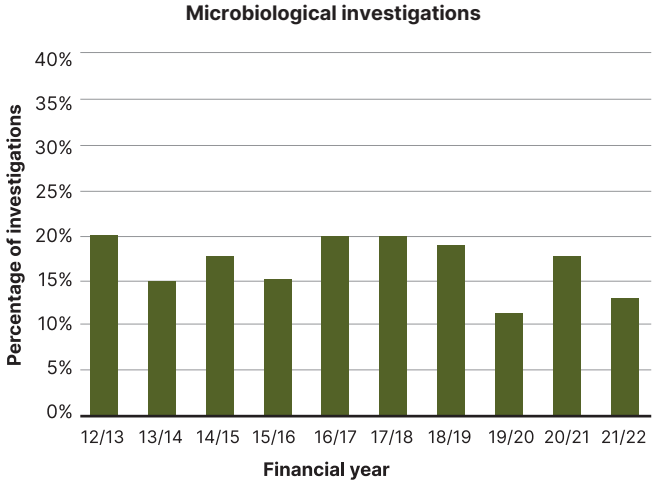

Figure 7. Microbiological investigations conducted by the AWRI helpdesk from 2012/13 to 2021/22

Several wineries reported difficulty in completing inoculated malolactic fermentations (MLF) in 2021 Merlot wines, despite these wines having important MLF-related compositional parameters (pH, temperature, alcohol and SO_2) within acceptable ranges. Wines of other varieties from the same regions and with similar analytical parameters had no such issues. Some research has reported that certain red wine varieties, including Merlot, Zinfandel and Tannat, can have difficulty with MLF induction, which is thought to be associated with tannin/red wine phenolic composition. Nevertheless, while inhibitory or stimulatory properties of certain phenolic compounds towards malolactic bacteria have been observed, there does not appear to be a clear consensus as to how this might relate to MLF inhibition in a variety such as Merlot. To investigate the problematic Merlots further, several affected wines were analysed for different types of tannins/phenolics, but results thus far are not conclusive, reflecting the complex nature of the potential interactions of these components with malolactic bacteria.

Sensory investigations

Similar to last year, there was a lower proportion of sensory investigations (Figure 8). This trend was driven by lower than typical numbers of oxidation or sulfide-related wine faults. Instead the investigations conducted covered a wide array of unrelated sensory issues including saltiness, mould-related faults, mousiness, volatility and indole and aldehyde characters in sparkling wines.

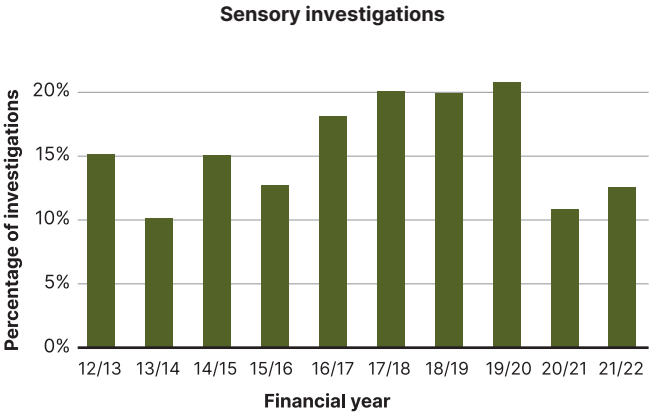

Figure 8. Sensory-related investigations conducted by the AWRI helpdesk from 2012/13 to 2021/22

Taints and contaminations

The proportion of taint and contamination investigations was similar to previous years (Figure 9). Pleasingly, there were fewer hydraulic oil leaks and brine contaminations over vintage. Three taints were imparted from wine filtration processes, including halophenol and 'musty' characters. Investigations of wines with potential smoke taint continued in the aftermath of fire events from this year or from previous years. The wetter season also resulted in investigations of insect taints in wine. Pests observed this year where concerns were raised about taints included slugs, snails, caterpillars, grasshoppers, moths, millipedes, native stink bugs and aromatic weeds such as Lincoln weed (where weeds had grown into canopies).

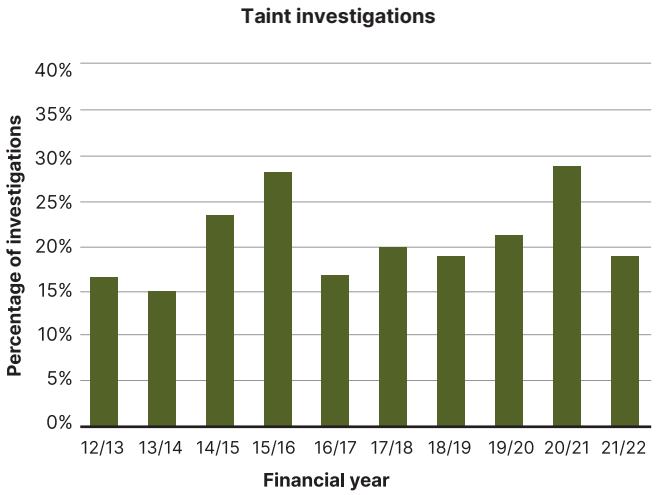

Figure 9. Taint-related investigations conducted by the AWRI help-desk from 2012/13 to 2021/22

Other investigations

The increase in investigations classified as 'other' this year (Figure 10) was assisted by eight viticultural investigations of vineyard scale. An apparent greater proportion of frosted scale and soft brown scale rather than the typical grapevine scale was suspected, with these scale types having different control measures, including biological agents. Results from DNA analysis are expected in the next financial year. There were three investigations regarding suspected grape or wine substitution or dilution and two investigations (plus additional queries) suggesting that pinking in white wine was a concern. Several investigations were prompted by large increases in transit time for containers of exported wine, in some cases up to 100 days, with producers seeking assessment of any potential downgrade in wine quality. There were also several investigations to determine reasons for excessive pressure and spritz in bottled table wine.

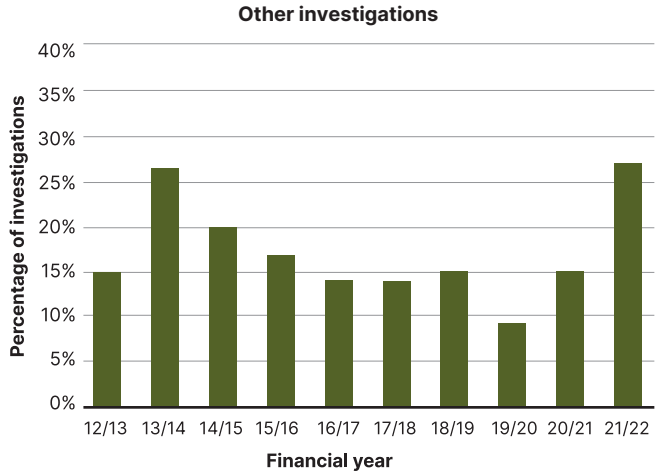

Figure 10. Other investigations conducted by the AWRI helpdesk from 2012/13 to 2021/22

Sensor trials

Following successful initial trials in 2021 using differential pressure measurement to monitoring ferment density and level, trials were expanded in 2022 to more styles of red fermenters and yeast culture tanks as well as other styles of pressure sensors. Trials were again very successful, and information has been gathered that will be useful for wineries looking to make large-scale installations.

Library services

Background

The John Fornachon Memorial Library holds one of the largest collections of grape and wine resources in the world, with more than 82,400 print and digital resources on offer via a range of information discovery tools and services. The library supports the Australian grape and wine sector by providing access to technical information that assists learning, understanding and adoption of research outcomes.

Library resources

During the year, the library added 4,982 new resources (including eBooks, books and articles) to its collection, which is searchable via the library catalogue on the AWRI website. To connect users more easily to open access articles, more than 1,590 resources were updated to include direct links to publishers' websites. The eBooks collection now has 243 titles and 6,682 activities (book/chapter downloads, online views or pages printed) were recorded this year.

Staff publications

The staff publications database, accessible via the AWRI website, holds more than 2,265 AWRI-authored articles. This year, the database received more than 5,900 hits. Many publications are now offered via open access direct to the full-text articles. For non-open access articles, a total of 694 staff publications were requested and delivered under copyright declarations.

Online information packs

Online information packs are reference lists with a specific topic focus, which provide growers and winemakers with seamless access to highly curated and relevant information. The number of requests for resources from information packs increased from 299 requests in 2020/21 to 840 requests in 2021/22. Thirty-two new information packs were added to the AWRI website this year.

Library reference and information requests

The number of requests for information and advice dealt with by library staff increased by 85% this year, with 1,966 requests answered. These requests covered literature searches, article and book requests and advice on copyright. About 43% of the requests came via an information pack. A total of 1,688 non-open access articles were requested and supplied by the library (Table 4), including 543 non-open access articles supplied from the *Technical Review* collection. A further 2,398 open access articles were provided via direct links to publishers' websites

Library staff also performed 56 specialised literature searches on a variety of topics across winemaking, vineyard management, winery operations and pest management, an increase of 26 requests compared to the previous year.

Table 4. Non-open access articles supplied from library collections in 2021/22

Article type	Number of items supplied
AWRI staff publications	694
Technical Review collection	543
Library reprint collection	451
Total	**1,688**

Performance, products and processes

There are numerous processes involved in wine production, from grapegrowing all the way through to delivery of finished product to consumers. Projects under this theme aim to optimise these processes and reduce costs, resulting in overall improvements to wine quality and business sustainability. Specific areas include target setting and objective measures for grape quality and wine style; optimisation of primary and secondary fermentation; assessing new winery processes and equipment; preventing and treating taints and faults; and achieving a greater understanding of wine flavour and texture.

Staff

Sheridan Barter, Dr Marlize Bekker, Dr Jenny Bellon, Laura Bey, Eleanor Bilogrevic, Dr Keren Bindon, Dr Anthony Borneman, Ben Cordingley, Dr Peter Costello, Adrian Coulter, Kate Cuijvers, Dr Julie Culbert, Simon Dillon, Damian Espinase Nandorfy, Assoc. Prof. Leigh Francis, Dr Toni Garcia Cordente, Dr Richard Gawel, Dr Yevgeniya Grebneva (to 31 December 2021), Laura Hale, Prof. Markus Herderich, Kieran Hirlam, Dr Josh Hixson, Wen-Hsiang (Denny) Hsieh, WenWen Jiang, Dr Alicia Jouin (to 31 January 2022), Stella Kassara, Radka Kolouchova (to 23 July 2021), Renata Kucera (to 10 June 2022), Allie Kulcsar, Dr Darek Kutyna, Deanna Langone (from 4 April 2022), Desireé Likos, Simone Madaras, Jane McCarthy, Dr Agnieszka Mierczynska-Vasilev, Dr Cristobal Onetto, Elli-Marie Panagis, Dr Mango Parker, Dr Wes Pearson, Lisa Pisaniello, Song Qi, Tim Reilly, Jessica Scudds, Dr Simon Schmidt, Alex Schulkin, Neil Scrimgeour, Dr Tracey Siebert, Con Simos, Mark Solomon, Dr Cristian Varela, Flynn Watson, Dr Eric Wilkes, Dr Patricia Williamson.

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Stephanie Angela (University of Adelaide), Jana Hildebrandt (University of South Australia), Yiming Huo (University of Adelaide), Yihe (Eva) Sui (University of Adelaide), Colleen Szeto (University of Adelaide).

Collaborators

Accolade Wines (Preet Sidhu); Adelaide Hills Wines (Peter Leske); Australian Grape & Wine (Anna Hooper); Australian National University, Eccles Institute of Neuroscience (Prof. John Bekkers); Ball Corporation, USA (Justin Benore, Adam Stowitts, Brent Trela); Belvidere Winery (Sam Dunlevy); Best Bottlers (Mark Zeppel); Brown Family Wine Group (Geoff Alexander, Joel Tilbrook); Constellation Wines NZ (David Edmonds, Katrina Sutherland); Constellation Wines USA (Martin Di Salvo, Chris Hartless, John Thorngate); CSIRO (Dr Fabienne Reisen); Deakin University, CASS Food Research Centre (Prof. Russell Keast, Assoc. Prof. Robert Shellie); E. & J. Gallo Winery, USA (Dr Gal Kreitman, Steve Tallman); DogRidge (Fred Howard); Firmenich (Nicholas Garfield); Flavourtech (Paul Ahn); Flinders University (Dr Ruvini Dabare, Assoc. Prof. Martin Johnston, James Tsoukalas, Prof. Krasimir Vasilev); Gulbali Institute, Charles Sturt University (Dr John Blackman, Dr Andrew Clark, Dr Sijing Li, Prof. Leigh Schmidtke); Hochschule Geisenheim University, Germany (Prof. Doris Rauhut, Prof. Manfred Stoll); Indonesian Institute of Sciences, Indonesia (Dr Satriyo Wahono); Northwest Agriculture and Forestry University, China (Dr Anque Guo); Orora Beverage (Kane Chandler, Gary Thompson); Pernod Ricard Winemakers (Kate Lattey, Dr Jean Macintyre); PIRSA (Bodhi Edwards); SARDI (Dr Marcos Bonada, Dr Paul Petrie); Sofia University, Bulgaria (Dr Aleksey Vasilev);

Stellenbosch University, South Africa (Prof. Wessel Du Toit); Tolley Viticulture (Simon Tolley); Treasury Wine Estates (Iain Jones, Josh Miles, Paul Milton); University of Adelaide (Assoc. Prof. Sue Bastian, Prof. Timothy Cavagnaro, Assoc. Prof. Cassandra Collins, Dr Lukas Danner, Dr Robert Falconer, Assoc. Prof. Paul Grbin, Assoc. Prof. David Jeffery, Dr Richard Muhlack, Dr Lira Souza Gonzaga, Prof. Kerry Wilkinson); University of South Australia (Dr Miguel de Barros Lopes, Prof. Krasimir Vasilev); VA Filtration/Memstar (Katy Cordova, David Wollan); Vinpac International (Greg Edwards); Wines by Geoff Hardy (Shane Harris); Yalumba Family Winemakers (Heather Fraser, Greg Nattrass, Louisa Rose).

Identification and control of compounds responsible for important sensory attributes

Background

The aroma and flavour properties of wine are largely directed by numerous volatile aroma compounds. While many wine sensory attributes can be explained by knowledge of compounds previously studied, there remain several significant wine flavour characteristics where the causative compounds are not known. The ability to identify and measure compounds that give desirable flavour in wines is important to provide targets for grape and wine producers for improvements in vineyard practices and winery processes. This project also studies less time-consuming sensory methods for wine evaluation, to better link wine composition and sensory outcomes.

Foliar nutrient sprays to increase 'tropical' thiols at a commercial scale

Foliar sprays of sulfur and nitrogen have previously been shown at a research scale to increase the concentration of potent 'tropical' thiols in wines. In vintage 2021 a study was completed in an Adelaide Hills Chardonnay vineyard using the vineyard's own spray equipment to assess foliar applications under commercial vineyard practice conditions. The influence of vineyard sprays was compared with the known thiol modulation practice of choosing high-thiol-releasing yeast strains. The resulting wines possessed higher concentrations of 'tropical' thiols than the control wines regardless of whether thiol modulation was conducted with vineyard spraying or yeast selection, although a combination of techniques resulted in the highest thiol concentrations. Overall, the impact of yeast selection on 'tropical' thiols was slightly greater than foliar applications of sulfur and nitrogen, with sensory analysis of the wines showing similar responses for 'tropical fruit flavour'. The successful use of commercial spray equipment to perform foliar spray applications and modulate 'tropical' wine attributes confirmed the applicability of this technique in vineyard operations and saw the technique selected as a 'practice change' focus for future extension and adoption activities.

Assessing key flavour compounds in commercially produced wines

The concentrations of key monoterpenes and norisoprenoid aroma compounds were quantified in 131 commercially produced white wines aged from 1 to 20 years old, to assess the relevance of several compounds whose role in wine flavour is not clear. The set of wines included examples of Viognier, Chardonnay, Pinot Gris, Riesling, Sauvignon Blanc and Semillon. As expected, aged Riesling wines had higher concentrations of TDN, while older Semillon wines had negligible TDN but could be high in the potent and little studied but structurally similar compound, TPB. The monoterpene compound, wine lactone, which is implicated in 'woody' or 'cooked citrus' aroma, was notable in aged Riesling and Semillon, while Viognier wines were especially high in many monoterpenes. These results provide a foundation for future work on shelf life or bottle ageing.

A study assessing aroma compounds in sweet *Botrytis*-affected white wines and dry white wines found that some lactones were generally at much higher concentration in the sweet wines, especially Rieslings, suggesting these compounds may be important to the desirable 'apricot' flavour often found in this wine style.

'Peach' flavour in white wine

Continuing earlier work on 'peach' flavour in Chardonnay wine, studies were conducted to investigate the influence of juice clarification and yeast selection on the concentration of fermentation-derived ethyl esters, with wines made from fruit from two regions. A sensory-directed analytical study and a consumer preference test of Chardonnay wines covering the style spectrum of 'peachy' to 'flinty' character were completed. More details are included later in the report under the heading 'Formation and fate of sulfur compounds associated with negative attributes in wine'.

'Raisin'/'jammy' flavour in ripe Shiraz

The volatile compounds that cause overripe 'port-like' or 'dried fruit'/'jammy' aroma in red wines, and especially in Shiraz, are not well characterised. After determining the key odorants of overripe and late-hanging Barossa Shiraz grapes, an optimised method for compound quantitation was used to screen Shiraz grapes from a number of warm and cooler climate regions. The markers associated with overripe Shiraz were present in grapes from all regions with no direct correlation to temperature, and most of these compounds were found to persist from grapes into the resulting wine. This supports earlier work suggesting that shrivel is a major driver for the accumulation of compounds associated with overripe character. Additionally, grapes grown under artificially warmer temperatures (approximately 1.5°C warmer) possessed higher concentrations of some of these marker compounds, but the resulting wines did not show consistent differences in 'jammy' aroma, only differing in 'opacity' and 'dark fruit' aroma.

The role of amino acids in red wine flavour

The amino acid proline, which is abundant in grapes and wine, was shown in previous studies to be involved in 'fruit sweetness', playing a role in enhancing perceived viscosity and fruit flavour, and reducing astringency and bitterness. When the amino acid glutamic acid was added to a Shiraz wine at wine-relevant concentrations, a savoury/umami taste was imparted.

Since high levels of proline can be typically found in some warm inland Cabernet Sauvignon wines, the potential of such wines to improve a flavour-deficient Cabernet Sauvignon by blending was tested. Three wines were blended in different proportions using a statistical experimental design. Two Riverland Cabernet Sauvignon wines – one relatively 'green' in flavour and 'thin', and the other high in proline – were blended with up to 30% of a Lagrein wine. The wine from this variety was low in proline, but high in tannin, 'dark fruit' flavour and colour. Fourteen blends were subjected to chemical and sensory analysis as well as consumer acceptance testing. Proline-rich blends had increased sweetness, viscosity and fruit flavour, with lower astringency and bitterness, and were well liked by consumers. Specific optimal blends were found, with either a high proportion of the flavour-deficient Cabernet Sauvignon with a lower amount of the high-proline Cabernet Sauvignon and small proportion of the Lagrein; or a high proportion of the high-proline Cabernet Sauvignon with less than 20% of the Lagrein. Using high-proline blend components to improve a 'thin' red wine provides a simple means of optimising desirable in-mouth sensory properties. This work received two awards at the 18th Australian Wine Industry Technical Conference – for best oenology poster and best oenology Fresh Science presentation.

Using glycosides and other flavour precursors for improved wine flavour

Background

Odourless grape-derived glycoside compounds in wines can be broken down during tasting, releasing a surge of long-lasting flavour. This effect is caused by the action of enzymes from salivary bacteria. Previous work showed that there is a wide range of sensory responses to glycosides among individuals, with some easily able to perceive strong flavour from all types of glycosides, some only able to perceive flavour from some glycoside compounds, and others who

report only a weak taste or do not respond at all. Glycosides can also release flavour compounds during winemaking and bottle ageing. The high concentrations of glycosides present in grape marc have been shown to be accessible and useful in modulating wine flavour when added back into wine, making use of previously unused flavour potential. However, the varietal source of the marc used to create a glycoside-rich extract has a large impact on the flavour outcomes in wines, with Muscat varieties yielding more potent extracts.

Glycoside flavour precursors in no- and low-alcohol products

A glycoside-rich extract prepared from Muscat Gordo marc was used in experiments assessing the potential role of glycosides when formulating no- and low-alcohol wine products. Sensory assessments of the glycoside extract added to low-alcohol Sauvignon Blanc (1.2% alcohol v/v) showed that there is potential for glycoside additions to improve this style of product, providing aspects of body and flavour.

Storage trials of the Muscat Gordo marc extract in no-alcohol wines (<0.05%) and in model wines of varying alcohol concentrations (from 0.5 to 12% v/v) showed an expected formation of monoterpenes in all cases. The similarities in monoterpene formation in the model wines with differing alcohol concentrations suggests that the knowledge previously generated on the role of glycosides in providing wine flavour in-bottle is transferable into beverages with no- and low-alcohol concentrations. However, some differences in the monoterpene disaccharide concentrations between model wines and commercially produced wines with added marc extract may point towards solubility differences, which will require further exploration.

Molecular drivers of wine texture and taste

Background

Consumers' overall impression of how wine tastes and feels in the mouth is a critical component of wine quality. As a result, wine texture plays a significant role in product differentiation and the market value of wine. Understanding the compounds that affect wine texture and their winemaking origins is essential for ensuring wine texture that is appropriate to the intended wine style. With the help of this knowledge, winemakers will be able to maximise favourable textural characteristics while minimising unfavourable ones.

New insights into the role of phenolics in white wine bitterness

A glycoside of trans-*p*-coumaric acid (4-β-d-glucopyranosyl coumaric acid) had been previously identified as a potential bitterant in white wine. This compound was synthesised and purified on a preparative scale and subjected to formal taste and texture descriptive analysis when presented in model white wine. Contrary to expectations, the sensory assessment indicated that the compound at low concentration suppressed the inherent bitterness of the model wine, which is presumably elicited by ethanol. As hydroxycinnamic acids such as coumaric acid are a predominant class of phenolic compounds found in white wine, this result suggests that the presence of glycosylated forms of hydroxycinnamates may positively contribute to the taste of white wine by reducing bitterness.

Towards an understanding of 'savoury' character in wine

'Savoury' is a term often used to describe complex, high-value wines. While the molecular drivers of 'savoury' character in wine are ambiguous, it is likely that 'savouriness' in wine is driven in part by the interaction between the amino acid glutamic acid, succinic acid, and sodium and potassium salts. A survey of the concentrations of these compounds in 425 commercially available Australian wines was completed (Figure 11). The survey was extended to include concentrations of sodium chloride in wine, as this salt is also known to contribute to mouthfeel characteristics such as viscosity and soapiness. The results of the survey, combined with findings from the AWRI's flavour research, will be used to design sensory experiments that further explore the interactions between compounds in wine known to produce savouriness, to gain knowledge that could benefit winemakers seeking to enhance the 'savoury' character in their wines.

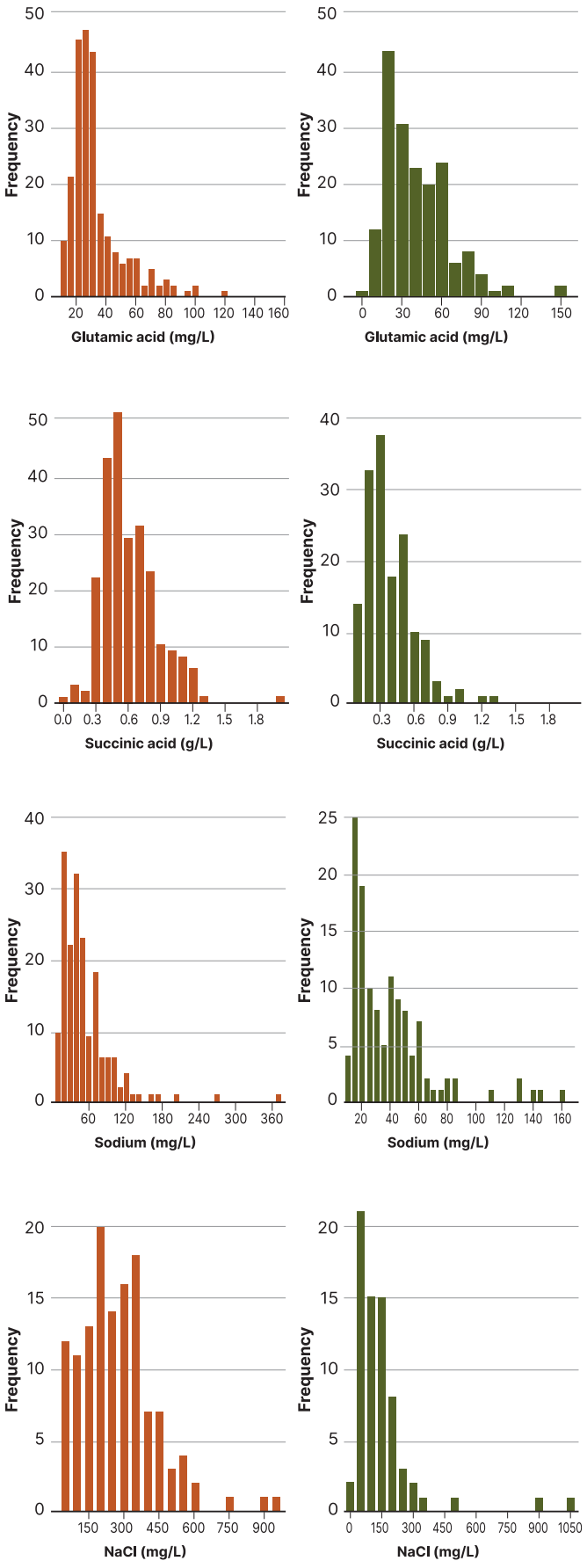

Figure 11. Distribution of concentrations of compounds associated with 'savoury' character in Australian wine. Tan bars (red wine), green bars (white wine). For glutamic acid n=425, for succinic acid n=400, for sodium n=334, for sodium chloride, n=200.

Possible winemaking impacts on the key compounds thought responsible for 'savoury' character in red wine were also explored in a small-scale winemaking scoping study with Adelaide Hills Pinot Noir and McLaren Vale Shiraz. The study investigated whether *Saccharomyces cerevisiae* strain choice, must sugar concentration, must nitrogen status or fermentation temperature could affect the glutamic acid and succinic acid concentrations in the free run and pressings wines. The preliminary results suggest that glutamic acid in finished wines can be enhanced when the ferment is conducted at a higher temperature and particularly through the addition of pressings (Figure 12). Succinic acid concentration was positively influenced by lower must YAN, higher fermentation temperature and also by yeast strain.

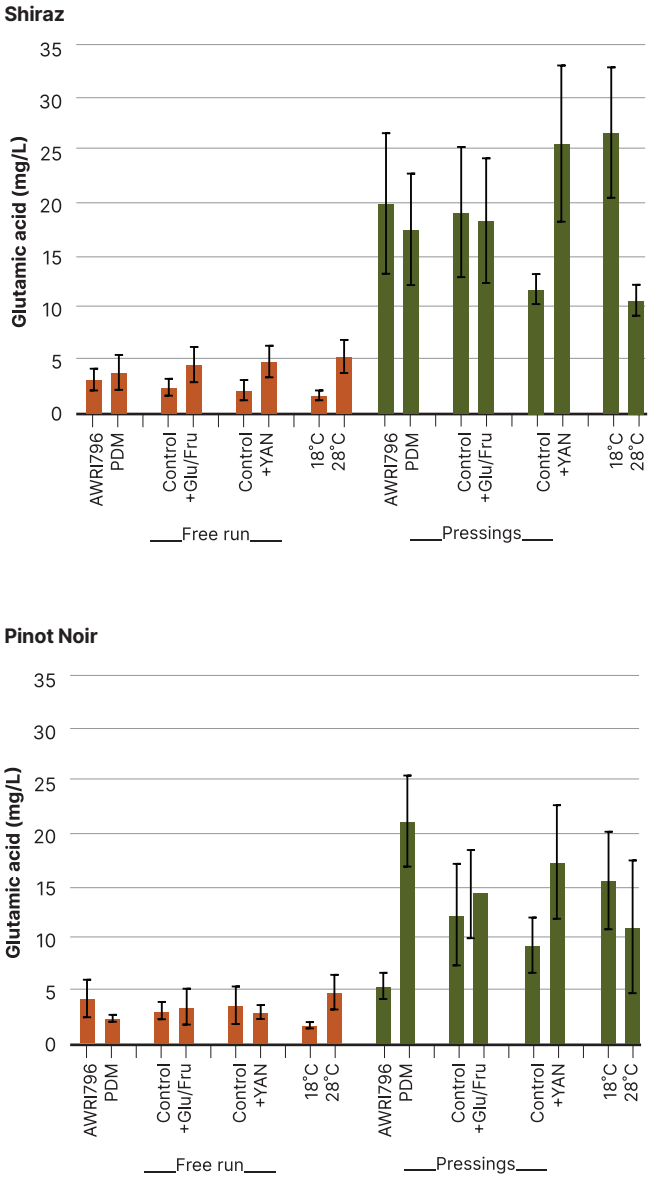

Figure 12. Glutamic acid concentrations in free run and pressing wines (Shiraz, top and Pinot Noir, bottom) produced using different yeast strains, must sugar concentrations, DAP additions and fermentation temperature. +Glu/Fru = +2Be', +YAN = +200 mg/L DAP.

Winemaking factors influencing taste and texture

In the late 1990s large wine producers began using flotation to clarify white juices, as solids could be removed rapidly and the flotation process was more efficient and less costly than cold settling, due to its lower energy requirements and continuous nature. In the 2016 AWRI Vineyard & Winery Practices Survey, respondents nominated switching from traditional cold settling to flotation for white juice clarification as second on the list of winery practices that had made the greatest positive impact in the previous five years.

While the efficiency of grape solids removal by flotation has been well documented, information has been scarce on the effect of flotation on white wine composition and sensory properties. Past work has demonstrated that the time that grape solids are in contact with white juices prior to fermentation affects the polysaccharide profile of the must, which has the potential to influence white wine mouthfeel. A study involving two commercial wineries from the Murray Valley was conducted to compare the composition, taste and mouthfeel properties of Chardonnay and Frontignac wines made with three different clarification practices: flotation using nitrogen, cold settling/racking and no clarification (where fine grape solids were not removed prior to fermentation).

The non-volatile composition (including total phenolics, total polysaccharides, phenolic profile and polysaccharide molecular weight profile) of the wines produced by flotation were much like those made using cold-settled juices (Figure 13), which was reflected in the wines having similar mouthfeel and taste properties. Both the Chardonnay and Frontignac wines made using flotation were perceived to be slightly more viscous than the wines made from either the cold-settled or unclarified juice. Perceived viscosity was best correlated with higher pH and higher total phenolic concentration and specifically with the concentration of the phenolic compound, caftaric acid. Surprisingly, higher total polysaccharide concentration was associated with lower perceived viscosity. The cold-settled Frontignac wines were also slightly less bitter than the unclarified and low-solids floated wines, but the differences in bitterness could not be attributed to total wine phenolics nor to any of the quantified phenolic compounds. This suggested that the compounds responsible for the greater bitterness in the cold-settled wines made from this variety were not captured in this study. Perceived hotness, astringency and acidity were not consistently affected by juice settling methods.

Overall while a few differences in mouthfeel attributes between wines made from floated and cold settled juices were observed, the differences were small, a result which should provide winemakers with greater confidence in using the efficient and cost-effective flotation method for white juice clarification.

