



"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 a range of strategic changes, with the goal of ensuring a sustainable future for our organisation and our ability to support the Australian grape and wine community for many years to come."

- Dr Mark Krstic, Managing Director



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 and 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.

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. Final Reports will be developed early in 2022/23 and made available through the Wine Australia website.

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. 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.

NEW NO- AND LOW-ALCOHOL WINE FACILITY

It is clear that consumers across the world are increasingly interested in no- and low-alcohol (NOLO) beverages. 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 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 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 create trial product batches at a much smaller scale than has previously been available to our industry.