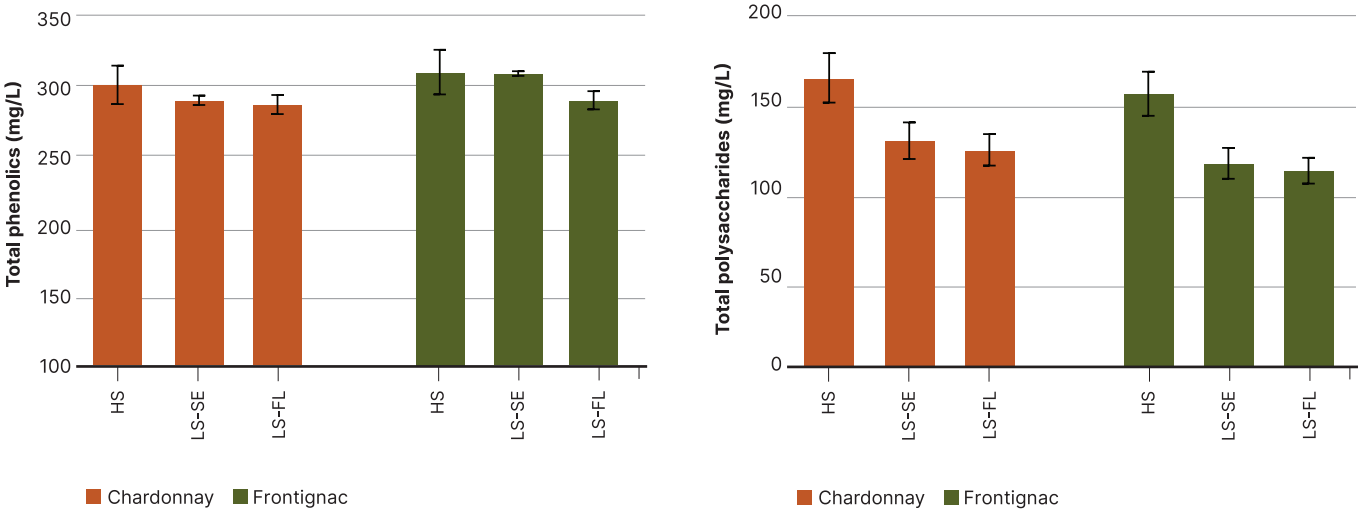

Figure 13. Total phenolics (left) and total polysaccharide (right) concentrations of wines produced using different methods for juice solids removal (HS=high solids/unclarified, LS-SE=low solids by cold settling/racking, LS-FL=low solids by flotation)

Managing wine extraction, retention, clarity and stability for defined styles and efficient production

Background

This project investigates wine macromolecules such as tannins, polysaccharides and proteins to understand their extraction and subsequent impact on wine stability, clarity and filterability. The research seeks to identify improved ways to measure wine macromolecules and their interactions, to better understand the impacts of winemaking techniques, additives or surfaces (e.g. filtration membranes, adsorbents) on the colour, cold and heat stability of wine. The results generated will provide winemakers with options to better predict and manage macromolecule extraction, stability and loss, ultimately with the aim of improving production efficiency.

New solutions to tartrate instability

Tartrate stabilisation of wines continues to be a necessary step in commercial wine production. The conventional method of preventing potassium bitartrate (KHT) from crystallising and precipitating after wine has been packaged is to add KHT seed crystals and keep the wine at temperatures below 0°C for a specific time. This process is time-consuming and energy-intensive and involves a filtration step to remove the sediment.

One alternative to established cold stabilisation approaches is to harness the potential of plasma-polymer coated surfaces as processing aids. Plasma-modified surfaces with different surface functional groups were originally created using magnetic nanoparticles for the removal of haze-forming proteins from white wines. The application of plasma surface modification is now being extended to improve cold stability in wines. Homogenous chemical modifications were generated across surfaces by employing a thin layer of plasma-polymerised acrylic acid (AcrA), allylamine (AA) and oxazoline (POx). These surfaces were then used as processing aids to remove KHT from wine at 15°C by initiating binding and crystal growth. Results indicated that the surface chemistry modulated the binding mechanism, with the binding capacity decreasing in the following order: AA>POx>AcrA (Figure 14).

The results showed that three months of storage in contact with coated surfaces at 15°C brought cold-unstable Sauvignon Blanc and Chardonnay wines to cold stability and a Pinot Grigio close to cold stability, as measured using a mini-contact test and by quantifying unstable KHT following a three-day cold test. The Sauvignon Blanc and Chardonnay wines became stable regardless of the coating used

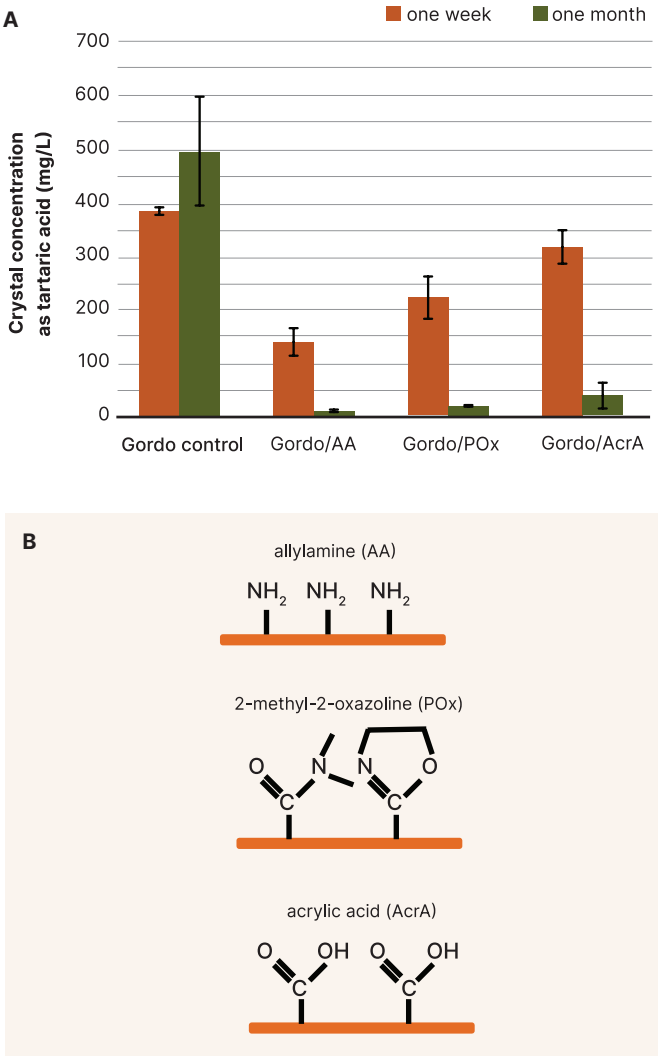

Figure 14. (A) The concentration of unstable KHT crystals recovered following a three-day cold test in a control Muscat Gordo wine and the same wine treated with three different plasma polymer-coated surfaces after one week and one month of storage at 15°C. Lower concentrations of crystals recovered imply greater cold stability. (B) Schematic of the allylamine (AA), 2-methyl-2-oxazoline (POx) and acrylic acid (AcrA) plasma polymer-coated surfaces used in this work.

on the surfaces. The Pinot Grigio wine came close to cold stability after treatment with allylamine and POx functionalised surfaces. The potassium and tartaric acid concentrations decreased in all treated wines, while changes in wine pH were minimal. The main advantage of this method is that coated processing aids can be easily applied to wine and that the approach does not require cooling during treatment, thereby saving on energy costs. A further advantage is that functionalised surfaces are classified as processing aids rather than additives and, as such, are exempt from ingredient labelling that would apply to permitted additives.

Impact of natural zeolites on heat and cold stability

Five natural zeolites with different pore diameters and sodium contents were selected for benchmarking to assess their impact on the heat and cold stability of wine. Four of the zeolites selected were Australian and one was from Indonesia. For wines treated with all the zeolites tested, the potassium content was reduced by ~50%, resulting in the initiation of crystallisation and precipitation of KHT. The reduction of potassium ions in the treated wines was due to the cation exchange of potassium ions with sodium ions in the zeolite, as schematically shown in Figure 15. Crystallisation of KHT in response to a three-day cold test was reduced by 94-99% following zeolite treatment, demonstrating that cold stabilisation was achieved very effectively. In addition, the protein concentration was also reduced by 50-95% after zeolite treatment. Based on structure-activity studies, it was found that natural zeolites with a low calcite content had a better ability to remove haze-forming proteins in wines, making these zeolites more attractive as they could induce both heat and cold stability in a single treatment. Unfortunately, however, four of the five zeolites tested significantly increased the aluminium concentration in the wines after treatment. Two different approaches were used to attempt to decrease the aluminium leaching into wine, namely zeolite dealumination and heat treatment to immobilise alumina. While the first approach was not successful, the second approach (where the zeolites were heated prior to their use in wine) resulted in a substantial decrease in aluminium leaching, as shown in Figure 16 for Muscat Gordo and Pinot Grigio wines. This suggests that pre-treatment of zeolites could enable their safe application as wine processing aids.

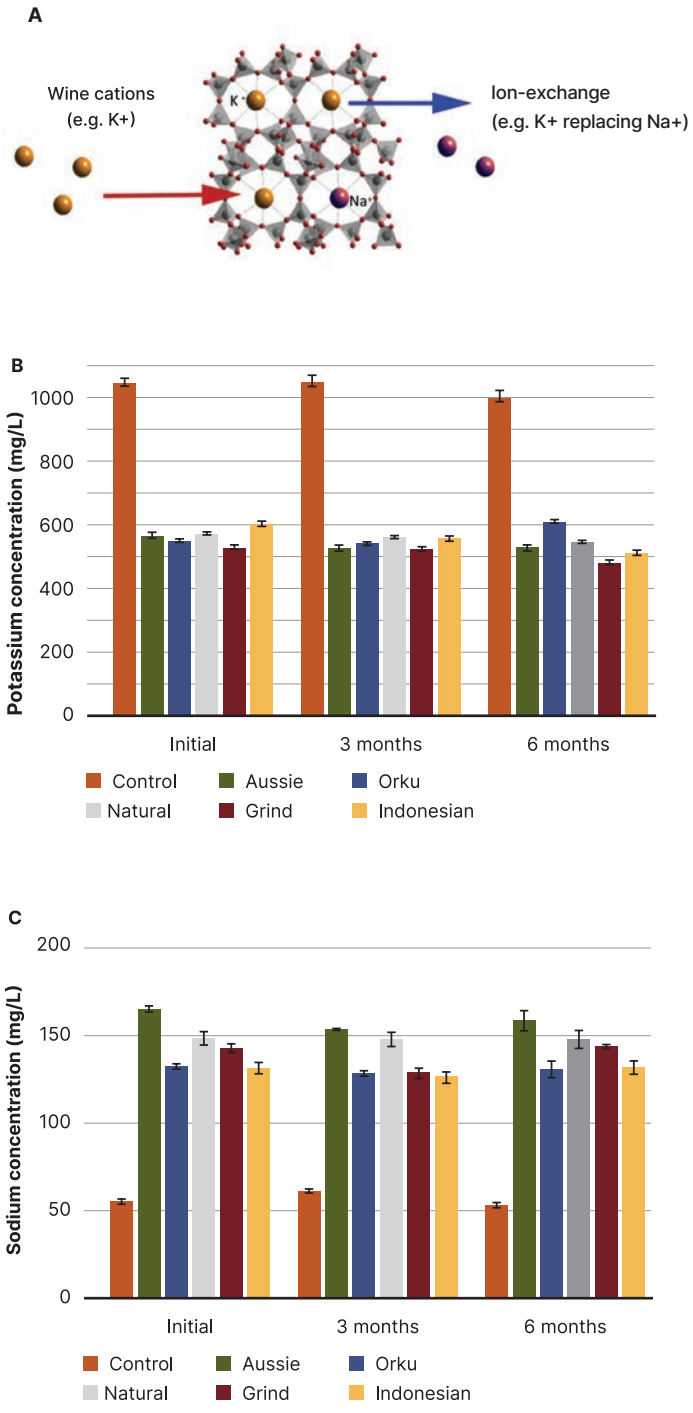

Figure 15. (A) Schematic representation of the cation exchange mechanism between potassium ions in the wine and sodium ions in the zeolite; (B) the concentration of potassium and (C) the concentration of sodium in control and zeolite-treated Muscat Gordo wines as a function of time

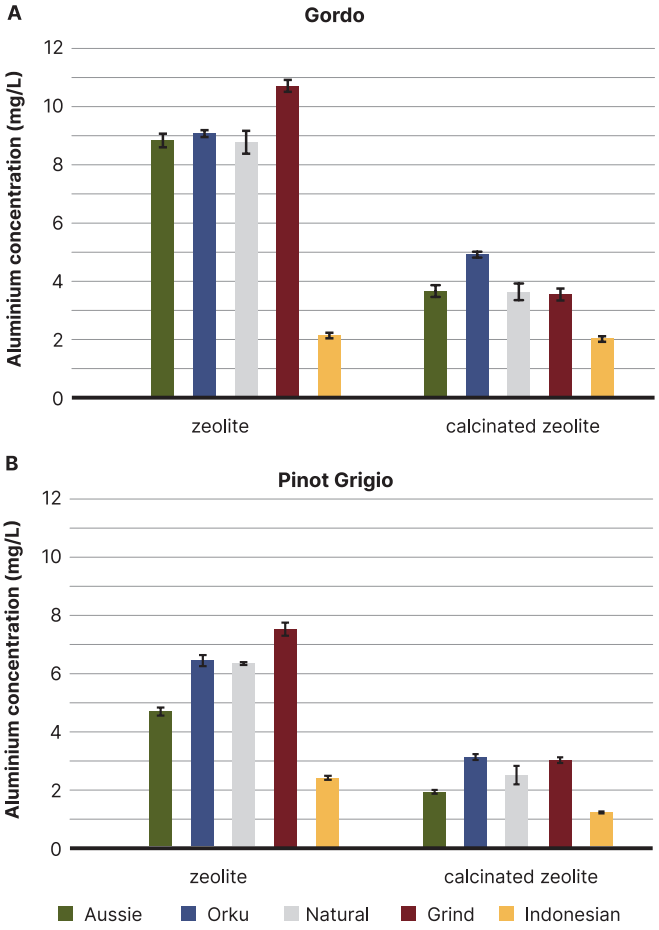

Figure 16. The concentration of aluminium in (A) Muscat Gordo and (B) Pinot Grigio wines after treatment with untreated and heat-treated (calcinated) zeolites

Using ultrafiltration to remediate white wine

Membrane ultrafiltration (UF) is a type of separation technology which is seeing increased use in a wide range of food production applications, including in wine (Sui et al. 2022). Ultrafiltration primarily fractionates wine molecules based on their molecular weight, and this is dependent upon the molecular weight cut-off (MWCO) specifications of the membrane used. In this process, larger molecules tend to be retained (retentate), while low molecular weight substances are able to pass through the membrane (permeate). Figure 17 presents a schematic of how UF works. The AWRI has been participating in a project exploring ultrafiltration applications in wine, led by the University of Adelaide/ARC Training Centre for Innovative Wine Production, with VA Filtration as a commercial partner. The aim of this project was to apply UF to ameliorate excessive phenolics in heavy-pressed or laccase-affected white wines. Permeate and retentate were obtained following pilot-scale fractionation of a phenolic-rich white wine. To achieve this, 10 and 20 kDa membranes were used, and the wine was subjected to different degrees of permeation (50, 80, 90 and 95%). Following fractionation, the alcohol, pH and viscosity in either the permeate or the retentate were not significantly different from the original wine. However, titratable acidity, proteins, polysaccharides and phenolic compounds were concentrated in the retentate, depending on the specific MWCO of the membrane used and the degree of permeation. The selective removal of white wine phenolics demonstrated a unique opportunity to employ UF to remediate oxidised or excessively phenolic white wine. Also, the concomitant removal of white wine proteins, which are predominantly haze-forming, indicates a dual fining effect which could be used to improve heat stability at the same time as removing phenolics.

Reference

Sui, Y., Wollan, D., McRae, J., Muhlack, R., Tuke, J., Wilkinson, K. 2022. Impact of commercial scale ultrafiltration on the composition of white and rosé wine. *Separat. Purificat Technol.* 284: 120227.

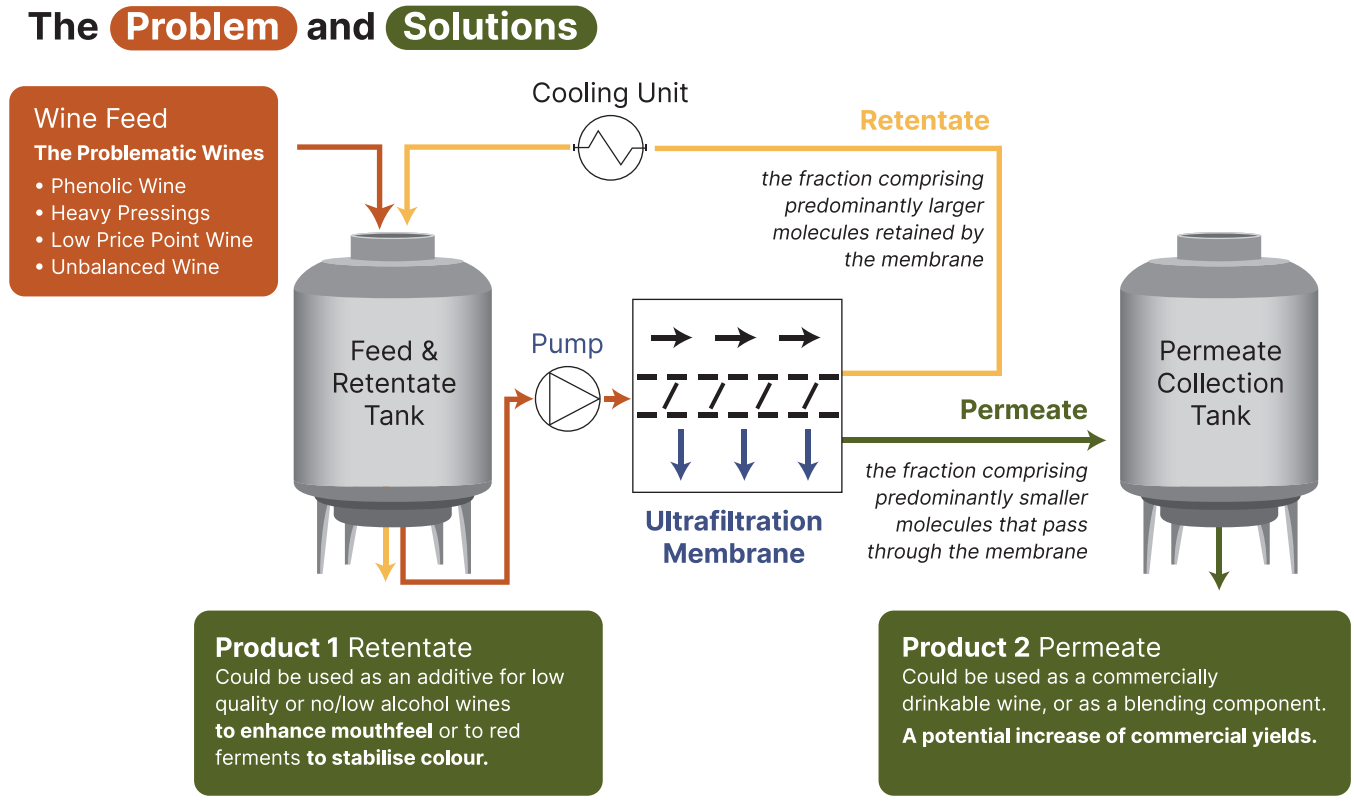

Figure 17. Schematic of ultrafiltration system, and potential feed and uses of the resulting retentate and permeate

Influencing wine style and efficiency through management of oxygen during wine production

Background

This project uses model systems and pilot-scale fermentations to investigate the impacts of oxygen exposure at crushing or during fermentation on both fermentation efficiency and wine style. It also monitors wines with known oxygen exposure as they age to assess oxygen-related chemical changes after fermentation. In collaboration with industry partners, the project team is exploring different approaches to oxygen delivery. Aeration of ferments has also been selected as one of the practice change priorities being pursued through the AWRI's extension project.

Aeration of wild ferments: pilot-scale trials

The motivation for using aeration as a fermentation management tool may vary for those conducting non-inoculated fermentations compared to those aerating inoculated ferments, and the practice may also introduce new opportunities. Modulating the timing of aeration provides a chance to interact with microbial community members other than *Saccharomyces cerevisiae*, which can be dominant during the early phases of fermentation. Previously published work (Varela et al. 2021) showed that aeration timing can differentially benefit microbial community members in non-inoculated fermentations.

To further understand the ramifications of early aeration of uninoculated ferments, the project team initiated a pilot-scale trial (1,000 L) in collaboration with colleagues working on the AWRI's bioprospecting project and an industry partner (Yalumba). Shortly after pressing, non-inoculated Chardonnay ferments were provided with a low flow rate of air (0.5 L/min) for 24 hours. Such early aeration increased the viable cell concentration of non-*Saccharomyces* yeast and their persistence through the fermentation. The provision of air during this early stage decreased the time of fermentation onset. In response, chilling of aerated ferments was initiated two days earlier than untreated control ferments. The result of this temperature control was a synchronous completion of fermentation by the two treatments. There were very few measurable changes to volatile composition in response to early aeration. Of the 33 compounds measured, only 7 changed in response to aeration, with the size of the changes being generally small. Aerated ferments showed a minor increase in volatile acidity, driven predominantly by an increase in ethyl acetate concentration (0.05 g/L), although acetic acid concentration was also elevated (increased by 0.08 g/L).

The effect of aeration of wild ferments on wine sensory properties was evaluated using quantitative sensory descriptive analysis. Most notable was an increase in 'drain aroma' and 'nail polish remover' attributes in the aerated wines. The relationship between 'nail polish remover' and aeration was consistent with the increase in ethyl acetate concentration. This work provides some guidance on the timing of aeration in non-inoculated ferments. It also helps set some boundaries in its application to white grape fermentations and highlights some of the risks for those who may be over-enthusiastic in wanting to give a leg-up to the non-*Saccharomyces* members of the microbial community in their ferments.

Modelling the effects of air delivery method at pilot scale

Another focus this year has been trying to understand how aeration programs can be implemented effectively in the winery. Acknowledging that most winemakers will not use devices that measure oxygen concentration either directly or indirectly (e.g. oxygen or redox probes), the project team questioned whether there might be simple control measures that could be applied to different winemaking situations. This work was inspired by industry trials in 2021 and discussions with winemakers about the practice of aeration.

The project team aimed to determine whether gas flow rate, or sparger surface area, or both, should scale with ferment size when aerating static white fermentations. Starting with a baseline airflow rate, the effect of increasing sparger surface area or distribution in the tank was explored at pilot scale (1,000 L) in a white ferment. The team also explored whether experiments undertaken at 20 L scale could be extrapolated to ferments of 1,000 L. Because the dissolved oxygen concentrations were low, the change in redox value relative to both sparger surface area and gas flow rate was used to assess the effectiveness of the aeration treatment. For a given airflow rate there was little evidence that an increase in sparger surface area or a change in the distribution of spargers within the vessel had any effect on total change in redox potential. The main effect was derived from increases in gas flow rate. For short duration treatments an inline sparger coupled with a pump was much more effective, for a given airflow rate, at increasing the redox potential. This is most likely due to the mixing induced by pumping over the ferment. Although preliminary in nature, this study suggests that for the low gas flow rates being advised for the aeration of white ferments, complex sparger arrangements may not be necessary for effective ferment aeration, especially if considering longer duration aeration treatments.

Reference

Varela, C., Cuijvers, K., Van Den Heuvel, S., Rullo, M., Solomon, M., Borneman, A., Schmidt, S. 2021. Effect of aeration on yeast community structure and volatile composition in uninoculated Chardonnay wines. *Fermentation* 7(2): 97.

No- and low-alcohol wine products: understanding technical and sensory-related challenges and opportunities

Background

This project seeks to define the desirable sensory attributes of existing no- and low-alcohol (NOLO) wines or other beverages in the market and use this information to support development of NOLO wine and wine-like beverages that can satisfy consumers' demands. The project is also evaluating the production practices, technologies and ingredients required to give NOLO products the palate attributes found in full-bodied dry wine.

Industry reference group

An industry reference group was formed from a diverse range of stakeholders along the supply chain. The group was engaged to evaluate the sector's interest in NOLO wine products and to help establish relevant researchable questions.

Sensory analysis of commercially available products

Sensory evaluations were completed on more than 130 NOLO products available in Australia, including sparkling, white and red wine products; beer; cider; and spirits. From these products, a subset were selected based on a range of sensory properties and quality designations. These products were then subjected to more rigorous sensory evaluations using quantitative descriptive analysis and the Pivot©profile rapid sensory method. They also underwent comprehensive chemical analysis, which offered insight into production methods and characteristics that are best suited to these products. Evaluation of the compositional fingerprints of these products can help producers optimise the pre-processing of grapes/wine that will be made into NOLO products in order to achieve more 'wine-like' characteristics in the final products.

Alcohol removal technology

Various methods for the removal of alcohol were evaluated through communication with producers as well as a review of existing literature. Options for removing alcohol from wine include:

- spinning cone column (SCC)
- reverse osmosis (RO) in combination with evaporative perstraction or nanofiltration
- vacuum distillation
- freeze concentration
- extraction with organic or supercritical solvents
- resin adsorption.

However, only SCC and RO methods are commonly used in the wine industry. Spinning cone column tends to be the preferred choice for the production of wines with an alcohol content of < 0.5% alcohol v/v, while RO combined with evaporative perstraction or nanofiltration tends to be used for low-alcohol products > 5% v/v.

Putting microbial diversity to work in shaping wine style

Background

While many wine yeasts are currently available for winemaking, extensive genetic analysis has shown the genetic diversity among these yeasts to be extremely shallow. This limited depth means there is scope to expand the genetic diversity of wine yeasts through breeding and selection. This project builds on previous work in which *Saccharomyces cerevisiae* was mated with non-*cerevisiae* members of the *Saccharomyces* genus to produce genetically complex hybrids and work where non-GM methods of selection were employed to develop low-H_2S and low-acetate-producing yeasts. Together these breeding and selection strategies deliver non-genetically modified germplasm for winemakers seeking a point of differentiation in their wines.

Hybrid yeast: when genomes evolve

Previous work in this project generated a hybrid between *Saccharomyces cerevisiae* and *Saccharomyces uvarum* that displays robust fermentation properties in high-sugar juices while producing wines with lower concentrations of acetic acid than either parent. Genetic analysis demonstrated that the hybrid's retention of a specific *S. uvarum* chromosome was responsible for the low acetic acid trait. To discover whether this hybrid required a specific chromosomal segment to maintain the low acetic acid trait, the project team initiated a program in which segments of the chromosome were deleted and the resulting strains were assessed for their acetic acid production potential. Four areas of interest within the chromosome were quickly defined, and deletion of individual genes within those regions identified a known negative regulator of glycerol production as a critical factor in the loss of the low acetic acid trait. Glycerol is a metabolite necessary for osmoadaptation in yeast. This work suggests that there is a level of interplay between *S. cerevisiae* and *S. uvarum* genomes within the hybrid, improving its ability to adapt to high sugar concentrations and lowering its production of acetic acid.

During the genetic dissection of the *S. uvarum* hybrid, several daughter strains were isolated that produced substantially more glycerol than either of the strains of which the hybrid was composed or indeed the hybrid itself. Whether high glycerol production was a feature of these daughter isolates that could be reproduced at pilot-scale was assessed as part of a collaboration with an industry partner. Replicate Chardonnay ferments (200 L) were used to compare the fermentation performance and influence on wine composition of two hybrid daughter-strains isolated from AWRI 1572 and the *S. cerevisiae* parent of the hybrid (AWRI 838). There was no evidence that the daughter hybrids produced wines with elevated glycerol concentrations in a commercial winemaking environment. Nevertheless, the creation and characterisation of these yeast with exceptionally low acetic acid production phenotypes and a stabilised genome structure demonstrates the potential to help winemakers control volatile acidity during the fermentation of white wine.

Looking for a polar bear in a snowstorm: the search for novel wine yeast

The AWRI's bioprospecting project has characterised and deposited a large number of new yeast strains into the AWRI Wine Microorganism Culture Collection. This represented an opportunity for this project to assess strains of *S. cerevisiae* isolated from non-inoculated ferments to identify strains of oenological interest, a task akin to finding a polar bear in a snowstorm.

From the initial collection, whole genome sequence data was used to identify yeasts that were not already part of the commercial pool of wine yeasts. This set of 416 *S. cerevisiae* yeasts was screened using growth assays. Growth on specific amino acids was used to identify those that had potential for the enhanced production of varietal thiols. Eight *S. cerevisiae* strains were selected based on those assays and evaluated in laboratory-scale fermentations for their ability to complete fermentation and produce volatile thiols. Two of these strains produced concentrations of the thiol 3-SH that were significantly higher than those produced by the control strain.

Using a similar approach, the project team also investigated the contribution of non-*Saccharomyces* yeast to the production of aroma compounds such as benzaldehyde ('almond') and benzyl alcohol ('chocolate', 'fig' and 'tobacco'). Benzaldehyde is also known to be one of the precursors of phenylmethanethiol (PMT, previously known as benzyl mercaptan), a compound that has been associated with 'flint' characters in wine. A subset of nine *Hanseniaspora vineae* and *Hanseniaspora osmophila* strains from the culture collection were evaluated in a synthetic media for their potential to produce benzenoid-derived compounds. The study found that although the *H. vineae* strains produced higher levels of benzaldehyde and benzyl alcohol than their *S. cerevisiae* counterparts, this did not result in an increase in the formation of PMT. Conversely, the *H. osmophila* strains produced high levels of PMT. This study demonstrated the potential for non-*Saccharomyces* yeast to be used in the modulation of 'flint' aromas in wine.

The relationship between grape juice composition and the progress of alcoholic and malolactic fermentation

Background

This project combines yeast and bacterial fermentation to achieve an integrated approach to studying fermentation performance. A rich ecosystem is the starting point for any ferment. However, the uncontrolled growth of non-target microorganisms can inhibit alcoholic or malolactic fermentation through competition for nutrients or the production of secondary metabolites. In addition, simultaneous alcoholic and malolactic fermentation (MLF) is increasingly used to manage winery scheduling more efficiently. This work focuses on the interaction between different microorganisms and the grape juice environment, both individually and as a community, and how those interactions shape fermentation performance.

Acclimatisation by stress: is there a benefit for MLF?

Despite historical improvements in malolactic fermentation (MLF) control, stuck or sluggish MLF issues still occur, particularly in white and sparkling base musts and wines. In these cases, seemingly minor variations in juice composition can significantly affect bacterial survival. The project team previously showed that adding a sub-lethal concentration of SO_2 can result in growth arrest and an inability to initiate the general stress response. The difference in free SO_2 concentration that elicits either the general stress response or growth arrest is small (5 mg/L). That such a small difference in SO_2 concentration can be a life and death factor for *Oenococcus oeni* highlights the narrow margins for successful MLF. These previous findings and the involvement of specific stress response elements in the adaptation of *O. oeni* to SO_2 led the project team to investigate options for rapid acclimatisation of *O. oeni* to SO_2.

To this end, several post-rehydration procedures, including transient heat shock and several sub-lethal stresses, were investigated to determine whether such treatments can improve the SO_2 resistance of commercial malolactic starter cultures. These investigations revealed that, compared to standard rehydration in water, additional post-rehydration treatments of either heat shock (42°C, 30 min) or sub-lethal stress factors of low pH (2.9-2.7), ethanol (10-12.5% v/v) or bound SO_2 (10-20 mg/L) did not significantly improve bacterial survival of a commercial *O. oeni* malolactic starter culture inoculated into Chardonnay juice spiked with 40-60 mg/L bound SO_2. A minor improvement in starter culture survival following a short post-rehydration treatment with 10 mg/L bound SO_2 suggested that such an approach may be feasible. However, additional work is required to develop a successful enhancement strategy.

Searching for novel strains in wild *O. oeni* populations

Efforts to identify naturally occurring *O. oeni* strains with promising oenological traits have continued. From a prior screening of more than 200 natural *O. oeni* strains isolated from South Australian wild ferments, 12 genomically distinct strains exhibiting superior pH and ethanol tolerance were selected for assessment of MLF performance by co-inoculation in Chardonnay. From this screening, two strains were characterised as having favourable MLF performance characteristics and similar impacts on alcoholic fermentation and production of acetic acid to a commercial reference strain. The robust performance of these new strains suggests they have potential for future commercial use.

Investigating interspecies microbial interactions

Non-*Saccharomyces* yeasts are increasingly used to inoculate ferments, often at high cell densities and before inoculation with *Saccharomyces cerevisiae*. An obvious question is whether there are strain-specific interactions between non-*Saccharomyces* and *S. cerevisiae* yeasts. Previous competitive experiments using a barcoded *S. cerevisiae* collection showed substantial fitness differences between *S. cerevisiae* strains in response to the presence of non-*Saccharomyces* yeast species. Furthermore, it was demonstrated that some *S. cerevisiae* strains are better equipped to deal with fermentations in which there may be a higher than average concentration of non-*Saccharomyces* yeast. Ongoing experimental work sought to characterise the basis for inhibition of *S. cerevisiae* by various non-*Saccharomyces* species.

Preliminary work suggested that inhibition of *S. cerevisiae* by *Torulaspora delbrueckii* was related to the depletion of specific amino acids. This was experimentally demonstrated not to be the case. Inhibition could not be rescued by amino acid supplementation. It now appears increasingly likely that inhibition of *S. cerevisiae* results from vitamin and elemental nutrient sequestration that gives rise to the *Torulaspora*-related sluggishness of these ferments.

Complementary work is also underway to understand the inhibition of *S. cerevisiae* by *Metschnikowia pulcherrima*. *M. pulcherrima* can produce a pigment (pulcherrimin) that chelates iron. Therefore, iron sequestration was a primary candidate for the inhibition of fermentation by *M. pulcherrima*. However, recent experimental work has shown this not to be the case. Iron supplementation of mixed *M. pulcherrima* and S. *cerevisiae* ferments did not overcome fermentation inhibition. The basis for fermentation inhibition by these non-*Saccharomyces* yeasts remains unresolved.

Management and optimisation of the AWRI Wine Microorganism Culture Collection

Background

The Australian wine industry is fortunate to have access to the AWRI Wine Microorganism Culture Collection (AWMCC), a unique repository of yeast and bacteria that dates back to the late-1930s. This collection preserves Australia's winemaking heritage, allows access to rare strains for today's winemakers, and supports the latest research on wine microbiology, genetics and molecular biology. Over time, as the collection has expanded, the way microbial strains are identified has been adapted to reflect the latest scientific knowledge and technologies. Additions to the AWMCC are being constantly integrated from wineries, food manufacturers and researchers across Australia and the world, developing a unique source for Australia's microbial fermentation interests. A regularly backed up electronic database is employed to record information about each strain and to manage strain movements (deposition and supply) and intellectual property. The AWMCC holds type and reference strains, research strains, winemaking strains and many Australian indigenous microbial isolates.

Isolation, identification and dissemination of microbial cultures

In 2021/22, 142 strains of yeast and 18 strains of bacteria were deposited into the AWMCC. The deposits originated from researchers, Affinity Labs and wineries. A total of 418 yeast strains were distributed from cryogenic stocks, with 362 allocated to internal projects and 93 provided to external customers under a materials transfer agreement (MTA) or commercial arrangement. Forty-eight bacterial strains were supplied from the collection, with 39 allocated to internal projects and 9 to external customers under MTA.

During the year, approximately 160 strains of yeast and 20 strains of bacteria were identified by molecular biology methods. Microorganism species identification is a constantly evolving area. Techniques such as microscopic analysis of cell morphology, biochemical and physiological testing have been used historically to identify microorganisms, and they still have a place in the characterisation of species, although they can be prone to inaccuracy. The current benchmark molecular method of ITS sequencing is undergoing development at the AWMCC, to enable the identification of larger numbers of organisms at once rather than a one-at-a-time approach. The project team has developed a robust plate-based DNA extraction and PCR protocol which cuts down the time and cost of extraction of genetic material and the amplification of genetic regions from a range of yeast species. This will potentially increase the efficiency of molecular identification and will assist in maintaining a curated database of molecularly identified cultures, which can then be used for a range of purposes.

With the completion of the AWRI's *Brettanomyces* project and with the last few isolates entered into the culture collection in March 2022, the AWMCC now holds one of the largest *Brettanomyces* collections in the world. In addition to the diverse cultures collected from around Australia, the AWRI has a robust research history of genetics, physiology and spoilage potential of these isolates.

During the year, several yeast strains with unusual properties were characterised that have potential for use in wine and grape production and in other industries. These included several strains isolated from flowers, which can withstand a very high concentration of the antibiotic cycloheximide (400 mg/L), four times higher than is used to routinely isolate *Brettanomyces bruxellensis* from wine. These strains may be useful in pharmaceuticals, biodiesel and food manufacturing. Some of these species have the ability to protect against fungal infection in pre- and post-harvest fruit, and may be useful in the production of lower-alcohol wines.

A photographic collection was recently discovered containing micrographs of some of the first yeast and bacteria the culture collection ever retained (Figure 18). This resource is being digitised for future use by AWRI staff.

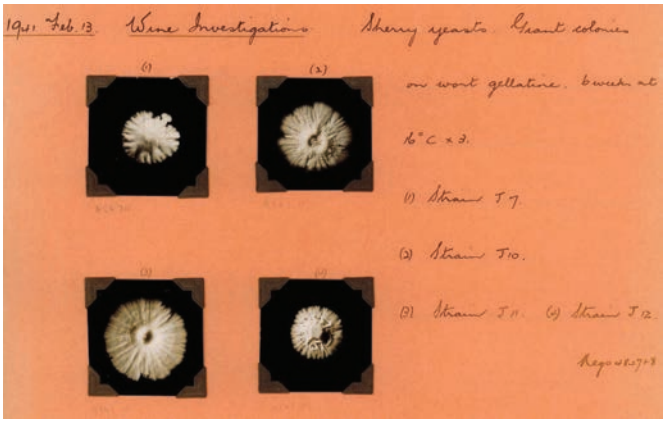

Figure 18. Four flor yeast strains (J7, J10, J11 and J12) photographed in 1940 showing growth on nutrient plates. J7 and J12 strains are still available for Apera production to this day. J7 is the most supplied strain to the Australian wine industry for this wine style.

Objective measures of quality and provenance in Australian vineyards

Background

The project formed part of a University of Adelaide-led multi-agency collaboration to research Shiraz terroir across a range of scales, primarily in the Barossa Valley. Twenty-four sites across six sub-regions were monitored, with fruit sampled for ripeness testing, yield assessment, chemical analysis and small-lot winemaking. The sub-regions were identified by the Barossa Grounds Project, and are classified as Northern Grounds, Central Grounds, Southern Grounds, Western Ridge, Eastern Ridge and the Eden Valley. Detailed chemical analysis was performed on the small-lot wines at the AWRI, and sensory analysis was conducted at the University of Adelaide as part of the collaboration.

Do the sensory properties of Barossa Shiraz wines reveal an underlying terroir?

This year saw the completion of this project, which sought to characterise the terroir of sub-zones within the Barossa Valley that consistently produce distinct Shiraz wines. Experimental wines were prepared from Shiraz grapes sourced from 24 vineyards within the Barossa Valley (three samples per vineyard) over four seasons. Vineyards were selected based on their location within the region, so that representation of potential sub-regions could be adequately captured. Sensory descriptive analysis was performed at approximately eight months after fermentation each year, using a trained panel. The data for each season were analysed using an agglomerative hierarchical clustering analysis (AHC) and significantly different attributes identified using this approach are presented in Figure 19. Preliminary analysis of the sensory results showed that in most seasons, two major clusters could be identified using the AHC approach. Some differences in the main sensory drivers could be found between clusters depending on the season studied. One cluster contained wines that were consistently characterised by 'cooked vegetable' and 'savoury' characters (green), while the other (tan) had wines which tended to demonstrate greater astringency, roughness, sourness and heat. Depending on the season, the second (tan) cluster also demonstrated wines with a more fruit-forward profile. In looking at multiple seasons, it was found that only wines produced from the Eden Valley were consistently distinguished from the rest of the Barossa Valley on the basis of their sensory profile. Eden Valley wines tended to cluster with wines consistently displaying 'savoury' and 'cooked vegetable' attributes (green). The results of the sensory analysis were supported by the observation that over multiple seasons, Eden Valley wines could also be defined as having lower concentrations of the key wine odorant, β-damascenone ('red fruit', 'floral') and higher levels of the C6 compound, E-2-hexenal, which has a 'vegetative', 'green' aroma. Overall, the results of this study indicate that the Eden Valley could potentially be defined as unique within the Barossa Valley in terms of its terroir, and the most likely driver for this is its relatively higher average elevation.

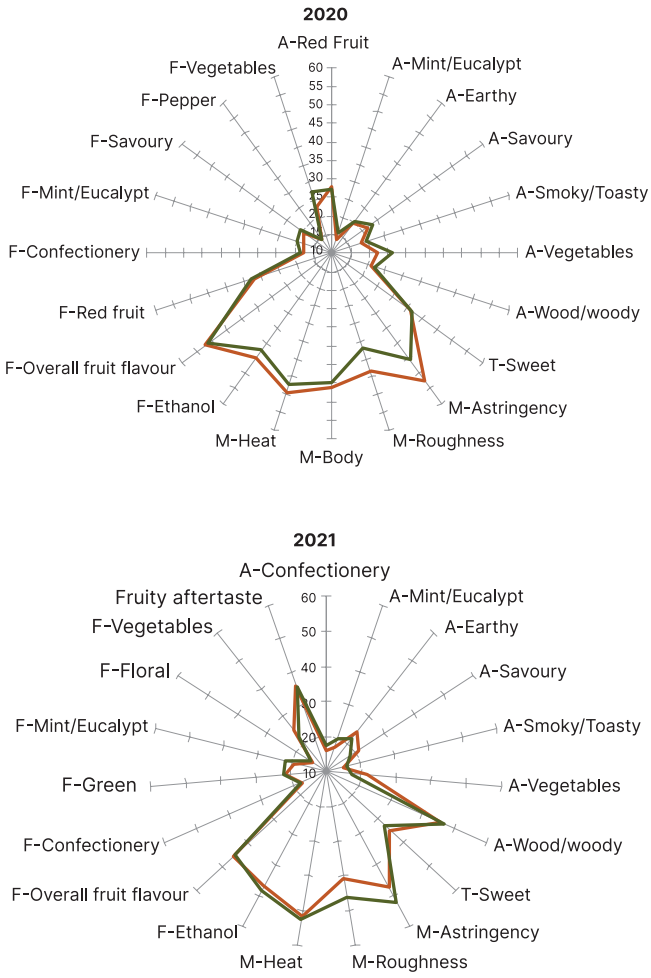

Figure 19. Spider plot of the significantly different sensory data (α = 0.05) and the agglomerative hierarchical clustering analysis, for vintages 2020 and 2021, where green and tan each represent a cluster

Development of resources for the objective measurement of grape parameters to address ACCC recommendations

Background

In 2018/19 the ACCC's Agriculture Unit conducted a market study of the wine-grape industry. The study examined competition, contracting practices, transparency and risk allocation in wine-grape supply chains. This project aims to address some of the recommendations of that study, by developing a range of standardised methods, endorsed by both industry and regulatory bodies, for the measurement of key parameters in grapes; for sampling in the vineyard, in the winery and at the weighbridge; and for validating secondary methods against the reference methods. It also provides training and tools to support the implementation of standardised methods and assist third parties mediating disputes.

Industry-endorsed standard procedures

Developing industry-endorsed standard procedures (IESPs) to ensure grape assessment practices are as accurate and reliable as possible has been an essential component of this project. The IESPs developed include methods for measurement of total soluble solids, pH, titratable acidity and colour in grapes, and validation of secondary methods, with each IESP acting as a supporting document for the Wine Industry Code of Conduct. This work has been guided and reviewed by a project reference group of representatives from key industry bodies.

To complement the IESPs, documents summarising recommended practices have been prepared for the quality assessment of grapes upon receival at the winery. These cover the assessment of matter other than grapes (MOG) and sampling at the weighbridge or point of grape receival. Guideline documents to support the adoption of the IESPs have also been produced, for total soluble solids, colour measurement and sampling in the vineyard.

A procedure for the sensory evaluation of wine attributes

Alongside the IESPs developed, a sensory procedure was generated for evaluation of wines for the presence of taints, off-flavours or other undesirable attributes, particularly those arising from the effect of bushfire smoke. This document aims to help producers evaluate wine sensory attributes in an objective matter, following standardised procedures to achieve reliable, repeatable and accurate results. The procedure was developed based on the fundamentals of sensory science, following a review of small panel and quality control sensory methods, and especially those defined by Australian, International or American Standards and following discussions with wine producers on smoke taint sensory analysis.

Resources for industry

Webinars were presented by the project team to explain the development of the IESPs and associated guidelines. Technical articles were also published in *AWRI Technical Review*, presenting data from vintage trials on analytical differences between different extraction methods used when analysing grapes. These trials have helped to guide and support the recommendations from this project. Engagement with industry on the new procedures will continue into vintage 2023.

Understanding *Brettanomyces* and its adaptation to control measures

Background

Brettanomyces yeast can cause wine spoilage by producing 4-ethylphenol and 4-ethylguaiacol, which contribute 'phenolic', 'leather', 'sweaty' and 'medicinal' aromas (collectively known as 'Brett' character). Although wine spoilage from this yeast was a major issue in Australian red wines produced in the late 1990s and early 2000s, the risk of 'Brett' spoilage is now commonly managed via a multi-faceted strategy disseminated by the AWRI, which enables winemakers to significantly decrease levels of 'Brett' spoilage compounds in finished wines. However, *Brettanomyces* has not been eliminated from Australian wineries, and loss of wine value still occurs. To ensure Australian winemakers' continued ability to manage *Brettanomyces* in a cost-effective manner, the control strategy must be future-proofed against potential market pressures to minimise levels of SO_2 in wine and augmented with rapid detection methods.

Ethylphenol production by sulfur dioxide-tolerant industry isolates

More than 300 isolates of *Brettanomyces* were obtained from industry-provided wines and screened for tolerance to SO_2. Tolerance levels across these isolates varied significantly, but there were many isolates that were able to grow in the presence of much higher concentrations of SO_2 than the most tolerant strains that had previously been observed. In order to determine if these SO_2-tolerant strains retained their ability to spoil wine, high-throughput screening was used to quantify the ability for each isolate to consume *p*-coumaric acid, the precursor of the main spoilage compound, 4-ethylphenol. There was no significant difference in the ability of tolerant strains to consume coumaric acid relative to their SO_2-susceptible counterparts. This indicates that the SO_2-tolerant strains retain the potential to spoil wine at a level similar to susceptible strains.

Options for dealing with potential sulfur dioxide tolerance

Previous investigations have shown that *Brettanomyces* can evolve high levels of tolerance to SO_2 in the laboratory and analysis of industry isolates has shown that tolerance to SO_2 is also increasing in the field. To provide information on effective options for winemakers dealing with potentially more SO_2-tolerant strains, tolerant industry isolates were tested for susceptibility to the antimicrobial agents, dimethyl dicarbonate (DMDC) and chitosan. Five isolates of *Brettanomyces* that displayed levels of SO_2 tolerance higher than the reference strain AWRI 1499 (previously considered an example of a more SO_2-tolerant strain) were treated with either DMDC or chitosan. DMDC was shown to be effective against all of the SO_2-tolerant isolates, with no viable cells observed four days after treatment of model wine containing actively growing *Brettanomyces*. Chitosan was also shown to be highly effective against the SO_2-tolerant isolates. No viable cells were observed in model wine inoculated with four of the industry isolates or AWRI 1499 as control after seven days of treatment with chitosan. One strain, AWRI 4513, was shown to be resistant to killing by the addition of chitosan; however, the chitosan treatment was able to inhibit the proliferation of this strain, keeping the level of viable cells after 14 days of incubation similar to those at the time of inoculation, while the control treatment saw extensive proliferation after inoculation.

Formation and fate of sulfur compounds associated with negative attributes in wine

Background

Volatile sulfur compounds (VSCs) can contribute both positive and negative attributes to wines, and it is therefore desirable to be able to control their concentrations in a winery environment. The occurrence of VSCs can be influenced by factors including yeast selection and fermentation conditions; the nature and quantity of precursor compounds; the availability or absence of oxygen at different points of the winemaking process; and the availability and speciation of transition metal ions such as copper. By exploring the chemistry of VSC formation and the important role played by metals, these common winemaking observations can be better understood, potentially leading to recommendations for ways to decrease the risk of undesirable 'reduced' aromas and maximise positive aromas.

Investigating the influence of yeast genetic background and nitrogen status on phenylmethanethiol production

It is known that the nitrogen content of grape must plays an important role in the formation of volatile sulfur compounds by wine yeast during fermentation. To investigate whether this was also the case for formation of phenylmethanethiol (PMT, 'struck flint', previously known as benzyl mercaptan), small-scale fermentations were carried out in both synthetic and Chardonnay musts, to which increasing concentrations of nitrogen in the form of inorganic ammonia were added prior to fermentation. In the synthetic must, addition of nitrogen resulted in an increase in the levels of PMT produced by three of the four yeast strains assessed (Figure 20A). Similar results were also obtained in a filtered Chardonnay must (Figure 20B), which confirmed the important role of must nitrogen content in PMT formation by yeast.

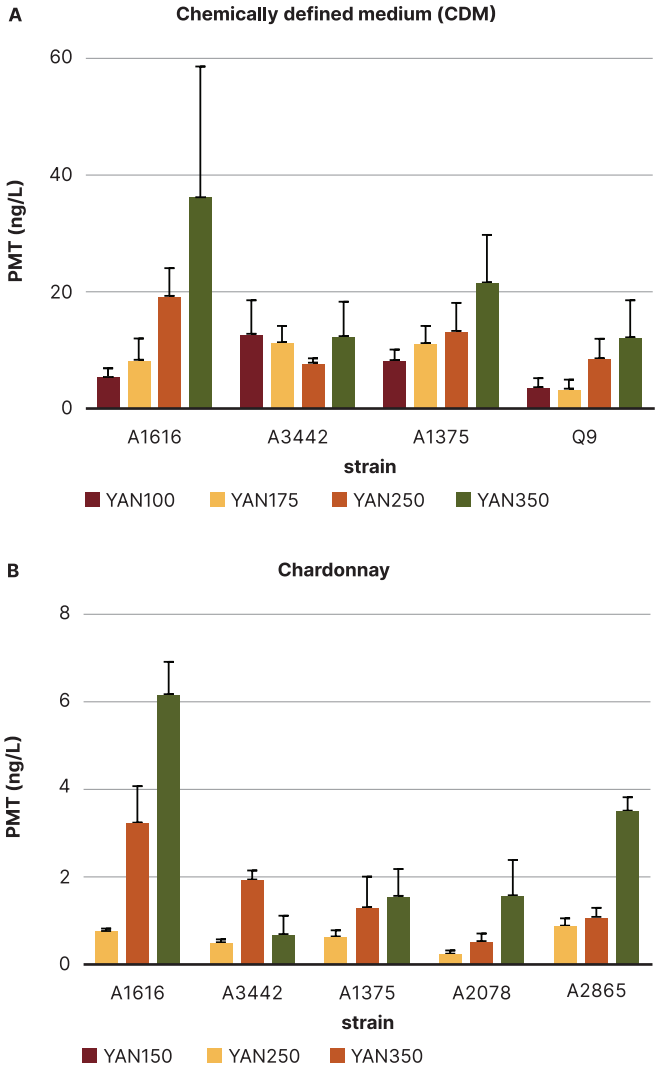

Figure 20. Production of phenylmethanethiol (PMT) by four wine yeast strains after fermentation of (A) a synthetic must with different concentrations of yeast assimilable nitrogen (YAN) (100, 175, 250 and 350 mg/L), and (B) a low-nitrogen Chardonnay must with a YAN concentration of 150 mg/L which was supplemented with inorganic nitrogen to achieve a final YAN concentration of either 250 or 350 mg/L

Factors affecting the chemical formation and preservation of PMT

The effect of pH, oxygen exposure, elevated residual concentrations of copper and iron, and elevated concentrations of H_2S and SO_2 on the formation and preservation of PMT were evaluated. Samples treated with oxygen and samples treated with either copper or iron were found to contain significantly less H_2S (a precursor of PMT) than samples protected from oxygen and without metal treatment. The limitation of H_2S in samples exposed to oxygen and/or copper and iron resulted in the formation of significantly less PMT than in the controls. The preservation of PMT in wines was also affected by copper and iron, as well as high residual concentrations of H_2S and SO_2, with significantly lower PMT measured in treated samples (Figure 21).

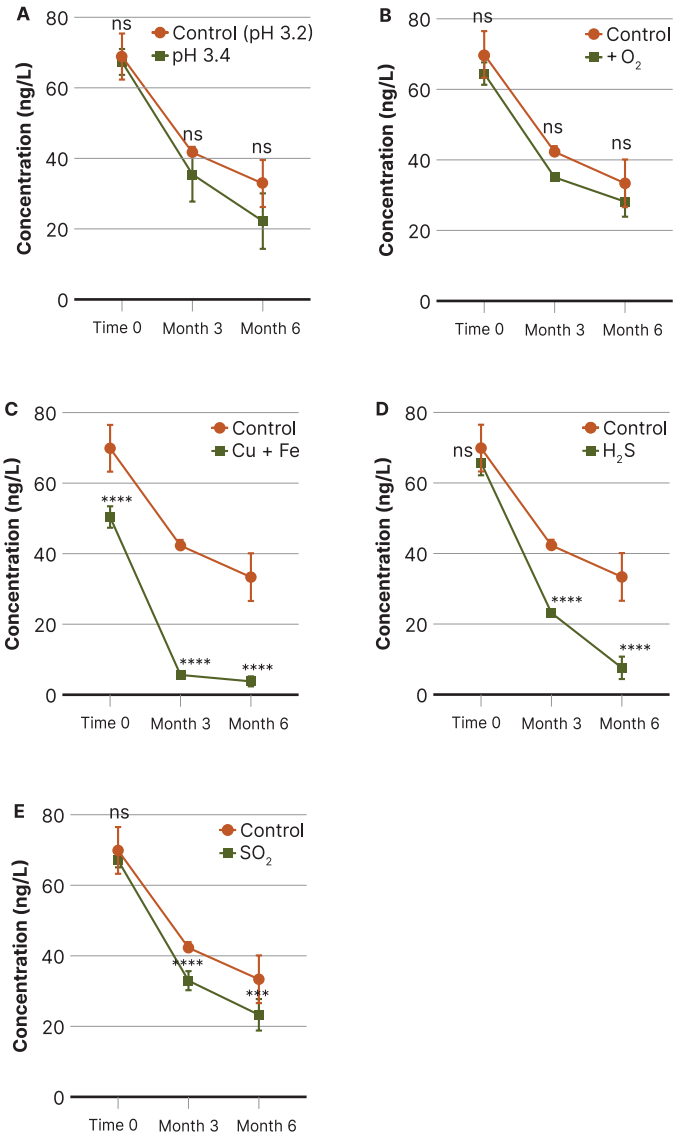

Figure 21. The effects of (A) pH, (B) oxygen (O_2) exposure, (C) residual copper (Cu) and iron (Fe), (D) elevated hydrogen sulfide (H_2S) and (E) elevated sulfur dioxide (SO_2) on the preservation of phenylmethanethiol (PMT) in model wine

This study demonstrated that anaerobic conditions promoted the formation of PMT, and that copper fining may inhibit its formation and/or affect its stability. As such, copper fining may have detrimental effects on the preservation of 'flint' aroma in wine post-bottling.

Understanding the prevalence of 'flint' aroma in white wine

A survey of 71 white wines targeting 'struck flint' aroma found PMT in all wines at concentrations between 0.2 and 5.0 ng/L (aroma threshold 0.3 ng/L). The compound 2-furylmethanethiol (furfuryl thiol, 2-FMT) was also found in all wines up to a surprisingly high concentration (0.1 – 165 ng/L, aroma threshold 0.4 ng/L). Both PMT and 2-FMT were linked to 'struck flint' aroma but when concentrations of 2-FMT were higher, the character tended toward a less pleasant 'burnt rubber' note. A subset of 24 Chardonnay wines were then chosen to cover a 'peachy' to 'flinty' style spectrum for a sensory/compositional study. Again, a relationship was found between the concentration of PMT and 2-FMT and the intensity of 'struck match/flint' aroma.

A consumer preference test was conducted with more than 90 consumers evaluating six Chardonnay wines. Results showed that 'peach' aroma was an important factor driving liking in this study, together with 'sweetness' and 'viscous mouthfeel', for most consumers. Around one-third of the consumers, however, preferred wines with 'struck flint' and 'toasty' aromas that were also low in 'hotness' and 'bitterness'.

A novel technology for the rapid and selective removal of VSCs

Volatile sulfur compounds such as H_2S, methanethiol (MeSH) and ethanethiol (EtSH) are associated with 'reductive' aromas in wine and account for 30% of wine faults, making the management and remediation of these unwanted off-aromas important to the wine industry. A novel method for the generation of smart surfaces that incorporate immobilised nanoparticles to remove VSCs compounds was developed to selectively remove unwanted VSCs from wine. The technology is based on immobilisation of nanoparticles on a mesh surface. The ability of smart surfaces to remove H_2S, MeSH and EtSH from spiked model wine solutions was investigated. Surfaces with 68 nm diameter nanoparticles immobilised on 2-methyl-2-oxazoline (POx) were the most effective (Figure 22A). When evaluating the optimum exposure time, it was determined that treating wine with the surface for 24 hours was the most effective in removing H_2S, MeSH and EtSH (Figure 22B).

The effectiveness of the smart surfaces in removing 'free' H_2S, MeSH, and EtSH was evaluated in real wines and compared with copper fining (Figure 23). Concentrations of the naturally occurring H_2S, MeSH and EtSH were significantly decreased after the wines were treated with the smart surfaces. The treatment was as effective or more effective than copper fining for white wines, suggesting that the newly developed technology could be used as an alternative to copper fining. The interference of SO_2 in H_2S removal by surfaces and their effect on 'tropical' thiols were also investigated. The results showed that SO_2 did not interfere with the ability of the smart surfaces to remove H_2S and the surfaces did not remove 'tropical' thiols.

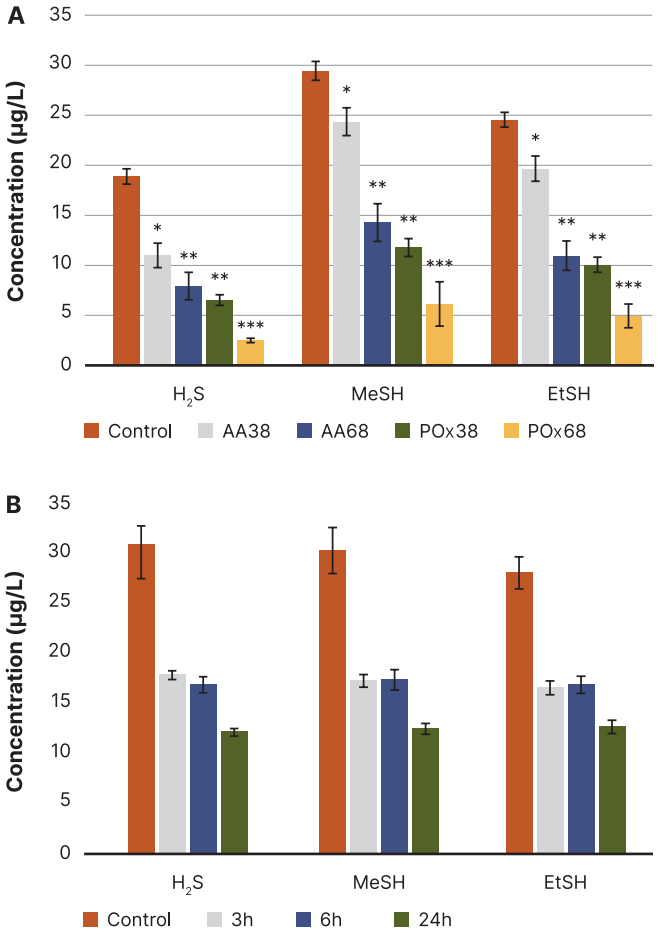

Figure 22. (A) The concentration of hydrogen sulfide (H_2S), methanethiol (MeSH) and ethanethiol (EtSH) in spiked model wine solution after treatment with 38 and 68 nm nanoparticles deposited on 2-methyl-2-oxazoline (POx) and allylamine (AA) coatings. (B) The concentration of H_2S, MeSH and EtSH in a spiked model wine solution after 3, 6 and 24-hour treatment with nanoparticles deposited on a POx surface.

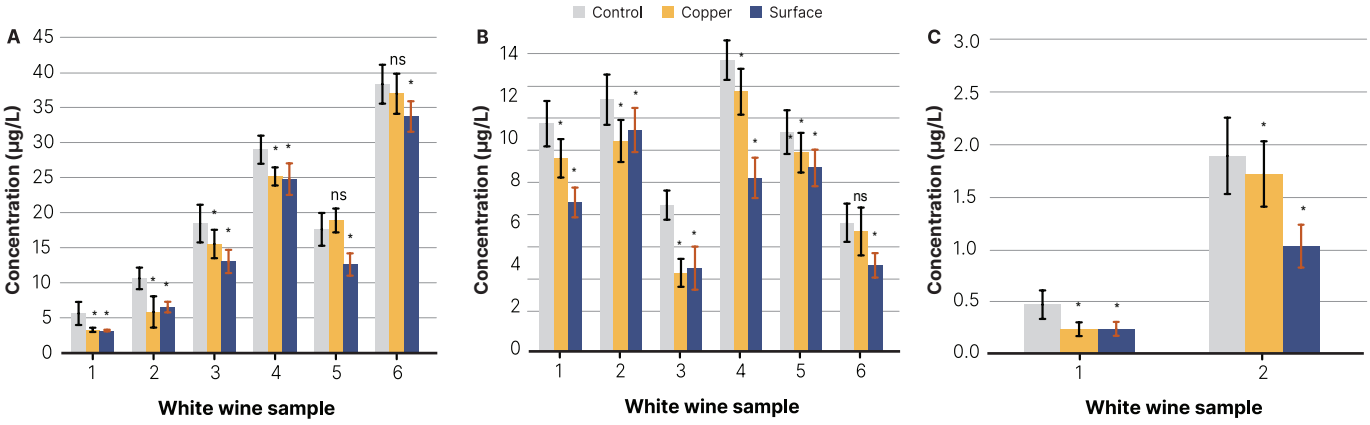

Figure 23. The concentration of (A) hydrogen sulfide, (B) methanethiol and (C) ethanethiol in real white wine samples before and after treatment with copper and smart surfaces

Understanding and mitigating the development of 'reductive' characters in canned wine

Background

Recent industry trends have indicated that wines packaged in cans are particularly susceptible to the formation of 'reductive' characters post-packaging, with the main culprit being hydrogen sulfide (H_2S), which can impart a 'rotten egg' aroma. Trials were carried out to understand the chemical pathways involved in the formation of H_2S in canned wines and the impact of different wine attributes on this process. This work showed that pH, free sulfur dioxide (SO_2), copper, oxygen and chloride can influence the corrosion chemistry at the internal aluminium surface of a can and this can result in the migration of aluminium into wine and subsequent reaction with SO_2 to produce H_2S, despite the presence of a protective barrier film. Further trial work has indicated that chloride, pH and free SO_2 are particularly important drivers for this process and that elevated temperatures can accelerate the aluminium migration and H_2S formation.

Based on this, a mitigation strategy targeting the removal of copper from the wine prior to canning was formulated. From a series of benchtop trials, the most effective method identified was the use of cross-linked poly-vinyl imidazole/poly-vinylpyrrolidone (PVI/PVP) co-polymers to scavenge the copper species.

Evaluating the impact of mitigation strategies on the shelf life of canned wine

A series of commercial wines provided by project consortium members were screened for compositional risk factors, treated with PVI/PVP and packaged using the AWRI's small-scale packaging facility. Chemical and sensory analysis were then carried out over a six-month period.

Results showed that the risk of reductive characters in canned wines can be minimised, if wines with a low-risk profile are pre-selected, according to the known risk factors. This can be combined with treatment using a commercial cross-linked polymer prior to canning to decrease the risk of aluminium migration into the wines and the subsequent formation of H_2S. Generally speaking, the polymer-treated wines showed lower concentration increases in aluminium and H_2S during the six-month storage period (Figure 24). Overall, resulting H_2S concentrations were lower than seen in previous benchmarking studies on canned wines. Sensory evaluation of these wines showed comparable quality ratings for the control and treated wines, with no obvious taints or faults attributed to the PVI/PVP treatment.

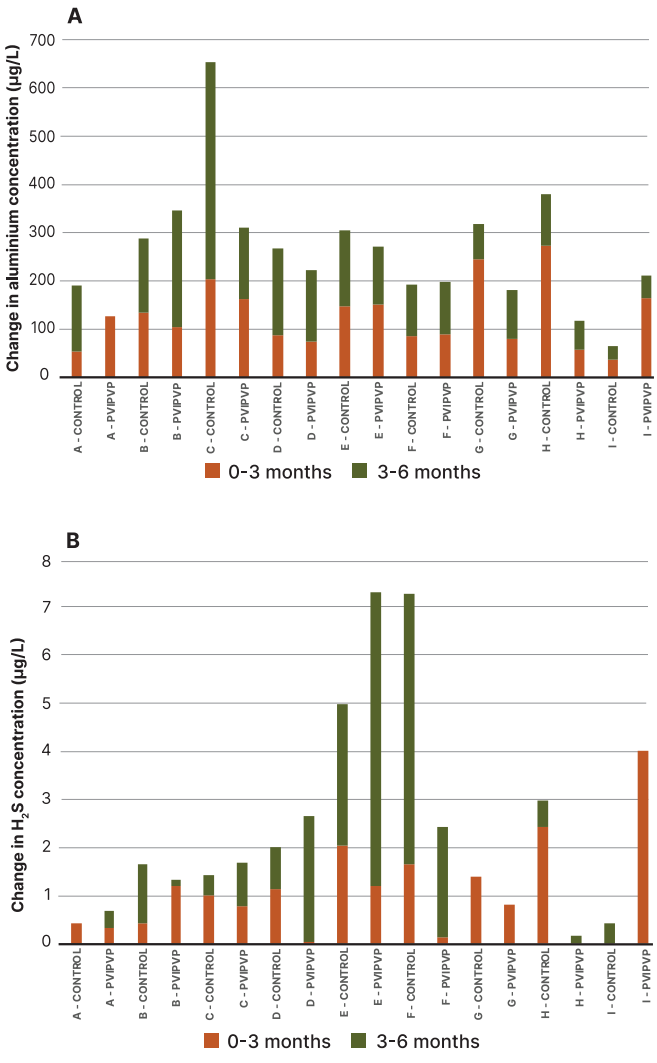

Figure 24. Changes in (A) aluminium concentration and (B) H_2S concentration (relative to the concentration at the time of canning) in control and PVI/PVP-treated wines over 0-3 months and 3-6 months from canning

Developing a predictive test for canned wines

Preliminary work has been carried out on a simple laboratory test that can be used to assess the potential impact of different wines on aluminium migration from the inner can surface, and therefore predict potential for H_2S formation. This involves the creation of aluminium coupons from the inner can surface and coating them with an inert polymer film, prior to immersion in a test wine matrix at elevated temperature. Further work is required to finalise and validate this method.

Smoke taint research and industry support

Background

This was the second and final year of a research project on smoke at the AWRI funded by Wine Australia with co-investment from the State Governments of South Australia and Victoria, initiated in response to the 2019/20 bushfires. Assessing the relationship between the concentration of smoke-derived compounds in grapes and wine and the intensity of 'smoky' sensory attributes in wine has been a major focus. The impact of early-season and late-season smoke exposure was assessed using grape samples collected across Australia during the 2019/20 bushfire season, many of which were made into wine under standardised conditions.

In addition, the AWRI continued to support several state-based initiatives which aim to enhance technical capacity at the regional level. AWRI researchers also collaborated with the Gulbali Institute at Wagga Wagga, NSW to understand the impact of winemaking processes on smoke taint and supported PhD research by students from the University of Adelaide's Industrial Transformation Training Centre and CRC-P project.

Linking chemical composition and sensory properties in smoke-affected wines

A suite of seven volatile phenols and six glycosides is typically used to assess smoke exposure by comparing concentrations to those found in non-smoke-exposed grapes and wine. Elevated concentrations of markers indicate smoke exposure of grapes. Analysis of more than 3,000 samples from the Australian 2020 vintage found approximately one-third were consistent with non-smoke-exposed samples, with no false negatives identified. Detailed information on background concentrations of volatile phenols in non-smoke-exposed fruit and how to use and interpret smoke exposure data is now available in an open-access peer-reviewed article (Coulter et al. 2022).

Heavily smoke-exposed grapes are known to result in wines with high concentrations of volatile phenols and glycosides and strong 'smoky' aroma, flavour and aftertaste. A mixture of volatile phenols and glycosides has been related to 'smoky', 'burnt', 'charred' and 'bandaid' aromas and flavours in wine. However, to date there has been a lack of information about the concentrations of smoke markers in grapes likely to produce smoky wines. To address this gap, 65 smoke-exposed Chardonnay, Pinot Noir and Shiraz grape samples were collected from multiple regions across Australia in 2020, and wines were made under controlled conditions at 50-kg scale. Chemical analysis was conducted on the grapes and wines. The wines were assessed for 'smoke flavour' intensity by the AWRI's smoke sensory panel, which consists of individuals who have been screened and trained to reliably detect smoke flavour. Relationships between smoke markers in grapes and wine and smoke flavour in wine were examined.

A subset of volatile phenols and glycosides (measured in wine) were found to be important in modelling smoke flavour in wine, with slightly different regression models produced for each variety. Guaiacol and *m*-cresol were most important predictors for all varieties, and *o*-cresol, *p*-cresol, and glycosides of guaiacol and cresol (guaiacol rutinoside and cresol rutinoside) were also important. Syringol gentiobioside is an excellent marker for smoke exposure, but was not important to the smoke flavour models. There was a high degree of correlation between smoke markers; that is, wines high in volatile phenols were also high in glycosides. While the best models for smoke flavour were obtained based on volatile phenols and glycosides, the simple sum of guaiacol, *m*-cresol, *o*-cresol and *p*-cresol gave good predictions for smoke flavour in wine in these samples (Figure 25).

Linking chemical composition of grapes to smoke flavour in wines

When comparing grape composition to wine composition, the relationship is affected by winemaking practices and a simple conversion cannot be applied to estimate the concentration of smoke markers in wine from concentrations measured in grapes. Volatile phenols increased in red wine compared to their concentrations in

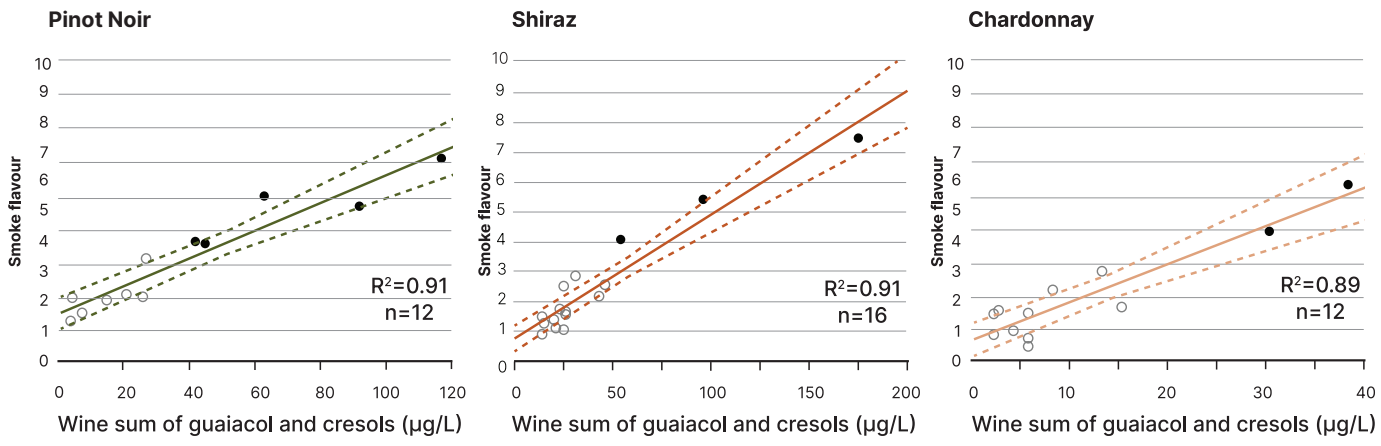

Figure 25. Prediction of smoke flavour in wine from the sum of guaiacol, *m*-cresol, *o*-cresol and *p*-cresol concentrations in wine in Pinot Noir, Shiraz and Chardonnay. Each variety had a slightly different slope. Shiraz wines had higher concentrations of guaiacol. Chardonnay wines had lower smoke flavour ratings and lower concentrations of volatile phenols due to the removal of grape skins during winemaking.

grapes, while some glycosides also increased and others decreased, in line with previous observations. The Chardonnay wines had lower concentrations of volatile phenols than the grapes, due to the removal of skins that occurs during white winemaking. Despite these complexities, a subset of the smoke exposure markers in grapes could be selected to predict smoke flavour in wine for each variety (see Figure 26 for Pinot Noir).

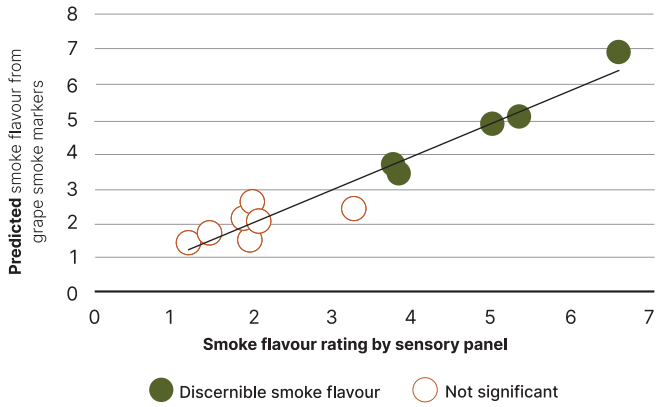

Figure 26. Prediction of smoke flavour in wine by key smoke markers in grapes for Pinot Noir samples taken from multiple regions across Australia that were exposed to varying degrees of smoke during the 2019/20 season. Different varieties had slightly different models.

Consumer response to smoke-affected wines

A consumer liking study was conducted with a set of unoaked Shiraz wines from the Adelaide Hills, made from grapes exposed to smoke early in the 2020 ripening season, almost two months before veraison. This study built on two consumer liking studies with diluted smoke-affected Chardonnay and Pinot Noir rosé wines reported previously. In each of the three studies, consumer liking was strongly negatively related to smoke flavour intensity in smoke-affected wines (Figure 27). Most consumers responded negatively to smoke flavour, with some (21-53%) highly responsive, giving low liking scores for wines even with only a low level of smoke. These studies have provided information about the smoke compound concentration ranges that affect consumer acceptance.

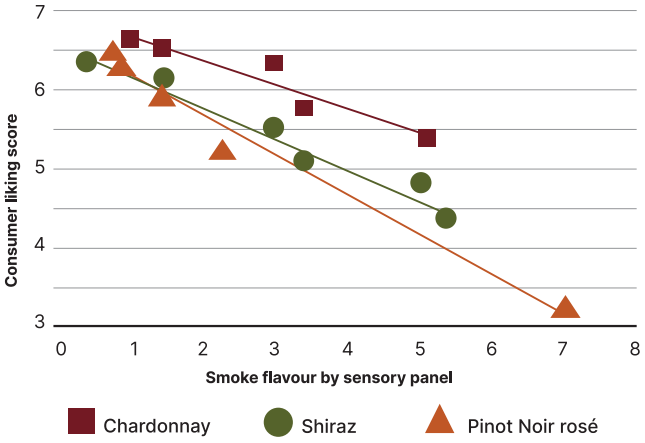

Figure 27. Relationship between consumer liking score and smoke flavour in separate studies on Chardonnay, Shiraz and Pinot Noir rosé wines

Through a partnership with Wine Victoria and funding from the Victorian Government, the AWRI completed projects in the Bushfire Technical Package which commenced in 2020. This package was funded by the Victorian Government to support activities that provided both immediate and longer-term support to the industry. This included the creation of targeted regional sensory panels, to improve the sensory evaluation within regions, and delivery of a series of sensory workshops.

Winemaking remediation trials were conducted in-house by ten wineries assessing a wide range of materials and technologies including glycosidase enzymes, activated carbon fining, choice of yeast strain and nanofiltration. Commercially available glycosidase enzymes reduced the concentration of smoke glycosides although with a corresponding increase in the concentration of the volatile phenols. The process of nanofiltration had little impact on the concentration of volatile phenols. Treating wines with activated carbon reduced the concentration of volatile phenols; however, the effectiveness depended on the carbon product, dose rate and wine type, and fining with activated carbon also led to stripping of aroma and flavour. Treating smoke-affected wines with untoasted oak did not reduce the levels of smoke compounds although it may mask bitterness and/or increase the perception of fruit sweetness. It is important that producers undertake laboratory-scale trials of mitigation options before treating commercial volumes. The outcomes of these trials were presented at a series of workshops where participants had the opportunity to taste the finished wines and discuss the findings with the winemakers involved in the trials.

Reference

Coulter, A., Baldock, G. A., Parker, M., Hayasaka, Y., Francis, I. L., Herderich, M. 2022. The concentration of smoke marker compounds in non-smoke-exposed grapes and wine in Australia. *Aust. J. Grape Wine Res.* 28(3): 459-474.

Environment, sustainability and natural capital

The success of the Australian grape and wine industry is strongly tied to its long-term custodianship of the natural environment. Soil, water, biodiversity and climate all contribute to the success or failure of grapegrowing across Australia. Electricity, fuel, refrigeration and waste disposal are all major costs in winemaking. Projects under this theme aim to assist producers to improve environmental, social and economic performance; to adapt to the challenges of a variable climate; to make the most of the grapevine clonal resources available; to develop tools to verify the origin of Australian wines; and to improve management of pests and diseases.

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Sustainable Winegrowing Australia

Background

Launched in 2019, Sustainable Winegrowing Australia is Australia's national program for grapegrowers and winemakers to demonstrate and continuously improve their sustainability in the vineyard and winery through the environmental, social and economic aspects of their businesses. The program takes a holistic approach to managing, supporting and promoting sustainability. In 2020, Australian Grape & Wine, the AWRI and Wine Australia signed a Memorandum of Understanding outlining the collaborative arrangements for governance and delivery of Sustainable Winegrowing Australia. The program is governed by a joint steering committee with representatives from Australian Grape & Wine, the AWRI and Wine Australia. The roles of the three partner organisations are as follows:

- Australian Grape & Wine provides oversight and guidance of the program, liaises with the Australian Government and state governments and consults with the sector's key stakeholders on policy and development.
- The AWRI provides program management, membership administration, technical development, and extension and adoption activities.
- Wine Australia provides marketing and communications to help attract and retain members and to promote Australia's sustainability credentials to key stakeholder groups globally.

Membership and trust mark

In 2021/22 Sustainable Winegrowing Australia membership increased from 631 to 933 (86% vineyard members, 12% winery members and 1% wine business members), with certified members representing 24% of total members. There was also significant and growing demand for certified membership of the program from across the sector. The Sustainable Winegrowing Australia trust mark, which is available for use by certified members, has grown in visibility during the year, appearing on more than 100 wine labels, 100 farm gate signs and in the marketing and promotions of a range of certified members.

Industry engagement

During 2021/22, the project team responded to 3,062 sustainability enquiries via the helpdesk. These included requests for information about the program, new membership requests, assistance to complete membership and technical support for certification. COVID-19-related travel and gathering restrictions continued to pose some challenges for industry engagement activities; however, the delivery of online and hybrid online/face-to-face workshops was well received. During the year the Sustainable Winegrowing Australia team delivered certification training to more than 600 participants across 24 regions. This included workshops and presentations in the Yarra Valley, Rutherglen, Barossa, Langhorne Creek, Adelaide Hills and McLaren Vale as part of projects funded by the National Landcare Program. On average, the certification workshops received an average participant rating of 92% in post-event surveys.

The project team instigated monthly online regional forums to provide support to regions that have dedicated resources to support Sustainable Winegrowing Australia. These meetings identified key communication tools needed by the regions to promote their sustainability performance. Regions were also supported through the collation of aggregated regional datasets to enable tracking of regional performance and the identification of regional focus areas.

Sequencing Australian wine grapevine germplasm

Background

Grapevine planting material represents a major investment and critical production asset for the Australian wine industry, but the genetic diversity that is present in Australia is poorly understood. Furthermore, while grapevine cultivars can be unequivocally typed by ampelography and/or genetic tests, clonal identification relies solely on the tracing of supply records to the point of origin. Such records are not always available or reliable, particularly for older accessions.

The AWRI has developed a world-first clonal sequencing methodology that combines the latest next-generation genome sequencing technologies, high-performance computing and customised bioinformatics tools. This technique has been successfully used to define a subset of clonal variation in Chardonnay, while providing historical insights regarding the origins of the Gingin clone. It has also been used to investigate sequence-verified sources of specific Pinot Noir clones for bushfire recovery efforts in collaboration with Adelaide Hills Vine Improvement Inc. This technology will now be used to assemble a foundational database containing hundreds of grapevine clonal genomes that will allow the robust identification of the majority of grapevine varieties and clones of economic importance within Australia.

Genome sequencing of Australian grapevine germplasm

For phase one of this project, DNA sequences were analysed from almost 400 clones of Chardonnay, Shiraz, Pinot Noir and Riesling. This represents the majority of clones from the main suppliers of grapevine germplasm in Australia. Clustering of samples using unique DNA fingerprints produced detailed maps of clonal-specific DNA variation that can be used to identify specific clones within each cultivar.

Bioprospecting Australian microbial genetic diversity

Background

Differences in wine microbiota are likely to be an important aspect of terroir, particularly where spontaneous fermentations are performed. Traditional microbiological research has shown that both vineyards and uninoculated wine fermentations contain diverse mixtures of microbial species, often with species being represented by multiple strains. However, the inability to efficiently and accurately assess the large numbers of samples required to understand such a complex concept as terroir has limited further insights into this important area. This lack of information is also an impediment to the exploitation of native microbial germplasm and spontaneous fermentation by the Australian wine industry. Recent advances in culture-independent microbiological techniques such as metagenomics (genomic sequencing of mixed microbial communities) can address these issues by efficiently providing detailed identification of the species, and their proportions, in complex microbial mixtures.

Development of non-*Saccharomyces* strains for industry

Modern winemaking predominantly relies on pure *Saccharomyces cerevisiae* yeast starter cultures, which establish a dominant yeast population from the beginning of fermentation and enable the production of good quality wines with well-accepted sensory properties. While some producers seek to decrease vintage variability, secure ferment reliability and blend their wines to achieve a preferred flavour profile, others are happy for their wines to reflect the conditions of the vintage and exhibit more diversity from one year to the next. One strategy winemakers can use to increase wine flavour diversity is to perform spontaneous (or wild) fermentations. Although they carry a higher risk of spoilage, wines fermented this way can have improved sensory attributes compared to inoculated wines, including mouthfeel, aroma and flavour complexity, and integration of flavours. A potentially less risky alternative to spontaneous fermentation, which can provide novel or complex flavour profiles and improve fermentation reliability, is the use of non-*Saccharomyces* starter cultures.

Since 2014 the AWRI has isolated yeast strains from ferment samples sourced from different Australian wine regions. A total of 1,291 non-*Saccharomyces* isolates have been characterised for winemaking-relevant attributes, including tolerance to common stress conditions found during wine fermentation, as well as enzyme activities relevant to the appearance, aroma and flavour of wine. From these enzyme activities, β-galactosidase and β-lyase activities were chosen as a focus for initial development work. Both enzyme activities act on volatile precursors which originate from grapes, with β-galactosidase releasing monoterpenes responsible for floral attributes and β-lyase releasing thiols which are linked to 'tropical' attributes.

Laboratory-scale experiments in grape juice supplemented with monoterpene and thiol precursors enabled the identification of three different yeast isolates, one strain of *Hanseniaspora uvarum*, one strain of *Metschnikowia pulcherrima* and one strain of *Torulaspora delbrueckii*, which showed either high β-galactosidase or β-lyase activity. In addition, the *T. delbrueckii* isolate displayed high production of some desirable esters. These three non-*Saccharomyces* strains were then assessed for their potential as starter strains that could be used in sequential inoculation strategies with *S. cerevisiae*. Pilot-scale trials were performed in Riesling (a grape variety that has precursors for both monoterpenes and thiols), with comparisons made against a common commercial *S. cerevisiae* strain. Chemical analysis showed that wines produced using the *Hanseniaspora* isolate contained higher concentrations of the monoterpene linalool, whereas wines produced with *Metschnikowia* and *Torulaspora* had higher levels of thiols. Sensory analysis revealed that all non-*Saccharomyces* wines were different from the *S. cerevisiae*-fermented control wines, with *Metschnikowia* wines associated with 'tropical fruit' attributes and wine produced with *Torulaspora* associated with 'stone fruit' and 'citrus' flavours. These findings demonstrate the potential for non-*Saccharomyces* starter cultures to shape wine flavour and aroma and suggest it would be worthwhile to evaluate them in other grape varieties.

The effect of temperature on the wild ferment microbiome

Currently, the quest for novel and distinct wine flavour profiles has led winemakers towards increasing the use of uninoculated wine fermentations in commercial settings. Several winemaking factors can affect the composition and structure of native microbial populations. These factors alter yeast growth and/or metabolism and can influence whether a particular species or strain contributes to wine aroma and flavour. The project team has shown previously that the addition of the antimicrobial compound sulfur dioxide (SO_2) prior to the initiation of uninoculated Chardonnay fermentations enables selection of *Hanseniaspora osmophila* and consequently changes the wine's volatile profile. Similarly, aeration, a common winemaking practice during fermentation, was shown to increase the viable cell population of non-*Saccharomyces* yeast and alter the yeast community structure in uninoculated Chardonnay ferments. These changes were accompanied by significant differences in the volatile composition of the finished wines.

To add to the repertoire of interventions that could be applied to wild fermentation, the effect of temperature on the microbial composition and structure of uninoculated Chardonnay and Shiraz fermentations was investigated in two sequential vintages. Three fermentation temperatures were evaluated: 12°C, 22°C and 28°C.

As expected, an increase in temperature increased fermentation kinetics and resulted in shorter fermentation times: at 12°C fermentation lasted 35-36 days depending on the grape variety, while at 28°C fermentations were complete in only 6-7 days. Total yeast cell counts were higher at higher temperatures, although some differences were found depending on grape variety. In Chardonnay, higher temperatures promoted the growth of *S. cerevisiae*, decreasing the abundance of *Hanseniaspora* and *Torulaspora* species. In Shiraz, relative abundance of *S. cerevisiae* and *Starmerella* species increased with higher temperature, while the abundance of *Metschnikowia* and *Lachancea* species decreased. Alongside these changes in microbial dynamics and structure, differences in chemical composition were also found for final wines. In Chardonnay, the concentrations of succinic acid, glycerol and higher alcohols increased with higher temperature, whereas the concentration of esters decreased. The concentrations of ethyl acetate and volatile acids were higher at lower temperatures. Similar trends were observed in Shiraz, with glycerol concentration increasing with higher temperature, while the concentration of esters decreased. The concentrations of ethyl acetate, higher alcohols and volatile acids were higher at lower temperatures, while acetic acid concentration was highest at 28°C. These findings highlight how winemaking factors can be used to systematically influence microbial population structure and shape wine style.

Citizen science – yeast catchers

Background

The AWRI is working with school students around Australia on a citizen science project called 'Yeast Catchers' that is looking for undiscovered Australian fungal species. This project is funded by a Citizen Science grant from the Australian Government Department of Industry Science and Resources as part of a program which seeks to engage the public in scientific research projects.

The Yeast Catchers project aims to isolate yeasts endemic to Australia, while introducing real-world scientific research into Australian schools. Sampling tubes containing yeast-selective media are distributed to participating schools. Students find natural objects from their local environment (documented in geo-tagged photos) and add these objects (e.g. soil, plants, rocks or insects) to the tubes. The tubes then sit in the classroom for two weeks to see if there are any signs of microbial growth. Samples that display microbial growth are returned to the AWRI, where a combination of metagenomic DNA sequencing, strain isolation and whole-genome sequencing are used to identify and characterise the species present in each sample. Feedback is provided to each school about the species their students isolated, and students may have the opportunity to participate in further experiments on yeasts they have isolated.

Initial results

In the first year of the project, eight schools participated and 90 positive cultures were re-cultured and arrayed on agar plates to obtain yeast isolates. A total of 958 isolates were typed to species-level using ITS profiling. Homology analysis indicated at least 37 different species of yeast across the dataset, with some species present in more than one sample. Draft whole genome sequencing was performed for 96 isolates that represented the breadth of predicted species and site diversity. Positive identification was established for 63 isolates based upon draft genomic data. At least 29 schools are expected to participate in year 2 of the project.

Understanding the basis of agrochemical resistance in biotrophic grapevine pathogens

Background

Grapevine diseases caused by fungal/oomycete pathogens such as *Botrytis cinerea*, *Erysiphe necator* (powdery mildew) and *Plasmopara viticola* (downy mildew) are responsible for significant crop losses. Current control measures rely on spraying with agrochemicals; however, the development of resistance to agrochemicals is an ever-increasing problem in agriculture, and one from which the Australian wine sector is not immune.

Population genomics of powdery mildew

Resistance to DMI (group 3) and QoI (group 11) fungicides can occur through a combination of different types of mutations. In addition to single nucleotide changes in the sequence of specific target genes (*cyp51* for DMIs, *cytB* for QoIs), changes in gene copy number can also influence levels of fungicide resistance. PCR-based testing provides the means to determine the status of single-nucleotide resistance mutations, but does not provide information on copy number or information on how individual isolates are related to each other (population structure). As an alternative to PCR-based approaches, whole genome sequencing was used to investigate the population structure of a number of isolates of powdery mildew provided by SARDI, while also quantifying all known single-nucleotide variants and any associated copy number alteration in genes that are known to provide resistance to group 3 and 11 fungicides.

Autonomous machinery to replace herbicide for undervine weed control

Background

There is increasing interest in non-chemical management of undervine weeds in Australian vineyards. However, common alternatives such as cultivation and mowing require more and slower tractor passes. Autonomous vehicles – either retrofits of existing tractors or new autonomous robots – are one solution to manage the extra work, and they are being investigated in this project funded by the Australian Government's Established Pests Animals and Weeds Management Pipeline Program. Different weeding implements are also being studied, including new electrical weeding equipment.

Autonomy kit for tractor

A GOtrack autonomy kit was purchased and installed on a Fendt 211P tractor. This was successfully used with different undervine weeding tools as well as a canopy sprayer and a mulcher. It navigates based on satellite positioning with real-time kinematic (RTK) corrections to achieve 2-3 cm precision.

Weeding trials

A 15-ha block of Shiraz grapes in the Barossa Valley is being used for side-by-side trials of different undervine weeding treatments. These include herbicide, cultivation with a dodge plough, cultivation by blades with rotary tillers, cultivation by roller and finger hoes, mowers, and no treatment at all. In 2021 and 2022, mechanical treatments were generally manually driven for initial passes but were then run increasingly autonomously for later passes. Yields were similar for all treatment in this first year of trials. The trials will be continued for the 2023 vintage, with the addition of areas managed by other techniques including electrical weeding and a weeding robot. Autonomous electric lawnmowers charged by an off-grid solar-battery station will also be evaluated.

Foundational data and support services

The research, development and extension activities of the AWRI are underpinned by an efficient service capacity that provides and supports infrastructure; delivers research support and analytical services; manages governance, legal and financial affairs, information technology and workplace safety; and monitors trends in Australian wine composition and production practices.

Staff

Manreet Bansal (to 3 September 2021), Caroline Bartel, Sheridan Barter, Ida Batiancila, Kate Beames (to 7 January 2022), Linda Bevin, Laura Bey, Eleanor Bilogrevic, Catherine Borneman, Natalie Burgan, Susanne Copeland (from 17 January 2022), Alfons Cuijvers, Georgia Davidson, Chris Day, Russell Desmond (from 29 November 2021), Dr Zung Do, Shiralee Dodd, Kerri Duncan (to 3 September 2021), Damian Espinase Nandorfy, Angus Forgan, Assoc. Prof. Leigh Francis, Josephine Giorgio-Ion, John Gledhill, Robyn Gleeson, Dr Nuredin Habili (to 31 December 2021), Jesse Hall, Kate Hardy, Alex Hennig (from 16 May 2022), Thomas Hensel, Prof. Markus Herderich, Kieran Hirlam, Dr Josh Hixson, Adam Holland, Leanne Hoxey, Wen-Hsiang (Denny) Hsieh, Dr Vilma Hysenaj, Pauline Jorgensen, Dr Mark Krstic, Jillian Lee, Desireé Likos, Dr Alan Little (to 31 December 2021), Dr Natoiya Lloyd, Brigitte Lynch (to 29 November 2021), Jacinta McAskill, Emily Milsom (from 23 May 2022), Dr Emma Muehlberg (from 8 November 2021), Bryan Newell, Dr Luca Nicolotti, Dr Simon Nordestgaard, Jennifer O'Mahony, Kara Paxton (to 20 May 2022), Dr Wes Pearson, Lisa Pisaniello, Dr Amy Rinaldo, Ella Robinson, Dr Tony Robinson, Kyla Schmidt (from 21 March 2022), Marco Schoeman (from 17 January 2022), Jessica Schrapel (from 21 February 2022), Neil Scrimgeour, Gina Sellars, Dr Tracey Siebert, Dean Smiley, Mark Solomon, Pamela Solomon, Dr Yihe (Eva) Sui (from 20 June 2022), Fang Tang, Dr Maryam Taraji, Randell Taylor (to 27 November 2021), Don Teng, Heather Tosen, Dr Lieke van der Hulst (to 14 September 2021), Flynn Watson, Kylee Watson, Caitlin Wellman (to 24 June 2022), Dr Rachel West, Dr Matthew Wheal, Dr Eric Wilkes, Paul Witt, Qi Wu, Sara Zhan (from 30 August 2021).

Collaborators

AB Biotek (Dr Tony Balzan, Dr Caleb Cheung, Dr Anthony Heinrich, Alex Moriarty, Dr Tina Tran, Pierre Van Rensberg); Archie Rose Distillery (Dave Withers); Australian Institute for Bioengineering and Nanotechnology, University of Queensland (Dr Esteban Marcellin Saldana); Compusense, Canada (Ryan Corrick); Food SA (Samantha Alexandra); SARDI (Dr Marcos Bonada, Sarah Cornish, Dr Gaston Sepulveda); University of Adelaide (Dr John Carragher, Assoc. Prof. Paul Grbin); University of Melbourne (Prof. Malcolm McConville); University of Western Australia (Assoc. Prof. Michael Clarke); Wine Industry Technical Advisory Committee (Iain Jones); Wine Australia (Rachel Triggs).

Efficient administration

Background

The AWRI's management and administration is carried out by a dedicated team of specialists who work together to provide leadership, infrastructure, financial, human resources, legal, contract management, risk management, workplace health and safety, corporate governance and IT services across the organisation. The team's objective is to enable all AWRI staff to focus on their core capabilities to ensure that the organisation is able to meet its objectives, and in turn the expectations of its stakeholders. The team works closely with the AWRI Board, which provides additional leadership and oversight to all AWRI activities.

Finance

Core activities included financial management; budgeting; and reporting to the AWRI's management and Board, funding organisations (particularly Wine Australia) and various arms of government. Administrative support was provided to entities such as the Australian Wine Industry Technical Conference, Interwinery Analysis Group and the Wine Innovation Cluster. Other notable activities included managing the ongoing impacts of COVID-19 on the AWRI's asset base, cashflow and liquidity; assisting in the formalisation of funding and collaboration agreements, particularly the development of renewed funding arrangements with Wine Australia; financial modelling and business case development in support of a range of strategic and capital investment initiatives; considering how environmental, social and governance aspects can best be incorporated within external financial reporting; and ensuring ongoing compliance with evolving accounting standards.

Human resources

The AWRI's human resources capability maintains responsibility for a broad range of functions including recruitment, employment contract management, visas, payroll and compliance activities. Many AWRI staff undertook a range of professional development activities during the year, with a focus on skills in delivering presentations and authoring posters in preparation for the 18th AWITC in June 2022, in addition to the participation of numerous AWRI staff in that event. Many AWRI Directors nominate for their directorship fees to be made available for such purposes, for which their support is gratefully acknowledged. The internal Leadership Development Program welcomed its second cohort of participants, and the AWRI continued its ongoing objective to transition its employees from fixed-term to permanent employment arrangements to support its ability to attract and retain world-class talent. The annual staff survey once again highlighted the AWRI's positive working environment, with 94% of respondents confirming that 'all things considered, the AWRI is a great place to work'. Themes which consistently contribute to this outcome include the collaborative, diverse and passionate workplace culture; close engagement with industry; workplace flexibility, particularly since the emergence of the COVID-19 pandemic; and the AWRI's well equipped and modern facilities.

Operations

The Operations and Research Laboratory Manager manages all AWRI infrastructure, equipment and engineering requirements with a strong focus on workplace health and safety activities including chairing the AWRI's Safety Advisory Committee and oversight of periodic safety inspections and assurance programs. Further responsibilities include chairing the AWRI's Institutional Biosafety Committee, maintenance of Office of the Gene Technology Regulator accreditation, and auditing and maintenance of Physical Containment Level 2 (PC2) laboratory facilities used for specialised research on genetically modified organisms (GMOs). During the year the Operations and Research Laboratory Manager attended the 9th National Institutional Biosafety Committee forum, following which procedures for handling GMOs were updated to reflect best practice. This included the decommissioning of three of five PC2 facilities and consolidating relevant GMO handling, in conjunction with physical controls which limit access to accredited persons. Continuing to optimise the efficient use of AWRI facilities remained a priority throughout the year. Following an organisation-wide review, an area previously used for administration was converted to house high-end analytical instrumentation, creating additional laboratory space for sample preparation, further instrumentation and a larger, safer chemical receival and waste handling station.

Corporate governance and legal support

Following an 18-month review of its composition and appointment processes, including a stakeholder consultation process, the AWRI Board finalised amendments to the AWRI Constitution and Board Charter, which were approved by members in February 2022. Key changes to Board composition and appointment processes include:

- The introduction of a position elected by Grape Research Levy payers
- A reduction in the number of positions elected by Levy payers (Elected Directors) from six to four, including one position nominated and elected by small, medium and large category Wine Grapes Levy payers and one position nominated and elected by Grape Research Levy payers
- An increase in the maximum number of positions appointed by the Board (Appointed Directors) from four to six, to ensure an appropriate balance of skills and diversity (including geography)
- The introduction of a Nominations Committee, made up of a mix of independent members and current Directors, to assist in the selection and reappointment of Appointed Directors
- The incorporation of an open recruitment process for the selection of Appointed Directors, seeking expressions of interest to address identified gaps in the Board's skills and diversity
- The introduction of a gender diversity quota for non-executive Director positions, specifying a minimum of at least four Directors of either gender.

These substantive changes ensure the AWRI remains best placed to meet the evolving needs of the Australian grape and wine industry and models contemporary principles of best-practice governance. The transition to the new composition and appointment processes will occur over a two-year period with the first two Directors appointed through the Nominations Committee process taking office in the second half of 2022 and the first Director elected by Grape Research Levy payers taking office in January 2023.

Information technology and knowledge management

In addition to provision of the usual IT support services to all employees, delivery continued of a range of strategic initiatives including the renewal of the AWRI's storage area network, firewall and other core infrastructure, expanded back-up capabilities and a range of network security enhancements. Providing resilience against cybersecurity threats continues to be a key organisational priority, resulting in the appointment of Alex Hennig in the newly created role of IT Support Officer to ensure that the organisation is able to devote appropriate resources to addressing such challenges. The IT Manager also provided in-house support to a range of complex initiatives fundamental to the roll-out of the new Affinity Labs identity.

Online collaboration tools including Office 365, Microsoft Teams and SharePoint Online continued to be important in enabling staff to manage and share files and to work from locations outside the AWRI's premises when required. The ability to provide external user access to certain files has also enabled project teams to work more effectively with collaborators.

Affinity Labs

Background

Affinity Labs (the new identify for AWRI Commercial Services) serves an important role in the Australian grape and wine industry, providing internationally recognised and accredited reference laboratory services, proof-of-performance testing, consulting services, microbiological and molecular services, grapevine virus testing and the design and implementation of trials and research for industry, covering all parts of the production chain from viticulture to packaged wine. Affinity Labs also continues to be actively involved in pre-competitively funded applied research projects and provides services to the broader agricultural industry and producers of other foods and beverages.

Affinity Labs – a new name but the same world-class service

Extensive consultation with stakeholders and industry as well as a detailed market survey highlighted the potential for the AWRI's commercial activities to grow not only in the grape and wine sector, but also in the beverage and food sector, where the organisation's vast experience, scientific rigour and significant equipment base could be leveraged without any impact on core customers. This growth would not only allow the AWRI's commercial arm to continue to invest in the capability to offer the most advanced services to the grape and wine sector, but also to contribute to the AWRI being able to sustainably continue its world-leading research, development, extension and adoption activities.

One of the outcomes of the consultation was that the commercial arm would benefit from having a more independent and recognisable identity, while still being tied to the strength and history of the AWRI. After working with a leading Australian brand agency and engaging the whole organisation in its development, Affinity Labs was born as the new identity for the AWRI's commercial activities. The name reflects the affinity between the diverse range of expertise and skills within the organisation and with our customers as we actively strive for their success. A refresh of the AWRI master brand was conducted at the same time as the Affinity Labs brand was developed, to ensure the two brands would work well together.

Affinity Labs was formally launched at the Australian Wine Industry Technical Conference in June, with the refreshed AWRI branding revealed at the same event. Affinity Labs now has its own independent website which details the services offered, allows ordering of analysis and will eventually also include tracking and receiving results. The new website is the cornerstone of the team's focus on continuing to improve customer delivery and experience. It will also make it much easier for non-traditional customers to find our services.

The industry's premier testing provider

Affinity Labs had a strong year despite its core wine industry customers facing difficult market conditions. Total sample numbers for 2021/22 (26,226) were slightly lower than the three-year (2019 to 2021) average (26,704) but in keeping with normal year-on-year variation. Customer numbers grew by 113, demonstrating continued demand for the services provided. During the year Affinity Labs conducted proof-of-performance testing for three new analytical instruments, all of which subsequently launched at the Australian Wine Industry Technical Conference.

Affinity Labs continues to reinvest revenue into ensuring the industry has access to the most modern and capable equipment. The Analytical Laboratory recently modernised its FTIR and turbidity instrumentation to increase capability and ensure reliability. The Trace Analysis Laboratory is commissioning a new Agilent 6456 QToF LCMS, which will allow a much wider range of residues to be routinely tested in grape and wine samples, shorten turnaround times and reduce cost pressures. In the Applied Biosciences team, a new QIAxcel capillary electrophoresis instrument has automated many of the tasks associated with the PCR component of grapevine virus testing, increasing efficiency, speed and reliability.

Continuing to prepare for smoke events

While this year has been thankfully relatively free of smoke incidents in Australia, Affinity Labs continues to improve its capacity to provide results when the need arises. Validation work has been completed on a more robust smoke glycoside method, which includes deuterated reference standards for all six glycoside compounds in the screen. This increases the robustness and sensitivity of the method, ensuring even greater confidence in the results. The new method has also been cross-validated across a range of instruments, allowing for even greater capacity if future events require it. The team is also developing and testing options to allow initial sample preparation to occur in an affected region, to speed up sample collection and reduce turnaround times.

Continued growth in bioscience capabilities

This year has seen a large focus on efficiency and quality improvements in both virus testing and elimination services. Virus testing procedures have been streamlined to include increased automation in both the sample preparation and PCR testing components, resulting in increased throughput while maintaining competitive turnaround times. A second round of ring testing for the three Australian grapevine virus testing laboratories saw a general improvement in the consistency of results among the laboratories and steps to further standardise methods are continuing. Significant improvements have been made to virus elimination procedures, resulting in an increase in the success of establishing plants in tissue culture and a reduction in the overall time to complete the process by up to 50%. This is timely, as discussions with industry indicate that germplasm collections may need to undergo virus elimination, which would likely see a large increase in samples for this service in the coming year.

Supporting a sustainable future

Affinity Labs continues to be a strong service provider assisting businesses to improve the sustainability of their practices. The Affinity Labs team continued to manage and update the Australian Wine Carbon Calculator (600+ downloads in 2021/22), and delivered presentations on the carbon calculator and carbon footprinting to organisations including Porto Protocol, Institute of Masters of Wine and Sustainability Victoria. The business provides services across the three pillars of sustainability (environmental, economic, social), assisting customers to understand the implications of sustainable practices on areas such as product performance, brand reputation or market access.

Research services

Background

The provision of complex instrumentation, testing facilities and highly specialised analytical methods is a basic element of modern scientific research. This project ensures access to expertise such as sensory evaluation, grape and vineyard sourcing, organic synthesis and purification of rare compounds, statistical analysis and running of advanced chemical analytical systems.

Sensory analysis

In the past 12 months, there has been consistently strong demand for smoke sensory analysis to determine the severity of smoke characters in wine, from both researchers and industry. Twenty-seven smoke intensity rating sessions were completed, with four quantitative descriptive analysis studies on smoke sample sets.

Twelve further large descriptive analysis studies and several shelf life studies were run, with 29 technical quality panel sessions also completed. Sixteen additional descriptive tests were conducted, involving Pivot©profile, Napping and free choice attribute sessions. Twelve difference test sessions, 22 preliminary ‘bench tastings’ and three consumer liking studies were also undertaken. New internal AWRI staff were incorporated into the difference testing panel pool. An evaluation of the triangle test compared to the duo-trio test was undertaken for a red wine with added proline, confirming that the duo-trio test, while less statistically powerful, is more sensitive for in-mouth comparisons especially for red wines with strong carry-over effects from sample to sample.

A variety of sensory experiences were presented at the AWRI/Affinity Labs stand at the WineTech trade exhibition, including one to assess participants’ specific inability to detect certain important wine aroma compounds. There was a high proportion of insensitive individuals for each compound tested, with no person able to correctly identify all compounds. This highlights the overall population’s variation in genetic ability to detect specific compounds and the need for caution in relying on only a single winemaker for taint assessments or other critical steps in production.

Sensory panel activities were completed while under continued constraints from COVID-19 protocols, assessor illness and working from home arrangements. Assessors returning following COVID-19 infection were tested using the standard UPSIT clinical smell identification test to ensure their sense of smell was back to normal levels. Portable sensory booths were purchased to allow tests to be completed in meeting rooms as needed. The booths in the sensory laboratory were also upgraded with controllable LED colour masking lights, which can provide a wide spectrum of colours and light intensities suitable for specific test requirements.

Analytical chemistry support

A new GC/MS-O was installed and commissioned, and users were trained. This sensitive state-of-the-art instrument expands capacity for automated high-throughput analyses of trace volatiles.

Synthetic organic and computational chemistry

The purity of in-house chemicals required for analytical determinations was determined to eliminate possible analytical artefacts. Computational chemistry techniques were used in several flavour projects to help understand the processes and products being observed in the laboratory.

WIC Winemaking Services

Background

Wine Innovation Cluster (WIC) Winemaking Services is based at the Hickinbotham Roseworthy Wine Science Laboratory and is a joint venture between the AWRI and the University of Adelaide that was established in 2010. Its location within the University of Adelaide's purpose-built small-lot and pilot-scale winemaking facility enables the delivery of high-quality research and small-scale commercial winemaking services.

2022 vintage

WIC Winemaking Services processed 150 research wines (6-100 kg) and 4 commercial (1-2 tonne) batches of wine during the 2022 vintage, made up of 60% white wines (22% in 2021) and 40% red wines (78% in 2021). Total fruit intake and processing was just under 20 tonnes. A cool start to the season saw a delayed start to vintage with the first fruit arriving on 15 February, almost two weeks later than 2021. Fruit intake peaked in the second week of March, again approximately two weeks later than 2021. The last fruit arrived on 28 April, four days later than in 2021. There will be another full off-season of agrochemical studies in the second half of the calendar year, which will provide an ongoing stream of work to complement bottling operations.

During the year, WIC Winemaking Services attained certified member status with Sustainable Winegrowing Australia. To achieve this benchmark, the team collated the required sustainability data, underwent training to prepare for audit, were audited and then performed any resulting actions from the audit before receiving the certification.

WIC Winemaking is increasing its capability in non-wine-related services. In one project, the team worked with the University of Adelaide, SARDI and Food SA, to investigate processing options for cherry juice production, with both fresh and frozen cherries. This work was well received and provided some very useful data to the client. The service has also been engaged by a large-scale distillery to conduct trial work to identify accelerated ageing techniques for spirits.

Metabolomics and bioinformatics service platforms

Background

The AWRI established the South Australian node of Metabolomics Australia (Metabolomics SA) in 2008 as part of the national NCRIS network with partners in WA, Victoria and Queensland and funding provided by Bioplatforms Australia and the South Australian Government. Metabolomics SA operates as a collaborative service platform that provides public and private researchers and industries with support, services and training, as well as access to infrastructure and specialist expertise.

New technology and capabilities for metabolomics in South Australia

Metabolomics SA offers profiling of more than 400 non-volatile metabolites related to primary metabolism and other metabolic pathways as a service to researchers and industry. A wide range of sample types can be analysed, including a microorganism's biomass or secretions, plants, aquatic organisms and biofluids. During the year, in response to client demands, Metabolomics SA developed new methods for proline quantitation in wine using NMR spectroscopy; hormone analysis in chicken egg yolk and plasma; sample preparation for sheep wool and hormone monitoring; primary and secondary metabolite profiling in fungi biomass and secretions; and bioinformatics tools for high-throughput metabolite profiling.

Partnerships

A new partnership with Adelaide's microbiome community has led to the establishment of a reference database for detection and annotation of metabolites in complex sample matrices. This extends existing methodologies for absolute quantitation of short-chain fatty acids in faecal, caecal and serum sample types.

Community engagement and service delivery

Metabolomics SA launched a new website (metabolomics.awri.com.au), which communicates the analytical technologies, services and expertise offered through the facility. Metabolomics SA staff provided support to research and industry partners by conducting more than 9,500 analyses; supporting projects from 26 industry clients; and training and upskilling 17 PhD students and early career researchers in metabolomics techniques, instrumentation and bioinformatics.

Tracking trends in Australian wine composition and vineyard and winery practices

Background

It is important for the Australian wine sector to track how it is evolving – how common different production practices are and how wine composition is changing. This allows producers to compare their practices with their peers and helps organisations like the AWRI in designing relevant research and extension activities. This project addresses these goals through a regular practices survey, aggregate analysis of chemical data from Affinity Labs' databases and other targeted activities.

Tracking compositional trends

A core focus this year was the collation and analysis of data tracking the compositional trends in Australian wine from 1985 until the present. An article reviewing the data with a focus on vintages 2015 to 2021 has been prepared for publication in *Wine and Viticulture Journal*.

A deeper dive on trends in alcohol content broken down by variety was also conducted for the last eight years of data and presented in a poster at the 18th AWITC. This study showed that for a number of individual varieties trends in alcohol concentration did not follow the same trends as seen for red and white wines as a whole. For example, over the last four years of data, average alcohol concentrations in red wines have trended downwards, but Shiraz wines have trended upwards in alcohol content (Figure 28). For white wines a similar overall downward trend was noted over the last four years; however, Sauvignon Blanc has tended to trend upwards (Figure 29).

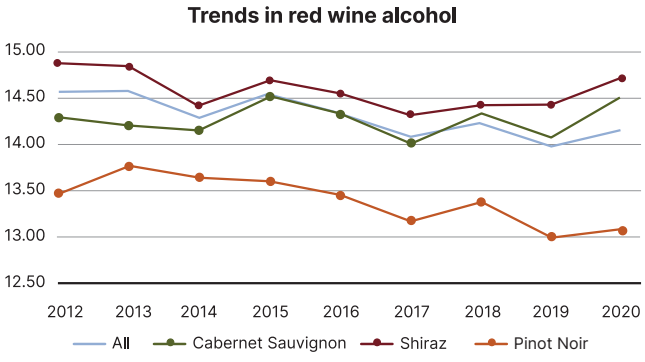


Figure 28. Trends in the alcohol concentration in Australian red wines, combined (light blue) and separated by variety

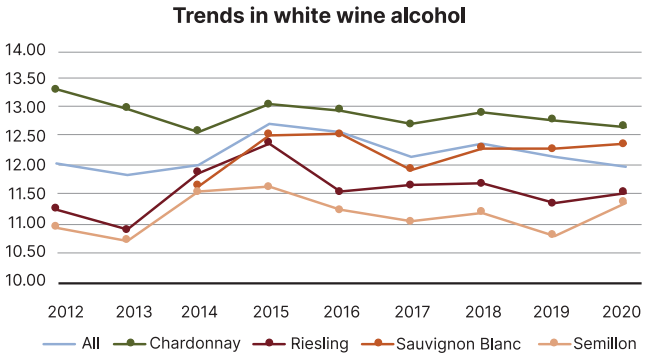


Figure 29. Trends in the alcohol concentration in Australian white wines, combined (light blue) and separated by variety

Accurately measuring alcohol content

In conjunction with the Interwinery Analysis Group, the project team also conducted a review on methods used to measure alcohol in wine by the Australian industry. This was done in part to support information being gathered by industry stakeholders for a submission to the UK government on proposed new excise laws on alcohol. The study looked at two years of proficiency testing data from 162 facilities, a total of over 3,800 results. From the data it was clear that by far the most common technique used for alcohol determination in the wine industry was NIR spectroscopy, accounting for 69% of results. FTIR instruments were the next most common (19%), followed by distillation-hydrometry (5%), distillation-densitometry (4%) and ebulliometry (3%).

Results from NIR spectroscopy were found to have a much narrower distribution than the other methods, with an interquartile range of 0.07% v/v and a standard deviation of 0.08% v/v, half that of the next best performing method. In other words, more than 95% of the NIR results were within 0.16% v/v of the mean result. The next best performing method was FTIR, which had a standard deviation of 0.15% v/v and an interquartile range of 0.16% v/v. The other three methods showed a significantly larger distribution of results than NIR or FTIR-MIR, all with standard deviations between 0.21% and 0.26% alcohol v/v, suggesting that 95% of results were within +/- 0.4 to 0.5% v/v of the mean value (Figure 30). The full study was published in *AWRI Technical Review*. Given these results, it is clear that the NIR technique, which is used by the majority of winery laboratories, is by far the most accurate option generally available. All the methods reviewed gave results that were within the accepted label tolerances for Australian wine.

Planning has also begun for the second edition of the AWRI Vineyard and Winery Practices survey. This survey, conducted six years after the original 2016 edition, will aim to identify changes in practices over that time period. It will be launched in September 2022.

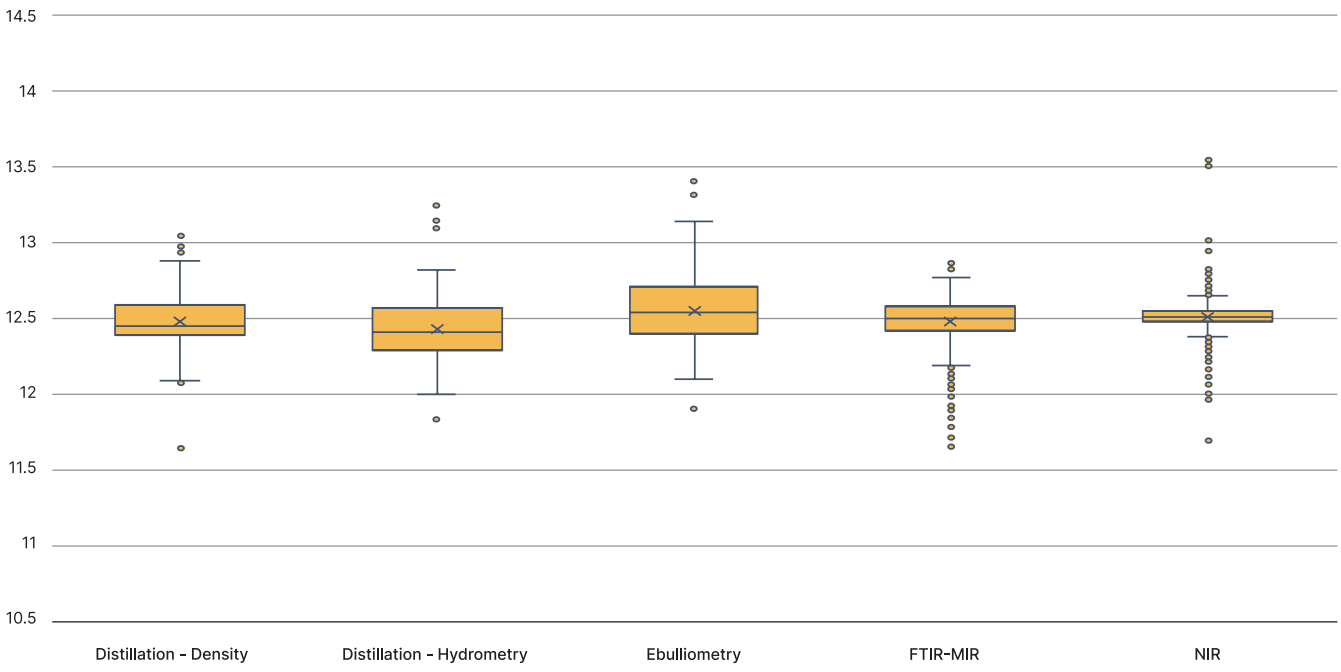


Figure 30. The relative spread of results from five different analytical methods for alcohol in wine, as measured by laboratories in the Interwinery Analysis Group, with each round of testing normalised to an average value of 12.5% (v/v). The boxes represent the spread from the first quartile to the third quartile of the data, with the horizontal line within the box representing the median value and the x representing the mean value. The 'whisker' lines above and/or below each box extend as far as the minimum and maximum values measured, excluding outliers (which are shown as circles).

AWRI Financial statements

for the year ended 30 June 2022

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 2022.

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
Ms Louisa E. Rose (Chair)	1 Jan 2011	–	4	4
Mr Tobias J. Bekkers	1 Jan 2014	–	4	4
Ms Patricia Giannini	16 Sep 2020	–	4	4
Prof. Kiaran D. Kirk	1 Jan 2017	–	4	4
Dr Mark P. Krstic	1 Feb 2020	–	3	4
Ms Courtney L. Ribbons	1 Sep 2021	–	4	4
Ms Elizabeth A. Riley	1 Jan 2012	–	4	4
Mr Brett M. McClen	1 Jan 2021	–	4	4
Mr T. Nigel Sneyd	1 Jan 2021	–	4	4
Ms Corrina N. Wright	1 Jan 2021	–	4	4

A – number of meetings attended

B – number of meetings held during the time the director held office 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 2022 the Company recorded a deficit of $786,180 (2021: surplus of $296,305). This deficit primarily relates to a once-off contribution of $672,389 made by the Company to its principal funding provider, Wine Australia, in connection with the 2020 wine-grape harvest which was sufficiently small to enliven revenue reduction provisions contained within the AWRI-Wine Australia Investment Agreement. The result also reflects the Company's depreciation and amortisation expense for the year which exceeded the funding received for such items by $532,149 (2021: $425,556), as well as a number of strategic investments made by the Company in developing and launching its new 'Affinity Labs' brand, and a range of other initiatives designed to further support its stakeholders in view of the capacity afforded by the Company's reserves position.

Other material developments

During the year the Company entered into an investment agreement with Wine Australia, in view of the conclusion on 30 June 2022 of the previous corresponding agreement which commenced on 1 July 2017. This new investment agreement commences on 1 July 2022 and will provide a material level of funding for the Company's ongoing research, development, extension and adoption activities until 30 June 2026, subject to contractual conditions and termination rights which are common for an agreement of this nature. During the year the Company developed a new identity 'Affinity Labs' for its commercial activities, which was publicly launched in June 2022 – further details are available at affinitylabs.com.au.

Objectives and strategy

The organisation's long-term objective is to support the Australian grape and wine industry through world class research, practical solutions and knowledge transfer.

The organisation's short-term objectives are reflected in its 8-Year Research, Development and Extension Plan *The AWRI 2017-2025* which was developed through a wide-ranging industry consultation process and formally commenced on 1 July 2017. This plan details 21 subthemes of activities designed to contribute to the achievement of the Company's mission, grouped within five main themes:

- *Customers, consumers and markets*
- *Extension, adoption and education*
- *Performance, products and processes*
- *Environment, sustainability and natural capital*
- *Foundational data and support services.*

Within these subthemes are 50 projects focusing upon specific outcomes. For each active project a project plan specifies relevant stakeholder needs, deliverables, approaches and methodologies as well as expected outcomes of benefit to the Australian wine industry. The consultation process with industry and other stakeholders remains ongoing, with active projects further developed and refined through Annual Operating Plans.

The Company's strategy for achieving the above objectives is to maximise its available funding to enable the delivery of projects within its Research, Development and Extension Plan, while optimising its internal operations and resources to ensure that such funding is applied as effectively and efficiently as possible. This strategy is implemented through a suite of initiatives, collectively described in the internal document *AWRI Directions – Business and Operational Initiatives 2021-2023*, clustered into five themes:

- *Best practice governance and organisational structure*
- *World class people and culture*
- *AWRI business infrastructure, systems and processes*
- *Future funding, capabilities and services*
- *Relationships, partnerships, engagement and communications.*

The 8-Year Research, Development and Extension Plan *The AWRI 2017-2025*, together with a status summary of the 50 projects within the plan, is available online at awri.com.au.

Principal activities

The Company's principal activities during the year were:

Research activities that strive for scientific excellence and industry relevance;

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

Extension activities that seek to disseminate research and development outcomes to facilitate rapid uptake by the viticultural and winemaking sectors; 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 *AWRI Directions – Business and Operational Initiatives 2021-2023*, 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 established and emerging markets. Progress against specific objectives is monitored though the achievement of specific milestones, outputs and performance targets as articulated in *AWRI Directions – Business and Operational Initiatives 2021-2023*, the 8-Year Research, Development and Extension Plan *The AWRI 2017-2025* and individual project plans. Aspects of the Company's performance are also informed through its extension platforms including metrics relating to awareness, adoption, value creation and service quality generated through engagement with stakeholders, which consist predominantly of grapegrowers and winemakers. 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

Ms Louisa E. Rose Chair (non-executive)

Qualifications BAppSc (Oen), BSc, GAICD

Experience Head of Winemaking The Yalumba Wine Company and Hill-Smith Family Vineyards, Chair the Alumni Council of the University of Adelaide and Chair of the Council of Barons of Barossa. Previously director of the Barossa Grape & Wine Association, member of Wine Barossa and Co-Chair of the South Australian Wine Industry Council. National wine show judge, 31 years' technical, winemaking, viticultural and commercial experience in the Australian wine industry.

Special Responsibilities
Ms Rose is the Chair of the Personnel committee.

Mr Tobias J. Bekkers Non-executive director

Qualifications BAppSc (Ag) (Hons), GradCert (Mgt), GAICD

Experience Principal of Bekkers Consulting and Bekkers Wine. Active as a viticulture and wine business consultant across Australia. Twenty-eight years' experience in viticulture and wine business. Formerly General Manager/Senior Viticulturist of Paxton Wines. Previously director of the McLaren Vale Grape, Wine and Tourism Association. Graduate of the Australian Wine Industry Future Leaders Program and Nuffield Farming Scholar (2017).

Special Responsibilities
Mr Bekkers is a member of the Nominations committee.

Ms Patricia Giannini Non-executive director

Qualifications BEc, GradDipAcc, CA

Experience Associate Director and CFO Advisor at Chapman Capital Partners, with a diverse finance background including within the audit division of 'Big Four' accounting firm KPMG, as well as a range of CFO and consulting roles. More than 25 years' experience in corporate finance and advisory working across a range of sectors including technology, agriculture, food and beverage, manufacturing, mining and finance. Previously a Facilitator in Audit and Financial Reporting for the Institute of Chartered Accountants, and currently involved in advising clients across a diversity of sectors in capital raising, general business consulting, M&A and CFO advisory.

Special Responsibilities
Ms Giannini is the Chair of the Audit committee.

Prof. Kiaran D. Kirk Non-executive director

Qualifications BSc (Hons), PhD, DPhil

Experience Dean of the College of Science at the Australian National University (ANU), Chair of Clonakilla Wines. Previously Director of ANU Research School of Biology, Head of ANU Department of Biochemistry and Molecular Biology, and Research Fellow at University of Oxford. More than 25 years' experience in the Australian research sector with a publication record of over 160 research papers in the field of biochemistry.

Special Responsibilities
Prof. Kirk is a member of the Personnel committee.

Dr Mark P. Krstic Managing Director

Qualifications BAgSc (Hons), PhD, MBA, GAICD

Experience Chair of The Australian Wine Industry Technical Conference, Director of the National Wine Foundation, Director of the South Australian Genomics Centre, professional member of the ASVO and ASEV, member of Horticulture Innovation's Table Grape Strategic Investment Advisory Panel, Co-Chair of the Wine Steering Committee, Associate Editor of the *Wine & Viticulture Journal*, member of the Wine Innovation Cluster Leadership Group and the Waite Strategic Leadership Group, member of Sustainable Winegrowing Australia Joint Steering Committee, OENOVITI and BAG Alliance Executive Committee, Honorary Senior Fellow at the University of Melbourne, Adjunct Professor at Macquarie University. Graduate of the Australian Wine Industry Future Leaders Program and 2020 ASVO Viticulturist of the Year.

Mr Brett M. McClen Non-executive director

Qualifications BAgSc (Hons), MBA

Experience Chief Viticulturist Brown Family Wine Group. More than 20 years' viticultural and management experience across a range of Australian wine regions, as well as experience working with other irrigated horticultural crops. Professional member and previously a director of the ASVO, finalist in the 2019 ASVO Viticulturist of the Year award.

Special Responsibilities
Mr McClen is a member of the Audit committee.

Ms Courtney L. Ribbons Non-executive director
(from 1 September 2021)

Qualifications BCom, CPA, GAICD

Experience Supply Chain Operations Manager for Pernod Ricard Winemakers. More than 16 years' experience in the wine industry across a broad range of areas including finance, manufacturing, operations and domestic and international supply chains. Co-Chair of The Drinks Association Supply Chain & Logistics Forum. Previously a Committee member of the Women in Drinks South Australian chapter.

Special Responsibilities
Ms Ribbons is a member of the Audit committee.

Ms Elizabeth A. Riley Non-executive director

Qualifications BAppSc (Wine Sci), Cert IV TAE, GAICD

Experience Managing Director and Viticulturist Vitibit Pty Ltd with 29 years' experience in the Australian wine industry. Nuffield Farming Scholar, professional member of the ASVO, associate member of the Hunter Valley Wine and Tourism Association, member of the Wine Innovation Forum and member of the National Wine Biosecurity Committee. Previously an Executive member of the New South Wales Wine Industry Association and Chair of its Research and Development Committee. Formerly a Viticulturist with Southcorp Wines between 1993 and 1999 in national and NSW-based roles. 2017 ASVO Viticulturist of the Year.

Special Responsibilities
Ms Riley is a member of the Nominations committee.

Mr T. Nigel Sneyd MW Non-executive director

Qualifications BAppSc (Wine Sci), DipNat (Oenol), MBA

Experience Global Director of Wine, Quality and Compliance for Accolade Wines. More than 40 years' domestic and international experience in the wine industry, including time spent with Brown Bothers Milawa, Hickinbotham Winemakers, Domaine Dujac, INRA, Champagne Krug, Evans & Tate, The Australian Wine Research Institute, BRL Hardy's

Domaine de la Baume, Abbotts SARL and most recently 15 years with E. & J. Gallo based firstly in Europe and then in California with exposure to winemaking in Italy, Spain, Germany, South Africa, California, Argentina and New Zealand, and responsibility for delivery of significant cross-functional projects in large-scale and boutique-scale wine production in diverse cultural settings.

Special Responsibilities
Mr Sneyd is a member of the Personnel committee.

Ms Corrina N. Wright Non-executive director

Qualifications BCom, BAgSc (Oen), MAICD

Experience Owner and winemaker for Oliver's Taranga Vineyards and owner of Swell Brewing Co. Advisory Board member of the Australian Women in Wine Awards and previously a director of the Winemakers' Federation of Australia and McLaren Vale Grape, Wine & Tourism Association. An active wine show judge and wine writer, Chair of the Australian Alternative Varieties Wine Show. 2019 ASVO Winemaker of the Year.

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 in their capacity as 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 $20 (2021: $26).

Auditor's independence

The auditor's independence declaration as required under section 60-40 of the *Australian Charities and Not-for-profits Commission (ACNC) Act 2012* is attached and forms part of the directors' report for the financial year ended 30 June 2022.

Dated at Urrbrae on this the 20th day of September 2022.

This report is made in accordance with a resolution of the directors, pursuant to subsection 60.15(2) of the *Australian Charities and Not-for-profits Commission Regulation 2013*.

Louisa E. Rose
Chair

Mark P. Krstic
Managing Director

Declaration of independence

Declaration of independence by Paul Gosnold to the directors of the Australian Wine Research Institute Limited.

As lead auditor of The Australian Wine Research Institute Limited for the year ended 30 June 2022, I declare that, to the best of my knowledge and belief, there have been:

1. No contraventions of the auditor independence requirements of section 60-40 of the *Australian Charities and Not-for-profit Commission Act 2012* in relation to the audit; and
2 No contraventions of any applicable code of professional conduct in relation to the audit.

Paul Gosnold
Director

BDO Audit (SA) Pty Ltd
Adelaide, 20 September 2022

Statement of profit or loss and other comprehensive income

For the year ended 30 June 2022

	Note	2022	2021
Revenue from operating activities			
Wine Australia			
Investment agreement project funding		8,711,047	8,506,513
Investment agreement capital funding		444,432	321,346
Other project funding		101,529	83,559
Other capital funding		–	–
Capital specific grant funding		306,569	533,521
Other grant funding		1,368,691	1,219,700
Commercial services analytical and consulting income		3,731,537	4,162,573
Contract research and other commercial income		1,620,208	1,283,404
Other revenue		350,267	256,783
Total revenue		16,634,280	16,367,399
Other income	*2*	188,030	(200)
Expenses from operating activities			
Personnel expenses	*3*	11,332,720	10,797,335
Analytical and project operating expenses		2,967,870	2,516,772
Infrastructure and general services expenses		1,354,784	1,436,549
Research funding contributions		1,095,050	435,000
Depreciation and amortisation expense	*8,9,10*	1,283,150	1,280,423
Travel expenses		103,987	53,805
Total expenses		18,137,561	16,519,884
Results from operating activities		(1,315,250)	(152,685)
Finance income		529,070	448,990
Profit/(loss) for the period		(786,180)	296,305
Other comprehensive income			
Items that will not be reclassified subsequently to profit or loss			
Gain/(loss) on revaluation of financial assets at fair value through other comprehensive income		(815,340)	1,099,063
Total comprehensive income for the period		(1,601,520)	1,395,368

The notes on pages 60 to 66 are an integral part of these financial statements.

Statement of changes in equity

For the year ended 30 June 2022

	Retained earnings	Co-investment reserve	Strategic IT investment reserve	Financial assets at fair value through OCI reserve	Total equity
Balance at 1 July 2020	14,746,677	666,396	11,175	409,925	15,834,173
Total comprehensive income for the period					
Profit or loss	296,305	-	-	-	296,305
Other comprehensive income					
Realised gain (loss) on revaluation of financial assets at fair value through other comprehensive income	-	-	-	(38,323)	(38,323)
Unrealised gain (loss) on revaluation of financial assets at fair value through other comprehensive income	-	-	-	1,137,386	1,137,386
Total other comprehensive income	-	-	-	1,099,063	1,099,063
Total comprehensive income for the period	296,305	-	-	1,099,063	1,395,368
Transfers between retained earnings and other reserves					
Transfers to (from) reserves	-	(20,000)	-	38,323	18,323
Transfers to (from) retained earnings	(18,323)	-	-	-	(18,323)
Balance at 30 June 2021	15,024,659	646,396	11,175	1,547,311	17,229,541
Balance at 1 July 2021	15,024,659	646,396	11,175	1,547,311	17,229,541
Total comprehensive income for the period					
Profit or loss	(786,180)	-	-	-	(786,180)
Other comprehensive income					
Realised gain (loss) on revaluation of financial assets at fair value through other comprehensive income	-	-	-	221,455	221,455
Unrealised gain (loss) on revaluation of financial assets at fair value through other comprehensive income	-	-	-	(1,036,795)	(1,036,795)
Total other comprehensive income	-	-	-	(815,340)	(815,340)
Total comprehensive income for the period	(786,180)	-	-	(815,340)	(1,601,520)
Transfers between retained earnings and other reserves					
Transfers to (from) reserves	-	(25,000)	(11,175)	(221,455)	(257,630)
Transfers to (from) retained earnings	257,630	-	-	-	257,630
Balance at 30 June 2022	14,496,109	621,396	-	510,516	15,628,021

Nature and purpose of reserves

Co-investment reserve

The objective of the co-investment reserve is to provide funds for co-investment in specific funding opportunities, enabling the Company to access certain funding programs subject to the following requirements:

(i) That any co-investment be matched on at least an equal basis from externally sourced funds

(ii) That co-investments create value over the medium to long term for the ultimate benefit of the Australian grape and wine sector

(iii) That co-investments be made only in instances whereby the overall grant funds available to the Australian grape and wine sector are expanded - that is, excluding grant funding programs which already exist for the benefit of that industry.

Strategic IT investment reserve

The objective of the strategic information technology (IT) investment reserve is to ensure that sufficient funds are available for appropriate strategic investment in the Company's IT capabilities, consistent with relevant strategic plans as developed and amended from time to time, approved by the Board of Directors. Resourcing to meet the Company's day-to-day operational IT requirements, as distinct from its strategic IT requirements, is provided by other funding sources as identified within the statement of profit or loss and other comprehensive income.

Financial assets at fair value through Other Comprehensive Income (OCI) reserve

The reserve is used to recognise increments and decrements in the fair value of financial assets at fair value through Other Comprehensive Income.

The notes on pages 60 to 66 are an integral part of these financial statements.

Statement of financial position

As at 30 June 2022

	Note	2022	2021
Assets			
Cash and cash equivalents	*4*	3,431,001	3,467,357
Trade and other receivables	*5*	1,775,309	1,327,778
Inventories	*6*	92,480	95,341
Prepayments		451,396	310,958
Total current assets		5,750,186	5,201,434
Financial assets at fair value through OCI	*7*	9,817,570	11,204,064
Property, plant and equipment	*8*	4,113,125	4,099,986
Intangible assets	*9*	506,131	231,424
Right of use assets	*10*	3,335,923	3,539,261
Total non-current assets		17,772,749	19,074,735
Total assets		23,522,935	24,276,169
Liabilities			
Payables and accruals	*11*	2,259,221	2,828,600
Contract liability	*12*	3,413,758	2,167,630
Provisions	*13*	1,923,465	1,838,410
Total current liabilities		7,596,444	6,834,640
Provisions	*13*	298,470	211,988
Total non-current liabilities		298,470	211,988
Total liabilities		7,894,914	7,046,628
Net assets		15,628,021	17,229,541
Equity			
Retained earnings		14,496,109	15,024,659
Co-investment reserve		621,396	646,396
Strategic IT investment reserve		–	11,175
Fair value reserve		510,516	1,547,311
Total equity		15,628,021	17,229,541

The notes on pages 60 to 66 are an integral part of these financial statements.

Statement of cash flows

For the year ended 30 June 2022

	Note	2022	2021
Cash flows from operating activities			
Cash receipts from project grants and other income		17,001,179	15,723,532
Cash paid to suppliers and employees		(17,116,814)	(15,974,672)
Net cash from operating activities		(115,635)	(251,140)
Cash flows from investing activities			
Cash receipts from capital specific funding		697,146	1,172,008
Interest received		147,491	152,163
Dividends and imputation credits received		284,896	293,852
Proceeds from sale of property, plant and equipment		20,000	-
Acquisition of property, plant, equipment and intangibles		(1,584,608)	(1,053,984)
(Acquisition)/proceeds from disposal of financial assets		567,637	(489,080)
Payment of transaction costs related to financial investments		(53,283)	(50,505)
Net cash used in investing activities		79,279	24,454
Net increase (decrease) in cash and cash equivalents		(36,356)	(226,686)
Cash and cash equivalents at 1 July		3,467,357	3,694,043
Cash and cash equivalents at 30 June	*4*	3,431,001	3,467,357

The notes on pages 60 to 66 are an integral part of these financial statements.

Notes to the financial statements

1. Significant accounting policies

The Australian Wine Research Institute Limited (the "Company") is a company limited by guarantee, domiciled in Australia, incorporated under the *Corporations Act 2001*, registered as a charity under the *Australian Charities and Not-for-profits Commission Act 2012* (ACNC Act) and endorsed by the Australian Tax Office (ATO) as a Deductible Gift Recipient (DGR) organisation under the general DGR category of 'Approved Research Institute'.

The registered office of the Company and its principal place of business is:

Cnr Hartley Grove and Paratoo Road
Urrbrae, SA 5064

The financial statements were authorised for issue by the Board of Directors on the 20th day of September 2022.

Australian Accounting Standards set out accounting policies that the Australian Accounting Standards Board (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 financial statements of the Company are Tier 2 general purpose financial statements which have been prepared in accordance with the requirements of the *Australian Charities and Not-for-profits Commission Act 2012* and *Regulation 2013*, Australian Accounting Standards - Simplified Disclosures, Accounting Interpretations and other authoritative pronouncements of the AASB. The Company is a not-for-profit entity for financial reporting purposes under Australian Accounting Standards.

The Company is exempt from income tax under Section 50-5 of the *Income Tax Assessment Act 1997*, and accordingly no provision for income tax is included in these financial statements.

(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 except for some financial assets which are measured at fair value, 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 Legislative Instrument 2016/191 dated 1 April 2016 and, in accordance with that Legislative Instrument, 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 Australian Accounting Standards 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. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances, the results of which form the basis of making judgements about the carrying value of assets and liabilities that are not readily apparent from other sources.

The 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. The Company has identified the allowance for expected credit loss in respect of trade receivables (note 6), the useful lives of property, plant and equipment (note 8), amortisation period of intangible assets (note 9), right of use assets including its interest in the WIC Central building (note 10) and provisions for employee entitlements (note 13) and their respective note 1 accounting policies as areas under which significant judgements, estimates and assumptions are made, and where actual results may differ from those estimates under different assumptions and conditions.

(v) Changes in accounting policies

The Company has adopted all of the new or amended Accounting Standards and Interpretations issued by the Australian Accounting Standards Board ('AASB') that are mandatory for the current reporting period.

The following Accounting Standards and Interpretations are most relevant to the Company:

Conceptual Framework for Financial Reporting (Conceptual Framework)
The Company has adopted the revised Conceptual Framework from 1 July 2021. The Conceptual Framework contains new definition and recognition criteria as well as new guidance on measurement that affects several Accounting Standards, but it has not had a material impact on the Company's financial statements.

AASB 1060 General Purpose Financial Statements - Simplified Disclosures for For-Profit and Not-for-Profit Tier 2 Entities
The Company has adopted AASB 1060 from 1 January 2020. The standard provides a new Tier 2 reporting framework with simplified disclosures that are based on the requirements of IFRS for SMEs. As a result, there is increased disclosure in these financial statements.

(b) Financial assets

Financial assets are initially measured at fair value. Transaction costs are included as part of the initial measurement, except for financial assets at fair value through profit or loss. Such assets are subsequently measured at either amortised cost or fair value depending on their classification. Classification is determined based on both the business model within which such assets are held and the contractual cash flow characteristics of the financial asset, unless an accounting mismatch is being avoided.

Financial assets are derecognised when the rights to receive cash flows have expired or have been transferred and the Company has transferred substantially all the risks and rewards of ownership. When there is no reasonable expectation of recovering part or all of a financial asset, its carrying value is written off.

Financial assets at fair value through profit or loss
Financial assets not measured at amortised cost or at fair value through other comprehensive income are classified as financial assets at fair value through profit or loss. Typically, such financial assets will be either: (i) held for trading, where they are acquired for the purpose of selling in the short-term with an intention of making a profit, or a derivative; or (ii) designated as such upon initial recognition where permitted. Fair value movements are recognised in profit or loss.

Financial assets at fair value through other comprehensive income
Financial assets at fair value through other comprehensive income include equity investments which the Company intends to hold for the foreseeable future and has irrevocably elected to classify them as such upon initial recognition.

Impairment
The Company recognises a loss allowance for expected credit losses on financial assets which are either measured at amortised cost or fair value through other comprehensive income. The measurement of the loss allowance depends upon the Company's assessment at the end of each reporting period as to whether the financial instrument's credit risk has increased significantly since initial recognition, based on reasonable and supportable information that is available, without undue cost or effort to obtain.

Where there has not been a significant increase in exposure to credit risk since initial recognition, a 12-month expected credit loss allowance is estimated. This represents a portion of the asset's lifetime expected credit losses that is attributable to a default event that is possible within the next 12 months. Where a financial asset has become credit impaired or where it is determined that credit risk has increased significantly, the loss allowance is based on the asset's lifetime expected credit losses. The amount of expected credit loss recognised is measured on the basis of the probability weighted present value of anticipated cash shortfalls over the life of the instrument discounted at the original effective interest rate.

For financial assets measured at fair value through other comprehensive income, the loss allowance is recognised within other comprehensive income. In all other cases, the loss allowance is recognised in profit or loss.

(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

Lease liabilities
A lease liability is recognised at the commencement date of a lease. The lease liability is initially recognised at the present value of the lease payments to be made over the term of the lease, discounted using the interest rate implicit in the lease or, if that rate cannot be readily determined, the entity's incremental borrowing rate. Lease payments comprise of fixed payments less any lease incentives receivable, variable lease payments that depend on an index or a rate, amounts expected to be paid under residual value guarantees, exercise price of a purchase option when the exercise of the option is reasonably certain to occur, and any anticipated termination penalties. The variable lease payments that do not depend on an index or a rate are expensed in the period in which they are incurred.

Lease liabilities are measured at amortised cost using the effective interest method. The carrying amounts are remeasured if there is a change in the following: future lease payments arising from a change in an index or a rate used; residual guarantee; lease term; certainty of a purchase option and termination penalties. When a lease liability is remeasured, an adjustment is made to the corresponding right-of use asset, or to profit or loss if the carrying amount of the right-of-use asset is fully written down.

(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

The carrying amounts 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. Value in use is determined as the current replacement cost of an 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.

(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 discounting using market yields at the reporting date on corporate bonds with terms to maturity and currencies that match, as closely as possible, the estimated future cash outflows.

(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 recognition

The Company recognises revenue as follows:

(i) Revenue from contracts with customers

Revenue is recognised at an amount that reflects the consideration to which the Company is expected to be entitled in exchange for transferring goods or services to a customer. For each contract with a customer, the Company: identifies the contract with a customer; identifies the performance obligations in the contract; determines the transaction price which takes into account estimates of variable consideration and the time value of money; allocates the transaction price to the separate performance obligations on the basis of the relative stand-alone selling price of each distinct good or service to be delivered; and recognises revenue when or as each performance obligation is satisfied in a manner that depicts the transfer to the customer of the goods or services promised.

(ii) Donations

Donations are assessed to determine whether they carry sufficiently specific performance obligations and meet other criteria for recognition in accordance with AASB 15 *Revenue from Contracts with Customers*, where this is not the case donations are recognised on receipt in accordance with AASB 1058 *Income of Not-for-Profit Entities*.

(iii) Grants

Grant revenue is recognised in profit or loss when the Company satisfies the performance obligations stated within the funding agreements.

If conditions are attached to the grant which must be satisfied before the Company is eligible to retain the contribution, the grant will be recognised in the statement of financial position as a liability until those conditions are satisfied.

(iv) Finance income

Finance income comprises interest income and dividends. Interest income is recognised as it accrues in profit or loss using the effective interest rate method. Dividend income is recognised in profit or loss on the date on which the Company's right to receive payment is established.

(v) Other revenue

Other revenue is recognised when it is received or when the right to receive payment is established.

(j) 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.

(k) Trade and other receivables

Trade receivables are initially recognised at fair value and subsequently measured at amortised cost using the effective interest method, less any allowance for expected credit losses. Trade receivables are generally due for settlement within 30 days. The Company has applied the simplified approach to measuring expected credit losses, which uses a lifetime expected loss allowance. To measure the expected credit losses, trade receivables have been grouped based on days overdue. Other receivables are recognised at amortised cost, less any allowance for expected credit losses.

(l) Right of use assets

A right of use asset is recognised at the commencement date of a lease. The right of use asset is measured at cost, which comprises the initial amount of the lease liability, adjusted for, as applicable, any lease payments made at or before the commencement date net of any lease incentives received, any initial direct costs incurred, and, except where included in the cost of inventories, an estimate of costs expected to be incurred for dismantling and removing the underlying asset, and restoring the site or asset.

Right of use assets are depreciated on a straight-line basis over the unexpired period of the lease or the estimated useful life of the asset, whichever is the shorter. Where the Company expects to obtain ownership of the leased asset at the end of the lease term, the depreciation is over its estimated useful life. Right of use assets are subject to impairment or adjusted for any remeasurement of lease liabilities.

The Company has elected not to recognise a right of use asset and corresponding lease liability for short-term leases with terms of 12 months or less and leases of low-value assets. Lease payments on these assets are expensed to profit or loss as incurred.

2. Other income

	2022	2021
Net gain/(loss) on sale of property, plant and equipment	15,925	(200)
Reimbursement received relating to prior period occupancy costs	172,105	–
	188,030	(200)

3. Personnel expenses

	2022	2021
Wages and salaries	9,715,681	9,423,732
Other associated personnel expenses	644,558	489,875
Contributions to defined contribution plans	972,481	883,728
	11,332,720	10,797,335

4. Cash and cash equivalents

	2022	2021
Cash on hand	229	133
Bank deposits at-call	3,430,772	3,467,224
Cash and cash equivalents in the statement of cash flows	3,431,001	3,467,357

5. Trade and other receivables

	2022	2021
Trade receivables due from those other than related parties	810,584	868,906
Trade receivables due from related parties	106,942	15,132
Other receivables	857,783	443,740
	1,775,309	1,327,778

Trade receivables are shown net of expected credit losses amounting to $28,140 (2021: $30,852) at reporting date. This allowance account is used to record expected credit 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 expected credit losses in respect of trade receivables during the year was as follows:

	2022	2021
Balance at 1 July	30,852	22,830
Payments received in relation to previous expected credit loss balances	(2,667)	(1,937)
Expected credit loss for the year	(45)	17,991
Written off during the year	–	(8,032)
Balance at 30 June	28,140	30,852

6. Inventories

	2022	2021
Course materials on hand - wine	87,480	88,341
Contingency supply of laboratory consumables	5,000	7,000
	92,480	95,341

7. Other investments

	2022	2021
Non-current		
Financial assets at fair value through OCI, comprising listed investments at fair value in:		
Interest rate securities	4,958,092	5,258,128
Equity securities	4,859,478	5,945,936
	9,817,570	11,204,064

All equity securities and interest rate securities are quoted on the Australian Securities Exchange. Interest rate securities include corporate bonds, subordinated notes and convertible and reset preference securities. Equity securities include direct shareholdings, exchange traded funds and managed funds.

8. Property, plant and equipment

	Plant and machinery	Office furniture and IT	Laboratory equipment	Capital WIP	Total
Cost					
Balance at 1 July 2021	681,587	1,182,428	13,001,648	399,289	15,264,952
Additions	–	130,033	814,993	65,449	1,010,475
Transfers	–	–	391,838	(391,838)	–
Disposals	–	(191,838)	(395,847)	–	(587,685)
Balance at 30 June 2022	681,587	1,120,623	13,812,632	72,900	15,687,742
Depreciation and impairment losses					
Balance at 1 July 2021	549,326	918,750	9,696,890	–	11,164,966
Depreciation charge for the year	42,250	107,991	843,020	–	993,261
Transfers	–	–	–	–	–
Disposals	–	(191,838)	(391,772)	–	(583,610)
Balance at 30 June 2022	591,576	834,903	10,148,138	–	11,574,617
Carrying amounts					
at 1 July 2021	132,261	263,678	3,304,758	399,289	4,099,986
at 30 June 2022	90,011	285,720	3,664,494	72,900	4,113,125

9. Intangible assets

	Computer software	Intangible assets under development	Total
Cost			
Balance at 1 July 2021	747,486	131,075	878,561
Additions	40,879	320,377	361,256
Transfers	120,375	(120,375)	–
Disposals	(6,491)	–	(6,491)
Balance at 30 June 2022	902,249	331,077	1,233,326
Amortisation and impairment losses			
Balance at 1 July 2021	647,137	–	647,137
Amortisation charge for the year	86,549	–	86,549
Transfers	–	–	–
Disposals	(6,491)	–	(6,491)
Balance at 30 June 2022	727,195	–	727,195
Carrying amounts			
at 1 July 2021	100,349	131,075	231,424
at 30 June 2022	175,054	331,077	506,131

Computer software

Computer software assets are recognised as the attributable software licence and development costs paid to third parties, and do not include employee costs or an attribution of relevant overheads, as only an immaterial component of software development and testing processes are performed in-house. These software assets are amortised over periods of between three and five years, based upon their estimated useful lives and expected technical obsolescence.

Intangible assets under development at 30 June 2022 represent expenditure towards the development of computer software which as of that date is not classified as ready for use.

10. Right of use assets

	2022	2021
Buildings (WIC) – right of use		
Cost		
Balance at 1 July	6,100,140	6,100,140
Balance at 30 June	6,100,140	6,100,140
Depreciation and impairment losses		
Balance at 1 July	2,560,879	2,357,541
Depreciation charge for the year	203,338	203,338
Balance at 30 June	2,764,217	2,560,879
Carrying amount	3,335,923	3,539,261

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 currently the University of Adelaide and Fight Food Waste Cooperative Research Centre. The term of occupancy is reviewable after 30 years based on the remaining economic life of the building. The value assigned to the AWRI's interest in the building is net of amounts contributed by Wine Australia (WA). The building cost is being depreciated over a period of 30 years from the date of practical completion (26 November 2008).

11. Payables and accruals

	2022	2021
Current		
Trade payables due to those other than related parties	471,272	266,245
Trade payables due to related parties	–	–
PAYG and GST	458,085	379,472
Non-trade payables and accrued expenses	1,329,864	2,182,883
	2,259,221	2,828,600

12. Contract liability

Any unexpended WA funding is reimbursable to WA, except where WA agrees that amounts can be retained by the AWRI for purposes approved by WA, at which point such amounts are considered to be committed towards that purpose.

The unexpended investment agreement funds for the current year totalled $248,662 (2021: $317,141). There were no unexpended funds from other WA contracts for the current year (2021: $75,238).

During the year unspent prior years' funds totalling $392,379 previously approved by WA for retention by the Company were utilised for the agreed purposes (2021: none) - this comprised $317,141 under the investment agreement for the acquisition of agreed capital equipment items and $75,238 for agreed project activities under other WA contracts. During the year no unspent prior years' funds relating to WA projects were returned to WA (2021: none).

	2022	2021
Unexpended funds carried forward to satisfy future performance obligations		
WA current year's investment agreement funding unexpended	248,662	317,141
WA current year's other contract funding unexpended	–	75,238
WA prior years' funding unexpended	–	–
	248,662	392,379
Income received in advance	3,165,096	1,775,251
	3,413,758	2,167,630

13. Provisions

	2022	2021
Current		
Employee entitlements	1,923,465	1,838,410
Non-current		
Employee entitlements	298,470	211,988
Number of employees (full-time equivalents)	106.3	106.4

14. Operating leases

Leases as lessee

Non-cancellable operating lease rentals are payable as follows:

	2022	2021
Within one year	3,432	3,432
One year or later and no later than five years	11,154	2,574
Later than five years	–	–
	14,586	6,006

The Company's operating leases are not considered to be material and the reported rental expenses are those at face value rather than as measured under *AASB 16 Leases*. During the year the Company entered into one new lease for an item of office equipment (running for a period of five years) under an operating lease agreement. This lease provides no option to renew or purchase at the completion of its term.

During the year ended 30 June 2022 an amount of $3,432 was recognised as an expense in respect of operating leases (2021: $3,432).

Leases as lessor

The Company leases out part of its interest in the WIC Central building (refer note 10) to the Australian Wine Industry Technical Conference Incorporated. Associated lease payments are included within the transactions with related parties disclosed within note 17. The future minimum lease payments under non-cancellable leases are receivable as follows:

	2022	2021
Within one year	8,000	8,000
One year or later and no later than five years	25,333	32,000
Later than five years	–	1,333
	33,333	41,333

During the year ended 30 June 2022 an amount of $8,892 was recognised as rental income (2021: $8,679). This amount exceeds the minimum lease payments disclosed above due to lease payments being subject to annual adjustment over the term of the lease with reference to an inflation-based index.

15. Capital commitments

	2022	2021
Property, plant and equipment *Contracted but not provided for and payable*		
Within one year	20,931	7,960
One year or later and no later than five years	–	–
Later than five years	–	–
	20,931	7,960
Computer software development *Contracted but not provided for and payable*		
Within one year	80,914	63,900
One year or later and no later than five years	–	–
Later than five years	–	–
	80,914	63,900

16. Research funding commitments

	2022	2021
Contracted but not provided for and payable		
Within one year	290,880	864,055
One year or later and no later than five years	364,306	228,334
Later than five years	–	–
	655,186	1,092,389

17. 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:

	2022	2021
Total remuneration	2,024,887	1,757,237

During the year non-executive directors became entitled to compensation totalling $93,249 (2021: $93,003). A number of directors voluntarily elected not to receive $61,750 of this entitlement (2021: $59,157), instead redirecting such amounts to support otherwise unfunded activities of the Company including individual and group professional development for AWRI staff, and the provision of support to visiting scientists.

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:

Arrivo Wine
Oenologie Requin Pty Ltd (trading as Bekkers Wine)
Oliver's Taranga Vineyards
Swell Brewing Co.
Vitibit Pty Ltd

Other related party transactions

During the year the Company provided administrative services and leased office premises to a jointly controlled entity, The Australian Wine Industry Technical Conference Incorporated.

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	
	2022	2021	2022	2021
Services received from related parties	60,445	2,082	–	–
Services provided to related parties	270,879	106,525	106,942	15,132

18. Auditor remuneration

During the year the following fees were paid or payable for services provided by accounting firm BDO Audit (SA) Pty Ltd, the auditor of the Company, and its network firms:

	2022	2021
Audit of the financial report	23,531	21,731
Other services:		
Preparation and lodgement of fringe benefits tax return	2,127	2,101
	25,658	23,832

19. Contingencies

In the opinion of the Directors, there were no material or significant contingent liabilities at 30 June 2022 (2021: none).

20. 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.

21. 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 $20 (2021: $26).

Responsible persons' declaration

The directors of The Australian Wine Research Institute Limited (the Company) declare that, in the directors' opinion:

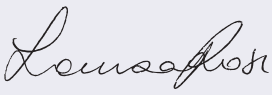
(a) the financial statements, comprising the statement of profit or loss and other comprehensive income, statement of financial position, statement of cash flows, statement of changes in equity, and accompanying notes, are in accordance with the *Australian Charities and Not-for-profits Commission Act 2012* and:

  (i) comply with Australian Accounting Standards – Simplified Disclosures and the *Australian Charities and Not-for-profits Commission Regulation 2013*; and

  (ii) give a true and fair view of the entity's financial position as at 30 June 2022 and of its performance for the year ended on that date; and

(b) there are reasonable grounds to believe that the Company will be able to pay all of its debts, as and when they become due and payable.

Signed in accordance with subsection 60.15(2) of the *Australian Charities and Not-for-profits Commission Regulation 2013*.



Louisa E. Rose
Chair

Mark P. Krstic
Managing Director

Dated at Urrbrae on this the 20th day of September 2022.

Independent auditor's report to the members of The Australian Wine Research Institute Limited

Report on the Audit of the Financial Report

Opinion

We have audited the financial report of The Australian Wine Research Institute Limited (the registered entity), which comprises the statement of financial position as at 30 June 2022, the statement of profit or loss and other comprehensive income, the statement of changes in equity and the statement of cash flows for the year then ended, and notes to the financial report, including a summary of significant accounting policies, and the responsible entities' declaration.

In our opinion the accompanying financial report of The Australian Wine Research Institute Limited, is in accordance with Division 60 of the *Australian Charities and Not-for-profits Commission Act 2012*, including:

(i) Giving a true and fair view of the registered entity's financial position as at 30 June 2022 and of its financial performance for the year then ended; and

(ii Complying with Australian Accounting Standards – Simplified Disclosures and Division 60 of the *Australian Charities and Not-for-profits Commission Regulation 2013*.

Basis for opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's responsibilities for the audit of the Financial Report* section of our report. We are independent of the registered entity in accordance with the auditor independence requirements of the *Australian Charities and Not-for-profits Commission Act 2012* (ACNC Act) and the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants (including Independence Standards)* (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other ethical responsibilities in accordance with the Code.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Other information

The responsible entities of the registered entity are responsible for the other information. The other information obtained at the date of this auditor's report is information included in The Australian Wine Research Institute Limited's annual report, but does not include the financial report and our auditor's report thereon.

Our opinion on the financial report does not cover the other information and accordingly we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial report, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial report or our knowledge obtained in the audit or otherwise appears to be materially misstated.

If, based on the work we have performed on the other information obtained prior to the date of this auditor's report, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

Responsibilities of responsible entities for the Financial Report

The responsible entities of the registered entity are responsible for the preparation and fair presentation of the financial report in accordance with Australian Accounting Standards – Simplified Disclosures and the ACNC Act, and for such internal control as the responsible entities determine is necessary to enable the preparation of the financial report that is free from material misstatement, whether due to fraud or error.

In preparing the financial report, responsible entities are responsible for assessing the registered entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the responsible entities either intends to liquidate the registered entity or to cease operations, or has no realistic alternative but to do so.

The responsible entities of the registered entity are responsible for overseeing the registered entity's financial reporting process.

Auditor's responsibilities for the audit of the Financial Report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of this financial report.

A further description of our responsibilities for the audit of the financial report is located at the Auditing and Assurance Standards Board website (http://www.auasb.gov.au/Home.aspx) at: http://www.auasb.gov.au/auditors_responsibilities/ar4.pdf

This description forms part of our auditor's report.

BDO Audit (SA) Pty Ltd

Paul Gosnold
Director

Adelaide, 4 October 2022

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 profit or loss and other comprehensive income give a true and fair view of each Trust's profit or loss for the year ended 30 June 2022; and

(ii) the statements of financial position give a true and fair view of each Trust's state of affairs as at 30 June 2022.

(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:

Louisa E. Rose
Chair

Dated at Urrbrae on this the 20th day of September 2022.

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 consist of interest rate securities and exchange traded funds, all of which are quoted on the Australian Securities Exchange and recorded at fair value through other comprehensive income. Investment income is brought to account as earned, with accrued earnings at balance date being included in the statement of financial position as receivables.

Statements of profit or loss and other comprehensive income

For the year ended 30 June 2022

	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	
	2022	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**
Income								
Investments	5,260	4,642	3,831	3,020	4,182	3,096	4,856	3,655
Donations and other income	–	–	–	–	–	–	–	–
Total income	5,260	4,642	3,831	3,020	4,182	3,096	4,856	3,655
Expenses								
Investment management expenses	647	566	509	488	533	506	568	447
Sponsorship of 18th Australian Wine Industry Technical Conference	–	–	10,000	–	–	–	7,000	–
Total expenses	647	566	10,509	488	533	506	7,568	447
Profit/(loss) from ordinary activities	4,613	4,076	(6,678)	2,532	3,649	2,590	(2,712)	3,207
Other comprehensive income Items that will not be reclassified subsequently to profit or loss:								
Gain (loss) on revaluation of financial assets at fair value through other comprehensive income	(9,398)	10,146	(6,369)	6,194	(7,278)	6,922	(8,140)	7,994
Total comprehensive income for the period	(4,785)	14,222	(13,047)	8,726	(3,629)	9,512	(10,852)	11,201

Statements of financial position

As at 30 June 2022

	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	
	2022	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**
Assets								
Cash at bank	7,238	2,527	4,523	1,603	4,251	1,885	5,626	1,981
Investments	–	–	–	–	–	–	–	–
Receivables	2,194	1,404	1,341	905	2,256	932	1,710	1,103
Total current assets	9,432	3,931	5,864	2,508	6,507	2,817	7,336	3,083
Investments	135,122	145,408	87,470	93,873	93,623	100,942	105,739	113,844
Total non-current assets	135,122	145,408	87,470	93,873	93,623	100,942	105,739	113,844
Total assets	144,554	149,339	93,334	96,381	100,130	103,759	113,075	116,927
Liabilities								
Committed funding contribution	–	–	10,000	–	–	–	7,000	–
Total current liabilities	–	–	10,000	–	–	–	7,000	–
Net assets	144,554	149,339	83,334	96,381	100,130	103,759	106,075	116,927
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	124,298	120,670	63,889	61,608	75,371	73,034	107,337	104,442
Profit/(loss) for the year	4,613	4,076	(6,678)	2,532	3,649	2,590	(2,712)	3,207
Transfers to (from) accumulated surplus	196	(448)	(392)	(251)	(415)	(253)	(614)	(313)
Closing balance	129,107	124,298	56,819	63,889	78,605	75,371	104,011	107,337
Financial assets at fair value through other comprehensive income reserve								
Opening balance	12,256	1,662	7,442	997	8,388	1,212	9,539	1,233
Gain (loss) on revaluation of financial assets at fair value through other comprehensive income	(9,398)	10,146	(6,369)	6,194	(7,278)	6,923	(8,140)	7,994
Transfers to (from) reserve	(196)	448	392	251	415	253	614	313
Closing balance	2,662	12,256	1,465	7,442	1,525	8,388	2,014	9,539
Total trust funds	144,554	149,339	83,334	96,381	100,130	103,759	106,075	116,927

APPENDIX 1

External presentations

Staff	Title of presentation	Presented to and where	Date
K.C. Hirlam	Understanding the carbon footprint of the wine industry	Climate Talks by The Porto Protocol – Mitigating climate change throughout the wine value chain (virtual)	2 Jul 2021
M.L. Longbottom	Sustainability – global and local insights	Mornington Peninsula Vignerons Association, Dromana, VIC	12 Jul 2021
L.M. Pitcher	Sustainable winegrowing in Mornington Peninsula – performance and targets		
M.L. Longbottom	Sustainability certification		
L.M. Pitcher	Sustainability in action – case studies		
E.N. Wilkes	Wine provenance, an isotopic approach	AWRI webinar	15 Jul 2021
M.L. Longbottom	Sustainability – global insights and introduction	Australian Wine Industry Standard of Sustainable Practice (AWISSP) certification training, Adelaide, SA (virtual)	19 Jul 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
M.L. Longbottom	Sustainability – global insights	Sustainability workshop, Great Southern, WA (virtual)	21 Jul 2021
L.M. Pitcher	Great Southern sustainability performance and targets		
M.L. Longbottom	Demonstrating functionality of the Sustainable Winegrowing Australia portal		
	Sustainability certification		
R.A. Dixon	Effective weed control at Vasse Felix: good decision-making and creative thinking		
M.L. Longbottom	Sheep and straw mulch for energy and water savings at Lake Moodemere Estate		
L.M. Pitcher	Air quality	AWISSP certification training, Adelaide, SA (virtual)	
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Mildura, VIC (virtual)	27 Jul 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction		28 Jul 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		

Staff	Title of presentation	Presented to and where	Date
M. Essling	Agrochemical update – the outlook for MRLs	AgLink Viticulture, Adelaide SA (virtual)	28 Jul 2021
G.D. Cowey	Potassium and nitrogen in the vineyard and winery		29 Jul 2021
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Barossa, SA	2 Aug 2021
L.M. Pitcher	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Sustainability – global insights	Sustainability workshop, Victoria (virtual)	10 Aug 2021
	Greater Victoria sustainability performance and targets		
M.L. Longbottom	Sustainability certification		
R.A. Dixon	Sustainability in action – Handpicked Wines' non-chemical weed control tools		
L.M. Pitcher	Sustainability in action – vineyard soil remediation at The Madgetts Block		
M.L. Longbottom	Sheep and straw mulch for energy and water savings at Lake Moodemere Estate		
	Sustainability – global insights and introduction	AWISSP certification training, Rutherglen, VIC (virtual)	11 Aug 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Sustainability – global insights	Sustainability workshop, Central Victoria (virtual)	13 Aug 2021
L.M. Pitcher	Greater Victoria sustainability performance and targets		

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	Sustainability certification	Sustainability workshop, Central Victoria (virtual)	13 Aug 2021
R.A. Dixon	Sustainability in action – Handpicked Wines' non-chemical weed control tools		
M.L. Longbottom	Sheep and straw mulch for energy and water savings at Lake Moodemere Estate		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Adelaide, SA (virtual)	16 Aug 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Sustainable Winegrowing Australia overview and benefits of membership	Adelaide Hills Wine Region focus vineyard field day, Ashton Hills, SA	25 Aug 2021
	Sustainability – global insights	Sustainability workshop (Landcare project), Langhorne Creek, SA	26 Aug 2021
	Demonstrating functionality of the Sustainable Winegrowing Australia portal		
	Sustainability – global insights	Sustainability workshop (Landcare project), Piccadilly, SA	
	Demonstrating functionality of the Sustainable Winegrowing Australia portal		
	Sustainability – global insights	Sustainability workshop (Landcare project), Barossa, SA	27 Aug 2021
	Demonstrating functionality of the Sustainable Winegrowing Australia portal		
M.L. Longbottom	Sustainability – global insights	Sustainability workshop (Landcare project), McLaren Vale, SA	1 Sep 2021
C. Penfold, R.A. Dixon	Non-chemical weed control	AWRI webinar	2 Sep 2021
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Yarra Valley, VIC (virtual)	3 Sep 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		

Staff	Title of presentation	Presented to and where	Date
C. Penfold	Weed management without synthetic chemicals	Non-chemical weed control and cover crop workshop, Barossa Valley, SA	6 Sep 2021
R.A. Dixon	Non-chemical weed control decision-making tool and resources		
	Non-chemical weed control case study		
M. G. Holdstock	Evaluation of wines made from different undervine cover crop treatments – vintage 2020		
C. Penfold	Weed management without synthetic chemicals	Non-chemical weed control and cover crop workshop, Clare Valley, SA	7 Sep 2021
R.A. Dixon	Non-chemical weed control decision-making tool and resources		
	Non-chemical weed control case study		
M.G. Holdstock	Evaluation of wines made from different undervine cover crop treatments – vintage 2020		
L.M. Pitcher	Sustainable Winegrowing Australia update		
S. Nordestgaard	Ferment density and level sensors – 2021 trials	WineEng 2021 – The Winery Engineering Association's National Conference and Exhibition (virtual)	8 Sep 2021
K.C. Hirlam	Understanding canned wine		
C. Penfold	Weed management without synthetic chemicals	Non-chemical weed control and cover crop workshop, Yarra Valley, VIC (virtual)	
R.A. Dixon	Non-chemical weed control decision-making tool and resources		
	Non-chemical weed control case study		
M.G. Holdstock	Evaluation of wines made from different undervine cover crop treatments – vintage 2020		
N. Scrimgeour	Smoke testing – what do labs actually measure and new ways to speed it up	AWRI webinar	9 Sep 2021
M.G. Holdstock	Evaluation of winemaking treatments in Australian Chardonnay	Chardonnay winemaking trial tasting, Riverland, SA (virtual)	13 Sep 2021
		Chardonnay winemaking trial tasting, Geelong, VIC (virtual)	
J.A. Gledhill		Chardonnay winemaking trial tasting, Gippsland, VIC (virtual)	14 Sep 2021
M.G. Holdstock		Chardonnay winemaking trial tasting, Mildura, VIC (virtual)	
L.M. Pitcher	Sustainable and organic wine production	AWRI webinar	16 Sep 2021
C. Penfold	Weed management without synthetic chemicals	Non-chemical weed control and cover crop workshop, Hunter Valley, NSW (virtual)	
R.A. Dixon	Non-chemical weed control decision-making tool and resources		
	Non-chemical weed control case study		
M.G. Holdstock	Evaluation of wines made from different undervine cover crop treatments – vintage 2020		
M. Essling	AWRI helpdesk – climate-related queries	Managing extreme weather events seminar, Limestone Coast, SA (virtual)	17 Sep 2021
L.M. Pitcher	Water and wastewater	AWISSP certification training, Yarra Valley, VIC (virtual)	
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	Sustainable Winegrowing Australia trust mark use	AWISSP certification training, Yarra Valley, VIC (virtual)	17 Sep 2021
	Audit preparation and subsequent actions		
	Sustainability – global insights from a legal perspective	International Wine Law Conference, McLaren Vale, SA	18 Sep 2021
E.N. Wilkes	Low- and no-alcohol wines, some challenges		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Langhorne Creek, SA	20 Sep 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
	Training and development		
	Suppliers		
	Customer and regulatory requirements		
	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Barossa Valley, SA	21 Sep 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
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	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		

Staff	Title of presentation	Presented to and where	Date
P.O. Williamson	Familiarisation with smoke-tainted wines	Smoke taint sensory workshop, Gippsland and Mornington, VIC (virtual)	21 Sep 2021
		Smoke taint sensory workshop, Yarra Valley, VIC (virtual)	
		Smoke taint sensory workshop, Rutherglen, VIC (virtual)	22 Sep 2021
		Smoke taint sensory workshop, Milawa, VIC (virtual)	
M.G. Holdstock	Cover crop wine tasting	SA Central Viti Expo, Adelaide, SA	
S. Nordestgaard	Autonomous vehicles for weed control		
K.C. Hirlam	Australian Wine Carbon Calculator		
P.O. Williamson	Familiarisation with smoke-tainted wines	Smoke taint sensory workshop, Macedon, VIC (virtual)	23 Sep 2021
R.A. Dixon	Non-chemical weed control decision-making tool and resources	Non-chemical weed control and cover crop workshop, Renmark, SA	28 Sep 2021
	Non-chemical weed control case study		
M.G. Holdstock	Evaluation of wines made from different undervine cover crop treatments – vintage 2020		
M.L. Longbottom	Introduction and recap of Sustainable Winegrowing Australia certification	AWISSP certification training, Rutherglen, VIC (virtual)	5 Oct 2021
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
M.G. Holdstock	An introduction to the services provided by the AWRI and the Industry Development and Support team	Melbourne Polytechnic (TAFE), VIC (virtual)	
N. Scrimgeour	Extending the shelf life of canned wines	AWRI webinar	7 Oct 2021
S. Nordestgaard	Autonomous robots and electric tractors – where are they at?	Wine Tasmania Field Day, TAS (virtual)	12 Oct 2021
M.P. Krstic	Welcome and overview of the AWRI	Advanced Viticulture Course (AVC 2), Adelaide, SA	13 Oct 2021
M. Essling	Agrochemical update		
M.L. Longbottom	Sustainability update		
A. Little	Virus testing		
A.R. Borneman	Genetics		
J.L. Hixson	Foliar sulfur and nitrogen applications		
C.A. Simos	AWRI projects overview		
N. Scrimgeour	Alternative wine packaging	4th Wine Tasmania Winemaker Symposium - 'Pinot Noir, You're a star', TAS (virtual)	
E.O. Bilogrevic, K.A. Bindon	Whole bunch fermentation: a focus on Pinot Noir		
D. Espinase Nandorfy	The relevance of statistical modelling and model systems in sensory science: case studies from wine research	Australian Institute of Food Science and Technology 2021 Convention (virtual)	
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, McLaren Vale, SA	14 Oct 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals	AWISSP certification training, McLaren Vale, SA	14 Oct 2021
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Internal audits	AWISSP certification training, Adelaide Hills, SA	15 Oct 2021
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
D. Espinase Nandorfy	Understanding interactions directing wine sensory properties using statistical experimental designs	Deakin University Research Symposium (virtual)	
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Riverland, SA	19 Oct 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	Energy and fuel	AWISSP certification training, Riverland, SA	19 Oct 2021
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
S.J. Dillon	AWRI wine microorganism culture collection – without microbes, wine is just grape juice	Australasian Biospecimen Network Association 18th Annual Conference, Adelaide, SA	21 Oct 2021
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Treasury Wine Estates growers, WA, SA, VIC (virtual)	25 Oct 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
E.O. Bilogrevic	Cabernet Sauvignon consumer sensory benchmarking project	Accolade Wines, Winemaking Technical Conference, Adelaide, SA (virtual)	26 Oct 2021
L.M. Pitcher	Water and wastewater	AWISSP certification training, Treasury Wine Estates growers, WA, SA, VIC (virtual)	27 Oct 2021
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Air quality	AWISSP certification training, Rutherglen, VIC (virtual)	29 Oct 2021
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		

Staff	Title of presentation	Presented to and where	Date
W.P. Pearson	Flavours, taints and faults	Advanced Wine Assessment Course (AWAC 54), Adelaide, SA	1 Nov 2021
S. Nordestgaard	Ferment density and level sensors – 2021 trials	Accolade Group Winemaking Technical Conference, Adelaide, SA (virtual)	2 Nov 2021
R. Gawel	Palate performance and statistical evaluation	Advanced Wine Assessment Course (AWAC 54), Adelaide, SA	4 Nov 2021
M.Z. Bekker	Managing reductive aromas in Syrah wines	New Zealand Syrah workshop (virtual)	
K.C. Hirlam	Australian Wine Carbon Calculator	Department of Jobs, Precincts and Regions/Agriculture Victoria (virtual)	9 Nov 2021
K.C. Hirlam, M.L. Longbottom	Sustainability from the vineyard to the glass	The Institute of Masters of Wine (virtual)	
J.A. Culbert	Smoke taint remediation	Smoke taint remediation workshop, North-east Victoria, VIC (virtual)	10 Nov 2021
		Smoke taint remediation workshop, Central Victoria, VIC (virtual)	
		Smoke taint remediation workshop, Yarra Valley, VIC (virtual)	13 Nov 2021
C.A. Simos	What the numbers mean – a regional snapshot of smoke taint grape data	Smoke taint new knowledge seminar, Hunter Valley, NSW (virtual)	15 Nov 2021
M.J. Herderich	Early season smoke exposure – Hunter Valley and Adelaide Hills		
T.M. Parker	Predicting smoke taint in wine. Are we there yet?		
J.A. Culbert	Do winemaking remediation treatments work?		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Brown Family Wine Group, VIC (virtual)	16 Nov 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
J.A. Culbert	Smoke taint remediation	Smoke taint remediation workshop, Mornington Peninsula, VIC (virtual)	17 Nov 2021
L.M. Pitcher	Water and wastewater	AWISSP certification training, Brown Family Wine Group, VIC (virtual)	18 Nov 2021
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
A.L. Robinson	AWRI update	Barossa Grape & Wine Association, Nuriootpa, SA	

Staff	Title of presentation	Presented to and where	Date
C.A. Simos	What the numbers mean – a regional snapshot of smoke taint grape data	Smoke taint new knowledge seminar, Canberra, ACT (virtual)	18 Nov 2021
M.J. Herderich	Early season smoke exposure – Hunter Valley and Adelaide Hills		
T.M. Parker	Predicting smoke taint in wine. Are we there yet?		
J.A. Culbert	Do winemaking remediation treatments work?		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Treasury Wine Estates, VIC (virtual)	22 Nov 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
S. Nordestgaard, D. Hsieh	Autonomous vineyard robots and tractors	Autonomous tractor demo morning, Barossa Valley, SA	25 Nov 2021
	Demonstration of tractor with autonomy kit using undervine weeding and canopy spraying implements		
J.L. Hixson	Riesling aroma throughout ageing: vineyard and winery considerations	Riesling producers' technical meeting, Barossa Valley, SA	26 Nov 2021
R. Gawel	The phenolic profiles and tastes and textures of Riesling as affected by juice extraction and processing		
M.J. Herderich	Advances in wine authenticity and provenance testing: a New World perspective	Technical University of Munich, Germany (virtual)	29 Nov 2021
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, (virtual)	
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
C.A. Simos	What the numbers mean – a regional snapshot of smoke taint grape data	Smoke taint new knowledge seminar, Orange, NSW (virtual)	30 Nov 2021
M.J. Herderich	Early season smoke exposure – Hunter Valley and Adelaide Hills		
T.M. Parker	Predicting smoke taint in wine. Are we there yet?		
J.A. Culbert	Do winemaking remediation treatments work?		

Staff	Title of presentation	Presented to and where	Date
R.A. Dixon	Regional snapshot	AWRI Riverland seminar, Renmark, SA	30 Nov 2021
S. Nordestgaard	Autonomous robots and electric tractors – where are they at?		
R.A. Dixon	Weed management without synthetic chemicals		
	Organic vs conventional practices compared – what's stopping you from going organic?		
S. Nordestgaard	Trends in Australian winemaking practices		
L.M. Pitcher	Water and wastewater	AWISSP certification training (virtual), Adelaide, SA	1 Dec 2021
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
K.C. Hirlam	Reviewing the standard procedures for grape sugar and colour measurement	AWRI webinar	2 Dec 2021
G.D. Cowey	Brett research and management – what's new?	Treasury Wine Estates (virtual)	7 Dec 2021
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Adelaide, SA	13 Dec 2021
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
	Water and wastewater		
	Biodiversity		
	Waste		
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Treasury Wine Estates, Limestone Coast, SA (virtual)	11 Jan 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
	Sustainability – global insights and introduction	AWISSP certification training (virtual), Adelaide, SA	
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Water and wastewater	AWISSP certification training, Treasury Wine Estates, Limestone Coast, SA (virtual)	14 Jan 2022
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Water and wastewater	AWISSP certification training (virtual), Adelaide, SA	
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training, Margaret River, WA (virtual)	17 Jan 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		18 Jan 2022
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training, Great Southern, WA (virtual)	20 Jan 2022
	Introduction to Sustainable Winegrowing Australia certification		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Property maps	AWISSP certification training, Great Southern, WA (virtual)	20 Jan 2022
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		21 Jan 2022
L.M. Pitcher	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training, Winegrapes Australia growers and others (virtual)	27 Jan 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		28 Jan 2022
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training (virtual), Adelaide, SA	7 Feb 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals	AWISSP certification training (virtual), Adelaide, SA	7 Feb 2022
M.L. Longbottom	Land, soil and nutrient management		8 Feb 2022
	Sustainability – global insights and introduction		
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
	Water and wastewater		9 Feb 2022
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Water and wastewater		10 Feb 2022
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainable Winegrowing Australia overview	Naked Wines, NSW (virtual)	29 Mar 2022
M.J. Herderich	Oenological risks caused by climate change	64th International Congress of the German Winegrowers' Association (virtual)	11 Apr 2022
M.L. Longbottom	Sustainability in the Australian grape and wine sector		
	Sustainable Winegrowing Australia update	Australian Grape & Wine regional update (virtual)	13 Apr 2022
A.F. Garcia Cordente	Generation of yeasts that intensify floral aromas in wine	Enoforum conference 2022, Zaragoza, Spain (virtual)	21 Apr 2022
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Mildura, VIC	27 Apr 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
C.M. Brodie	Internal audits		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Sustainability action planning and benchmarking reports	AWISSP certification training, Mildura, VIC	27 Apr 2022
C.M. Brodie	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
J.A. Gledhill	Evaluation of winemaking treatments in Australian Chardonnay	Chardonnay winemaking trial tasting, University of Adelaide, SA	28 Apr 2022
W. Jiang	Seedling – plant your dream	Women in Chemistry Group (RACI SA Branch), Adelaide, SA	
L.M. Pitcher	Sustainability – global insights and introduction	AWISSP certification training, Swan Hill, VIC	
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
C.M. Brodie	Customer and regulatory requirements		
	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training, Riverland, SA	29 Apr 2022
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals	AWISSP certification training, Riverland, SA	29 Apr 2022
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Sustainability – global insights and introduction	AWISSP certification training, Yalumba Winery, Barossa Valley, SA	2 May 2022
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
M.L. Longbottom	Sustainable Winegrowing Australia update	Limestone Coast Grape and Wine Council Technical Subcommittee (virtual)	5 May 2022
M. Essling	AWRI projects overview	AWRI roadshow seminar, Stanthorpe, QLD	10 May 2022
	Scale and mealybug – what can I do to control these sap-sucking insects?		
A.R. Borneman	Bringing science to wild wine		
S.A. Schmidt	The beneficial style and performance effects of oxygen addition during fermentation		
	Causes and management of slow and stuck fermentations		
M. Essling	Be alert: is fungicide resistance coming to your vineyard?		
J.L. Hixson	Increasing wine flavour with glycoside additions		

Staff	Title of presentation	Presented to and where	Date
M.L. Longbottom	Sustainability – global insights and introduction	AWISSP certification training, Yalumba Winery, Barossa Valley, SA	10 May 2022
	Introduction to Sustainable Winegrowing Australia certification		
L.M. Pitcher	Property maps		
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use	AWISSP certification training, McLaren Vale, SA	13 May 2022
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction		
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
	Sustainability – global insights and introduction	AWISSP certification training (virtual), Adelaide, SA	16 May 2022
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		

Staff	Title of presentation	Presented to and where	Date
C.M. Brodie	Internal audits	AWISSP certification training (virtual), Adelaide, SA	16 May 2022
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		19 May 2022
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
M.L. Longbottom	Sustainable Winegrowing Australia Tasmania update	Landcare Tasmania workshop, Penna, TAS	
E.N. Wilkes	FIVS STC Fire Impacts Working Group proficiency testing program results	FIVS members and secretariat, Brussels, Belgium	22 May 2022
L.M. Pitcher	Sustainability – global insights and introduction	AWISSP certification training, Barossa, SA	23 May 2022
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
C.M. Brodie	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
C.M. Brodie	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
C.M. Brodie	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
M.L. Longbottom	Sustainable Winegrowing Australia	EE Muir agronomy technical meeting, Barossa Valley, SA	25 May 2022
	Sustainable Winegrowing Australia Barossa update	Barossa sustainability forum, Barossa Valley, SA	26 May 2022
	Sustainability – global insights and introduction	AWISSP certification training, Adelaide, SA	27 May 2022
	Introduction to Sustainable Winegrowing Australia certification		

Staff	Title of presentation	Presented to and where	Date
L.M. Pitcher	Property maps	AWISSP certification training, Adelaide, SA	27 May 2022
M.L. Longbottom	Internal audits		
	Sustainability action planning and benchmarking reports		
	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
M.L. Longbottom	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
	Air quality		
M.L. Longbottom	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
M.L. Longbottom	Documentation		
	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
L.M. Pitcher	Sustainable Winegrowing Australia and project update	Sustainability workshop, Rutherglen, VIC	1 Jun 2022
	Sustainable Winegrowing Rutherglen – vision		
C.M. Brodie	Sustainable Winegrowing Rutherglen – performance and targets		
C.A. Simos	AWRI projects overview	AWRI roadshow seminar, Hunter Valley, NSW	
M. Essling	Organic vs conventional practices compared – what's stopping you from going organic?		
S.A. Schmidt	Is *Brettanomyces* able to evolve increasing sulfite tolerance		
	The beneficial style and performance effects of oxygen addition during fermentation		
K.A. Bindon	Using maceration techniques to tailor red wine styles		
M. Essling	Scale and mealybug – what can I do to control these sap-sucking insects?		
R. Dixon	AWRI projects overview	AWRI roadshow seminar, Mornington Peninsula, VIC	
	Organic vs conventional practices compared – what's stopping you from going organic?		
R. Gawel	White wine texture: the interactive effects of phenolics, polysaccharides, acidity and alcohol		
M.Z. Bekker	Managing 'reductive' aromas in wine		
A.R. Borneman	Bringing science to wild wine		
C.A. Simos	AWRI projects overview	AWRI roadshow seminar, Mudgee, NSW	2 Jun 2022
M. Essling	Organic vs conventional practices compared – what's stopping you from going organic?		
K.A. Bindon	Cold stability		
S.A. Schmidt	Is *Brettanomyces* able to evolve increasing sulfite tolerance		
K.A. Bindon	The beneficial style and performance effects of oxygen addition during fermentation		
	Using maceration techniques to tailor red wine styles		
J.A. Culbert	Smoke taint remediation	AWRI smoke taint remediation workshop, Mudgee, NSW	

Staff	Title of presentation	Presented to and where	Date
R. Dixon	AWRI projects overview	AWRI roadshow seminar, Geelong, VIC	2 Jun 2022
	Organic vs conventional practices compared – what's stopping you from going organic?		
R. Gawel	The effect of dissolved carbon dioxide on the taste and texture of still white and red wine		
M.Z. Bekker	Managing 'reductive' aromas in wines		
A.R. Borneman	Bringing science to wild wine		
M.L. Longbottom	Sustainability – global insights	Greater Victoria sustainability workshop (virtual)	6 Jun 2022
L.M. Pitcher	Greater Victoria sustainability performance and targets		
M.L. Longbottom	Sustainability certification		
C.M. Brodie	Sustainability in action in Greater Victoria – case study		
M.L. Longbottom	Sustainability – global insights		7 Jun 2022
L.M. Pitcher	Greater Victoria sustainability performance and targets		
M.L. Longbottom	Sustainability certification		
C.M. Brodie	Sustainability in action in Greater Victoria – case study		
M. Essling	Agrochemical update	Nutrien Ag Solutions (virtual)	16 Jun 2022
L.M. Pitcher	Sustainability – global insights and introduction	AWISSP certification training, Adelaide, SA	24 Jun 2022
	Introduction to Sustainable Winegrowing Australia certification		
	Property maps		
C.M. Brodie	Internal audits		
M.L. Longbottom	Sustainability action planning and benchmarking reports		
C.M. Brodie	Biosecurity		
L.M. Pitcher	Pest and disease management in vineyards and winery chemicals		
C.M. Brodie	Land, soil and nutrient management		
L.M. Pitcher	Water and wastewater		
M.L. Longbottom	Biodiversity		
L.M. Pitcher	Waste		
M.L. Longbottom	Air quality		
	Energy and fuel		
L.M. Pitcher	Scope and commitment to sustainability		
	Documentation		
C.M. Brodie	Training and development		
L.M. Pitcher	Suppliers		
	Customer and regulatory requirements		
M.L. Longbottom	Incident management, corrective and preventative actions, management review		
	Winery product identification, traceability, withdrawal and recall requirements		
L.M. Pitcher	Sustainable Winegrowing Australia trust mark use		
	Audit preparation and subsequent actions		
N. Scrimgeour	Developing new beverage products for a rapidly evolving market	18th Australian Wine Industry Technical Conference, workshop program, Adelaide, SA	26 Jun 2022
	Shelf-life testing for success		
K.C. Hirlam	Packaging considerations for NPD		
W.P. Pearson	Using sensory methods to guide NPD		
M. Essling	Conversion to organic viticulture – is it for me?		
L.M. Pitcher	Logistics and requirements of organic certification		
C. Penfold	Subduing weed issues in organic systems without the use of synthetic herbicides		
S. Nordestgaard	Introduction and experiences with a tractor autonomy kit		
	History of undervine weeding and equipment		
D. Hsieh	Undervine weeding equipment trials		
R. Dixon	Interviews and development of a non-chemical weed control tool		
A.R. Borneman	What's in your wilds?		

Staff	Title of presentation	Presented to and where	Date
C.A. Varela	Characterising non-*Saccharomyces* yeast species from wine ferments	18th Australian Wine Industry Technical Conference, workshop program, Adelaide, SA	26 Jun 2022
J.R. Bellon	Introducing a new breed of wine yeast		
K.A. Bindon	What makes a wine cold unstable?		
E.N. Wilkes	Measuring cold stability, hitting a moving target		
	Cold stabilisation technologies		
M.Z. Bekker	Modulating 'flint' and 'tropical' aromas and controlling 'reductive' aromas in premium Australian wines		
J.L. Hixson	Enhancing tropical thiols using nitrogen and sulfur foliar vineyard treatments		
T.E. Siebert	Prevalence of 'flint' aroma in Australian Chardonnays		
M.Z. Bekker	Modulating 'flint' aroma in white wine		
D. Espinase Nandorfy	Tasting of Chardonnay wines displaying 'struck match/ flinty' aroma and insights into consumer preference for this particular wine style		
S. Nordestgaard	Introduction and sensor technologies		
	Trials of sensors for monitoring level, density and hydrogen sulfide		
E.N. Wilkes	Process-driven analysis		
G.D. Cowey	Common issues in fermentation management		
K.A. Bindon	Water addition to must: when to use it and how much?		
S.A. Schmidt	Technical properties of wine yeast: considerations during wine yeast selection		
P.J. Costello	Malolactic fermentation: limitations and opportunities		
N. Scrimgeour	Achieving success with canned wines		
K.C. Hirlam	A consortium approach to canned wine development		
N. Scrimgeour	Understanding the limitations of canned wines		
T.M. Parker	Smoke taint: the latest research		
D. Espinase Nandorfy	Sensory assessment of wines made from smoke-exposed grapes		
E.O. Bilogrevic	The consumer response to smoke-exposed wines		
W. Jiang	Pre-veraison smoke exposure of vineyards affects wine flavour		
A.D. Coulter	Answering your questions on smoke taint		
S.A. Schmidt, M.G. Holdstock	Aeration during fermentation		
M.L. Longbottom	State of the nation	18th Australian Wine Industry Technical Conference, plenary program, Adelaide, SA	27 Jun 2022
C.E. Bartel	A *Brettanomyces bruxellensis* detection assay using flow cytometry technology to specifically identify and enumerate viable organisms	18th Australian Wine Industry Technical Conference, WineTech Floor talk, Adelaide, SA	
W.P. Pearson	Low- and no-alcohol wine: a category overview	18th Australian Wine Industry Technical Conference, workshop program, Adelaide, SA	28 Jun 2022
J. Hildebrandt	Unravelling the aroma of overripe Shiraz grapes	18th Australian Wine Industry Technical Conference, 'In the wine light' student forum, Adelaide, SA	
T.M. Parker	Smoke flavour: linking chemical composition and sensory properties in smoke-affected wines	18th Australian Wine Industry Technical Conference, Fresh Science session, Adelaide, SA	
A.M. Mierczynska-Vasilev	New solutions to tartrate instability in white wines		
D. Espinase Nandorfy	The influence of amino acids, and their interactions, on the sensory properties and consumer acceptance of dry red wine		29 Jun 2022
A.R. Borneman	A clone by any other name – the genetics of grapevine clonal identity		
M. Essling	Agrochemical update	AgLink Agronomy Forum, Adelaide, SA	30 Jun 2022
L.M. Pitcher	Sustainable Winegrowing Australia McLaren Vale update	Sustainable Winegrowing Australia season opening for McLaren Vale Grape, Wine and Tourism Association, McLaren Vale, SA	

APPENDIX 2

Events organised by AWRI staff

Staff	Title of event	Held	Date
M.L. Longbottom, L.M. Pitcher	Australian Wine Industry Standard of Sustainable Practice (AWISSP) certification training	Adelaide, SA (virtual)	19 Jul 2021
			21 Jul 2021
		Mildura, VIC (virtual)	27 Jul 2021
			28 Jul 2021
		Barossa Valley, SA	2 Aug 2021
M.L. Longbottom. L.M. Pitcher, R.A. Dixon	Sustainability workshop	Victoria (virtual)	10 Aug 2021
M.L. Longbottom, L.M. Pitcher	AWISSP certification training	Rutherglen, VIC (virtual)	11 Aug 2021
M.L. Longbottom	Sustainability workshop	Central Victoria (virtual)	13 Aug 2021
M.L. Longbottom, L.M. Pitcher	AWISSP certification training	Adelaide, SA (virtual)	16 Aug 2021
		Yarra Valley, VIC (virtual)	3 Sep 2021
R.A. Dixon, M.G. Holdstock	Non-chemical weed control and cover crop workshop	Barossa Valley, SA	6 Sep 2021
M.G. Holdstock, R.A. Dixon, L.M. Pitcher		Clare, SA	7 Sep 2021
R.A. Dixon		Yarra Valley, VIC (virtual)	8 Sep 2021
M.G. Holdstock, J. Scudds, E.-M. Panagis, F. Blefari	Chardonnay winemaking trial tasting	Riverland, SA (virtual)	13 Sep 2021
J.A. Gledhill, J. Scudds, E.-M. Panagis, F. Blefari		Geelong, VIC (virtual)	
		Gippsland, VIC (virtual)	14 Sep 2021
		Mildura, VIC (virtual)	
R.A. Dixon, M.G. Holdstock	Non-chemical weed control and cover crop workshop	Hunter Valley, NSW (virtual)	16 Sep 2021
M.L. Longbottom, L.M. Pitcher	AWISSP certification training	Yarra Valley, VIC (virtual)	17 Sep 2021
		Langhorne Creek, SA	20 Sep 2021
		Barossa Valley, SA	21 Sep 2021
P.O. Williamson	Smoke taint sensory workshop	Gippsland and Mornington, VIC (virtual)	
		Yarra Valley, VIC (virtual)	
		Rutherglen, VIC (virtual)	22 Sep 2021
		Milawa, VIC (virtual)	
		Macedon, VIC (virtual)	23 Sep 2021
L.M. Pitcher	AWISSP certification training follow-up session	Adelaide, SA (virtual)	
M.L. Longbottom			27 Sep 2021
M.G. Holdstock	Non-chemical weed control and cover crop workshop	Renmark, SA	28 Sep 2021
M.L. Longbottom, L.M. Pitcher, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	Rutherglen, VIC (virtual)	5 Oct 2021
R.A. Dixon, C.A. Simos, J. Scudds, M.P. Krstic, M. Essling, M.L. Longbottom, A. Little, A.R. Borneman, J.L. Hixson	Advanced Viticulture Course (AVC 2)	Adelaide, SA	11-13 Oct 2021

Staff	Title of event	Held	Date
M.L. Longbottom, L.M. Pitcher, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	McLaren Vale, SA	14 Oct 2021
		Adelaide Hills, SA	15 Oct 2021
		Riverland, SA	19 Oct 2021
		Treasury Wine Estates growers, WA, VIC, SA (virtual)	25 Oct 2021
			27 Oct 2021
		Rutherglen, VIC (virtual)	29 Oct 2021
C.A. Simos, F. Blefari, B. Cordingley, E.-M. Panagis, G. Cowey, J. Scudds, M.G. Holdstock, W.G. McSorley, W. P. Pearson, R. Gawel	Advanced Wine Assessment Course (AWAC 54)	Adelaide, SA	1-4 Nov 2021
C.A. Simos, E.-M. Panagis, J.A. Culbert, J. Scudds, F. Blefari, W.G. McSorley	Smoke taint remediation workshop	Central Victoria (virtual)	10 Nov 2021
		North-east Victoria (virtual)	
		Yarra Valley, VIC (virtual)	13 Nov 2021
C.A. Simos, E.-M. Panagis, M.J. Herderich, T.M. Parker, J.A. Culbert	Smoke taint new knowledge seminar	Hunter Valley, NSW (virtual)	15 Nov 2021
M.L. Longbottom, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	Brown Family Wine Group, VIC (virtual)	16 Nov 2021
C.A. Simos, E.-M. Panagis, J.A. Culbert, J. Scudds, F. Blefari, W.G McSorley	Smoke taint remediation workshop	Mornington Peninsula, VIC (virtual)	17 Nov 2021
M.L. Longbottom, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	Brown Family Wine Group, VIC (virtual)	18 Nov 2021
C.A. Simos, E.-M. Panagis, M.J. Herderich, T.M. Parker, J.A. Culbert, J. Scudds, F. Blefari, W.G. McSorley	Smoke taint new knowledge seminar	Canberra, ACT (virtual)	
M.L. Longbottom, L.M. Pitcher, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	Treasury Wine Estates, VIC (virtual)	22 Nov 2021
S. Nordestgaard, J. Scudds, D. Hsieh, E.-M. Panagis, F. Blefari, W.G. McSorley	Autonomous tractor demo morning	Barossa Valley, SA	25 Nov 2021
M.L. Longbottom, L.M. Pitcher, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training	Adelaide, SA (virtual)	29 Nov 2021
R.A. Dixon, S. Nordestgaard, C.Penfold, C. Davies J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWRI roadshow seminar	Riverland, SA (virtual)	30 Nov 2021
C.A. Simos, E.-M. Panagis, M.J. Herderich, T.M. Parker, J.A. Culbert, J. Scudds, F. Blefari, W.G. McSorley	Smoke taint new knowledge seminar	Orange, NSW (virtual)	
M.G. Holdstock, S.A. Schmidt, W.G. McSorley	Aeration of ferments workshop	Adelaide, SA (virtual)	
M.L. Longbottom, L.M. Pitcher, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley	AWISSP certification training		1 Dec 2021
			13 Dec 2021
M.L. Longbottom, J. Scudds, E.-M. Panagis, L.M. Pitcher			11 Jan 2022
M.L. Longbottom, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley, L.M. Pitcher		Treasury Wine Estates, Limestone Coast, SA (virtual)	
M.L. Longbottom, J. Scudds, E.-M. Panagis, L.M. Pitcher		Adelaide, SA (virtual)	14 Jan 2022

Staff	Title of event	Held	Date
M.L. Longbottom, J. Scudds, E.-M. Panagis, F. Blefari, W.G. McSorley, L.M. Pitcher	AWISSP certification training	Margaret River, WA (virtual)	17 Jan 2022
			18 Jan 2022
		Great Southern, WA (virtual)	20 Jan 2022
			21 Jan 2022
M.L. Longbottom, J. Scudds, E.-M. Panagis, L.M. Pitcher		Winegrapes Australia growers and others (virtual)	27 Jan 2022
			28 Jan 2022
		Adelaide, SA (virtual)	7 Feb 2022
			8 Feb 2022
			9 Feb 2022
			10 Feb 2022
L.M. Pitcher, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, D. Carter		Mildura, VIC	27 Apr 2022
J.A. Gledhill, J. Scudds, E.-M. Panagis, F. Blefari	Chardonnay winemaking trial tasting	University of Adelaide, SA	28 Apr 2022
L.M. Pitcher, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, D. Carter	AWISSP certification training	Swan Hill, VIC	
		Riverland, SA	29 Apr 2022
		Barossa Valley, SA	2 May 2022
M.L. Longbottom, J. Scudds, F. Blefari, W.G. McSorley, L.M. Pitcher, D. Carter			10 May 2022
M.G. Holdstock, J. Scudds, M. Essling, A.R. Borneman, S.A. Schmidt, J.L. Hixson, F. Blefari, W.G. McSorley	AWRI roadshow seminar	Stanthorpe, Qld	
M.G. Holdstock, E.-M. Panagis, F. Blefari, J. Scudds, R. Dixon, W.G. McSorley	Irrigation efficiency workshop: getting the most out of every drop	Mildura, VIC	
L.M. Pitcher, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, D. Carter	AWISSP certification training	McLaren Vale, SA	13 May 2022
L.M. Pitcher, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, D. Carter		Adelaide, SA (virtual)	16 May 2022
R. Dixon, E.-M. Panagis, F. Blefari, J. Scudds, W.G. McSorley	Irrigation efficiency workshop: getting the most out of every drop	Loxton, SA	17 May 2022
		Renmark, SA	18 May 2022
L.M. Pitcher, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, D. Carter	AWISSP certification training	Adelaide, SA (virtual)	19 May 2022
M.L. Longbottom, E.-M. Panagis, J. Scudds, F. Blefari, W.G. McSorley, L.M. Pitcher, D. Carter		Barossa Valley, SA	23 May 2022
		Adelaide, SA	27 May 2022

Staff	Title of event	Held	Date
L.M. Pitcher, E.-M. Panagis, C.M. Brodie, M.L. Longbottom, D. Carter	Sustainability workshop	Rutherglen, VIC	1 Jun 2022
C.A. Simos, J. Scudds, M. Essling, S.A. Schmidt, K.A. Bindon, F. Blefari, W.G. McSorley	AWRI roadshow seminar	Hunter Valley, NSW	
M.G. Holdstock, J. Scudds, R. Dixon, R. Gawel, M.Z. Bekker, A.R. Borneman, F. Blefari, W.G. McSorley		Mornington Peninsula, VIC	
M.G. Holdstock, J. Scudds, C.A. Simos, M. Essling, K.A. Bindon, S.A. Schmidt, F. Blefari, W.G. McSorley		Mudgee, NSW	2 Jun 2022
C.A. Simos, J. Scudds, J.A. Culbert, F. Blefari, W.G. McSorley	AWRI smoke taint remediation workshop		
M.G. Holdstock, J. Scudds, R. Dixon, R. Gawel, M.Z. Bekker, A.R. Borneman, F. Blefari, W.G. McSorley	AWRI roadshow seminar	Geelong, VIC	
L.M. Pitcher, E.-M. Panagis, C.M. Brodie, M.L. Longbottom, D. Carter	Greater Victoria sustainability workshop	Adelaide, SA (virtual)	6 Jun 2022
			7 Jun 2022
M.L. Longbottom, J. Scudds, F. Blefari, W.G. McSorley, C.M. Brodie, L.M. Pitcher, D. Carter	AWISSP certification training	Adelaide, SA	24 Jun 2022
N. Scrimgeour, W.P. Pearson, K.C. Hirlam	Developing new beverage products for a rapidly evolving market – W01	18th AWITC workshop program, Adelaide, SA	26 Jun 2022
M. Essling, L.M. Pitcher, C. Penfold	Conversion to organic viticulture: is it for me? – W03		
S. Nordestgaard, D. Hsieh, R. Dixon	Autonomous tractors and non-chemical weed control – W05		
S.A. Schmidt, A.R. Borneman, C.A. Varela, J.R. Bellon	A palette of yeast for your wine palate – W09		
K.A. Bindon, E.N. Wilkes	Predict and prevent: improving wine cold stabilisation across the value chain – W10		
R. Dixon	Improving vineyard water use efficiency – W14		
M.Z. Bekker, J.L. Hixson, T.E. Siebert, A.F. Garcia Cordente, D. Espinase Nandorfy	Modulating 'flint' and 'tropical' aromas and controlling 'reductive' aromas in premium Australian wines – W17		
S. Nordestgaard, E.N. Wilkes	Moving analysis from the lab to the tank – W18		
S.A. Schmidt, G.D. Cowey, K.A. Bindon, P.J. Costello	Fermentation 101: getting back to basics on fermentation management – W19		
E.N. Wilkes, N. Scrimgeour, K.C. Hirlam	Achieving success with canned wine products – W20		
R. Dixon	Lifting the veil on soil carbon – W23		
T.M. Parker, D. Espinase Nandorfy, E.O. Bilogrevic, W. Jiang, A.D. Coulter	Smoke taint: the latest research – W29		
S.A. Schmidt, M.G. Holdstock	Aeration of red wine fermentations – W30		
M.L. Longbottom, L.M. Pitcher	The 'S' word: what does sustainability really mean to small, medium and large wine producers? – W36		28 Jun 2022

APPENDIX 3
Posters

Authors	Title of poster	Presented at	Date
M.Z. Bekker, A.C. Kulcsar, G. Kreitman[1], D.W. Jeffery[2], J. Danilewicz	Factors contributing to the formation of latent sulfur sources and sulfur traps in wine	Pacifichem 2021, 2021 International Chemical Congress of Pacific Basin Societies	16-21 Dec 2021
W.P. Pearson, A. Corsi[3], R Dolan[3], S. Goodman[3]	NOLO in FOCUS: insight into consumer and category perceptions using focus groups	18th Australian Wine Industry Technical Conference, Adelaide, SA	26-29 Jun 2022
Y. Grebneva[4], E.O. Bilogrevic, D. Rauhut[4], M.J. Herderich, J.L. Hixson	Photoselective shading: implications from Riesling bunch zone light manipulation using different coloured shade cloth		
D. Hsieh, S. Nordestgaard	Non-chemical weed management using an autonomous tractor		
C. Ward, C. Onetto, M.J. Roach, S.A. Schmidt, A.R. Borneman	A clone by any other name – the genetics of grapevine clonal identity		
M.J. Roach, A.R. Borneman, S.A. Schmidt	Genetic origin of the Chardonnay clone Gingin in Australia		
C. Onetto, A.R. Borneman, S.A. Schmidt	Strain-specific responses of *Saccharomyces cerevisiae* to competition by non-*Saccharomyces* yeasts		
A.M. Mierczynska-Vasilev, R. Dabare[5], T.G. Reilly, S. Wahono[6], K. Vasilev[5], K.A. Bindon	New solutions to tartrate instability in white wines		
S. Van Den Heuvel, K.M. Cuijvers, L.J. Hale, A.R. Borneman	Wild wine: DNA profiling microbial communities during wine fermentation		
K.M. Cuijvers, S. Van Den Heuvel, C.A. Varela, M. Rullo, M.R. Solomon, S.A. Schmidt, A.R. Borneman	Predictable alterations in non-*Saccharomyces* yeasts in wild ferments through the addition of sulfur dioxide		
P.J. Costello, R. Kolouchova, J. McCarthy, C. Jordans, S.A. Schmidt	SO_2 production potential and early, transient acetaldehyde formation by *Saccharomyces cerevisiae* – implications for *Oenococcus oeni* co-fermentation		
C. Onetto, P.J. Costello, R. Kolouchova, C. Jordans, J. McCarthy, S.A. Schmidt	*Oenococcus oeni* and SO_2 stress: transcriptomic analysis reveals how this species responds to SO_2		
P.J. Costello, R. Kolouchova, J. McCarthy, C. Jordans, S.A. Schmidt	Malolactic starter performance during co-fermentation with SO_2-producing yeast: early, transient acetaldehyde formation is a key regulator		
R. Gawel, A. Schulkin, P. Milton[7], D. Espinase Nandorfy, P.A. Smith[8]	Float or sink? The effect of flotation and cold settling on wine non-volatiles, taste and mouthfeel of white wine		
A. Schulkin, R. Gawel	CO_2 evolution in the wine glass: implications for winemakers and consumers		
S.R. Barter, F.T. Watson, L. Pisaniello, R. Stegmann, I.L. Francis, T.E. Siebert	The role of lactones and monoterpenes in the flavour of sweet white dessert wines		
A.C. Kulcsar, P.A. Smith[8], M.Z. Bekker	Sneaky stinkies: the challenges associated with analysing volatile sulfur compounds		
M.Z. Bekker, A.C. Kulcsar, L. Pisaniello, F.T. Watson, T.E. Siebert, J.A. Gledhill[9]	Factors affecting the formation and preservation of 'struck flint' aroma in wine		
M.Z. Bekker, A.C. Kulcsar, A.L. Jouin, V. Felipe Laurie[10]	How do tannins clean up stinky wine?		
A.F. Garcia Cordente, M.R. Solomon, A.C. Kulcsar, F.T. Watson, L. Pisaniello, S.A. Schmidt, D. Espinase Nandorfy	Modulation of 'fruity' thiol release during fermentation of red musts by wine yeast		
E.O. Bilogrevic, D. Espinase Nandorfy, T.M. Parker, P.O. Williamson, D. Likos, W.P. Pearson, I.L. Francis	Good sensory practices for assessing wines made from smoke-exposed grapes		

Authors	Title of poster	Presented at	Date
E.O. Bilogrevic, T.M. Parker, J.A. Culbert, W. Jiang, D. Likos, M.J. Herderich, I.L. Francis	The consumer response to smoke flavour in wine	18th Australian Wine Industry Technical Conference, Adelaide, SA	26-29 Jun 2022
T.E. Siebert, L. Pisaniello, F.T. Watson, S.R. Barter, I.L. Francis	Can the varietal 'apricot' aroma of Viognier wine be controlled in the vineyard?		
T.E. Siebert, D. Espinase Nandorfy, L. Pisaniello, F.T. Watson, S.R. Barter, D. Likos, A.C. Kulcsar, I.L. Francis, M.Z. Bekker	'Struck flint' aroma in Chardonnay wines: what causes it and how much is too much?		
M.R. Solomon, E.O. Bilogrevic, I.L. Francis, J.L. Hixson	Influencing tropical thiol concentration in white wine by combining foliar sprays and yeast selection		
D. Espinase Nandorfy, F.T. Watson, D. Likos, T.E. Siebert, K.A. Bindon, S. Kassara, S. Qi, W.P. Pearson, R. Shellie[11], R. Keast[11], I.L. Francis	The influence of amino acids on the taste, mouthfeel and flavour of red wine		
D. Espinase Nandorfy, F.T. Watson, D. Teng, D. Likos, S. Lewin[11], J.A. Gledhill, T.E. Siebert, S.R. Barter, M.Z. Bekker, A.C. Kulcsar, K.A. Bindon, S. Kassara, R. Shellie[11], R. Keast[11], I.L. Francis	Using a scientific approach to the art of wine blending – a case study to optimise warm inland Cabernet Sauvignon		
D. Espinase Nandorfy, T.E. Siebert, M.Z. Bekker, E.O. Bilogrevic, D. Likos, F.T. Watson, S.R. Barter, L. Pisanello, A.C. Kulcsar, R. Shellie[11], R. Keast[11], I.L. Francis	Compositional correlations with the sensory properties and consumer preference of duelling styles of Chardonnay		
F.T. Watson, R. Stegmann, L. Pisaniello, J.L. Hixson, T.E. Siebert	Monoterpenes and C_{13}-norisoprenoids in aged white wines		
L. Pisaniello, D. Likos, F.T. Watson, T.E. Siebert, I.L. Francis, J.L. Hixson	Exploring the varietal effect of flavour precursors derived from grape marc on wine flavour		
J. Hildebrandt, I.L. Francis, E.O. Bilogrevic, J.L. Hixson	Increased late-season heat and its effect on overripe-related compounds in Barossa Shiraz		
J. Hildebrandt, E.O. Bilogrevic, K.A. Bindon, S. Kassara, I.L. Francis, S. Qi, J.L. Hixson	Unravelling the aroma of overripe Shiraz grapes		
J.A. Culbert, W. Jiang, E.O. Bilogrevic, D. Likos, I.L. Francis, C.A. Simos, M.P. Krstic, M.J. Herderich	Choosing the right carbon product for remediating smoke-affected juice and wine		
C. Onetto, M. Sosnowski[12], S. Van Den Heuvel, A.R. Borneman	Genetic diversity of Eutypa dieback in Australia		
T.G. Reilly, A. Schulkin, E.N. Wilkes, K.A. Bindon	New insights on how white and red wine composition affects cold instability		
J.A. Culbert, W. Jiang, E.O. Bilogrevic, D. Likos, I.L. Francis, M.P. Krstic, M.J. Herderich, C.A. Simos	Taking the smoke out: winemaking remediation options for smoke-affected juice and wine		
E.N. Wilkes, P.W. Godden	Variability of alcohol trends for different varieties of Australian wine		
K.C. Hirlam, E.N. Wilkes	Comparative performance of 18 laboratories in the measurement of smoke markers in wine		

Authors	Title of poster	Presented at	Date
K.C. Hirlam, E.N. Wilkes	Understanding the variability of juice extraction methods for quality analysis	18th Australian Wine Industry Technical Conference, Adelaide, SA	26-29 Jun 2022
S. Madaras, L.E. Bey, E.N. Wilkes	Comparison of commonly used analytical methods for the analysis of alcohol content in wine		
L.E. Bey, R.S. West, E.N. Wilkes	Comparison of analytical techniques for ethanol content of no- and low-alcohol wines		
W. Jiang, T.M. Parker, E.O. Bilogrevic, I.L. Francis, P. Leske[13], Y. Hayasaka, S.R. Barter, M.J. Herderich	Does pre-veraison smoke exposure of vineyards affect wine flavour?		
T.M. Parker, W. Jiang, E.O. Bilogrevic, I.L. Francis, A.D. Coulter, M.J. Herderich	How have the smoke-exposed wines from 2020 changed over the last two years?		
T.M. Parker, E.O. Bilogrevic, W. Jiang, D. Likos, P.O. Williamson, J.A. Gledhill[9], C.A. Simos, G.D. Cowey, A.D. Coulter, M.J. Herderich, I.L. Francis	Smoke flavour: linking chemical composition and sensory properties in smoke-affected wines		
D. Hsieh, K.C. Hirlam, N. Scrimgeour, E.N. Wilkes	The development of a predictive testing method for canned wines		
K.C. Hirlam, D. Hsieh, N. Scrimgeour, E.N. Wilkes	Predicting a product's shelf-life		
C.E. Bartel, A. Winterhalter[14], A.R. Rinaldo	Comparison of rapid detection of *Brettanomyces* in Australian wines using flow-cytometry and PCR methods		
K.C. Hirlam, D. Hsieh, N. Scrimgeour, E.N. Wilkes	Getting the most out of canned wine		

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APPENDIX 4
Teaching responsibilities (lectures) of AWRI staff

Institution	Subject number	Subject name	No. of lectures	Staff member
University of Adelaide	7520WT	Advances in wine science	1	C.A. Simos
	7038WT	Distillation, fortified and sparkling wine production	6	J.A. Gledhill
	3046WT/7046WT	Fermentation technology	1	J.L. Hixson
			1	M.Z. Bekker
			1	E.N. Wilkes
	3047WT	Winemaking at vintage	1	J.A. Gledhill
	3500WT	Grape and wine industry practice, policy and communication	1	M.L. Longbottom
			1	S.A. Schmidt
			1	A.L. Robinson
	7010WT	Stabilisation and clarification	1	R. Gawel
			3	A.D. Coulter
	3017WT	Soil and water: management and conservation	1	M.L. Longbottom
	2520WT	Microbiology and biotechnology II	1	S.A. Schmidt

APPENDIX 5

Student supervision responsibilities of AWRI staff

Student	Supervisors	Source of funds
PhD		
Jana Hildebrandt	J.L. Hixson, I.L. Francis, M.J. Herderich, M.A. de Barros Lopes[1]	Wine Australia, Australian Government Research Training Program Scholarship
Yiming Huo	K.L. Wilkinson[2], R. Muhlack[2], M.J. Herderich	CRC-P, University of Adelaide
Stephanie Angela	K.L. Wilkinson[2], K.A. Bindon, R. Muhlack[2], A. Mierczynska-Vasilev	University of Adelaide
Yihe (Eva) Sui	K. Wilkinson[2], P.W. Godden	University of Adelaide
Yanina Giordano	A.R. Borneman, P. Grbin[2]	ARC ITTC-2, University of Adelaide
Natalia Caliani	A.R. Borneman, V. Jiranek[2], K. Sumby[2]	ARC ITTC-2, University of Adelaide
Yu Hou	M.Z. Bekker, D.W. Jeffery[2]	AWRI-UA Collaborative Research Partnership Fund, UA-Wine Australia scholarship
Andrés Zhou Tsang	M. Gilliham[2], A.R. Borneman, M. Walker[3]	ARC ITTC-2, University of Adelaide
Qi Wu	S.D. Tyerman[2], N. Habili, F.E. Constable[4], A.R. Rinaldo	University of Adelaide, Wine Australia
Kamalpreet Kaur	F.E. Constable[4], B. Rodoni[4], A.R. Rinaldo	Wine Australia, La Trobe University
Damian Espinase Nandorfy	I.L. Francis, R. Keast[5], R. Shellie[5], J. Bekkers[6]	Wine Australia
Matija Leskovic	W.J. du Toit[7], M.Z. Bekker, J. Brand[8]	University of Stellenbosch
Sarah Schneidemann	M.J. Herderich, M. Rychlik[8]	Technische Universität Munich
Gail Gnoinski	S.A. Schmidt, D. Close[9], F.L. Kerslake[9]	University of Tasmania
Colleen Szeto	K.L. Wilkinson[2], V. Pagay[2], M.J. Herderich	ARC ITTC-2, University of Adelaide
Wenyu (Wayne) Kang	S.E.P. Bastian[2], R. Muhlack[2], P.A. Smith[10], K.A. Bindon	University of Adelaide, Wine Australia
Yevgeniya Grebneva	M.J. Herderich, J.L. Hixson, M. Stoll[11], D. Rauhut[11]	Hochschule Geisenheim University, AWRI
Masters		
Berlia Roux	W.J. du Toit[7], M.Z. Bekker	University of Stellenbosch
Justine Cohen	R. Nettle[12], C. Barnes[12], M.L. Longbottom	University of Melbourne
Bryce Polley	K. Mengersen[13], K. Helmstedt[13], M.L. Longbottom, M. Mitchell[14]	Food Agility CRC, AWRI, QUT

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APPENDIX 6

Media interviews

Date	Staff member	Discussed	Media
26 Aug 2021	M.P. Krstic	Overview of the AWRI	Sam Potter, *The CEO Magazine*
27 Aug 2021	M.J. Herderich	Smoke taint research	Benjamin Plackett, *Inside Science*
1 Sep 2021	E.N. Wilkes	Authenticity research	Jacquie van Santen, *Wine Australia RD&A news*
27 Sep 2021	M.L. Longbottom	Sustainable Winegrowing Australia certification	Janet Howie, *The Border Mail*
19 Oct 2021	R.A. Dixon	Non-chemical weed control	Simone Madden-Grey, *Australian & New Zealand Grapegrower & Winemaker*
1 Nov 2021	M.P. Krstic	Overview of the AWRI including current research projects	Clare Peddie, *The Advertiser*
3 Nov 2021	C.A. Simos	Advanced Wine Assessment Course	
26 Nov 2021	M.L. Longbottom	Sustainable Winegrowing Australia	Tony Love, *WBM*
	S. Nordestgaard	Autonomous technology in the vineyard	Lucas Forbes, ABC Rural, *Port Pirie*
1 Dec 2021	W.P. Pearson	NOLO project	Jacquie van Santen, *Wine Australia RD&A news*
6 Dec 2021	T.M. Parker and C.A. Simos	Smoke taint	Chris Scott, *UK Wine Show podcast*
7 Dec 2021	R.A. Dixon	Riverland seminar	Hugh Schuitemaker, *Murray Pioneer*
8 Dec 2021	M.L. Longbottom	Climate change and sustainability in the wine industry	Olivana Lathouris, *WIN News*
10 Dec 2021	E.N. Wilkes	Wine analysis	*Torrens University video*
14 Feb 2022	M.P. Krstic	NOLO project	Casey Treloar, *7 News*
			Mount Barker Courier
4 Apr 2022	T.M. Parker	'In the wine light' student forum at the AWITC	Jacquie van Santen, *Wine Australia RD&A news*
7 Apr 2022	S.A. Schmidt	Glutathione research	Sonya Logan, *Australian & New Zealand Grapegrower & Winemaker*
8 Apr 2022	W.P. Pearson	NOLO wines	Christine Webster, *Murray Valley Winegrowers News*
12 Apr 2022	M.J. Herderich	Smoke taint and the search for practical solutions	Laura Milnes, *wine writer, Canada*
11 May 2022	M.L. Longbottom	Sustainable Winegrowing Australia	Andrew Herlinger, *2SER Radio*
			Paul Turton, *ABC Radio, Newcastle*
			Sophie Clarke, *2GB Radio*
18 May 2022	R. Dixon	Irrigation workshop	Eliza Berlage, *ABC Radio*
24 May 2022	W.P. Pearson	NOLO wines	Max Allen, *Australian Financial Review*
25 May 2022			Evelyn Manfield, *ABC Adelaide*
26 May 2022	A.D. Coulter	Does allowing a wine to 'breathe' provide an insight into how it will age?	Max Allen, *Australian Financial Review*
2 Jun 2022	M.L. Longbottom	Sustainable Winegrowing Australia Rutherglen project	Jess Whitty, *Prime 7 Albury-Wodonga*
15 Jun 2022	K.C. Hirlam	Affinity Labs' services for food and beverage producers	*FoodSA video*
24 Jun 2022	M.P. Krstic	The Australian Wine Industry Technical Conference	Andrew Spence, *In Daily*
27 Jun 2022	M.L. Longbottom	Sustainable Winegrowing Australia	Cassandra Hough, *ABC SA Country Hour*

APPENDIX 7

Papers published by AWRI staff recorded during 2021/22

2251 Onetto, C.A., Borneman, A.R., Schmidt, S.A. Strain-specific responses by *Saccharomyces cerevisiae* to competition by non-*Saccharomyces* yeasts. *Fermentation* 7(3): 165; 2021.

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2281 Coulter, A. Ask the AWRI: Interpreting AWRI smoke panel analysis results. *Aust. N.Z. Grapegrower Winemaker* (698): 42-43; 2022.

2282 Kassara, S., Norton, E., Mierczynska-Vasilev, A., Sacks, G.L., Bindon, K.A. Quantification of protein by acid hydrolysis reveals higher than expected concentrations in red wines: implications for wine tannin concentration and colloidal stability. *Food Chem.* 385: 132658; 2022.

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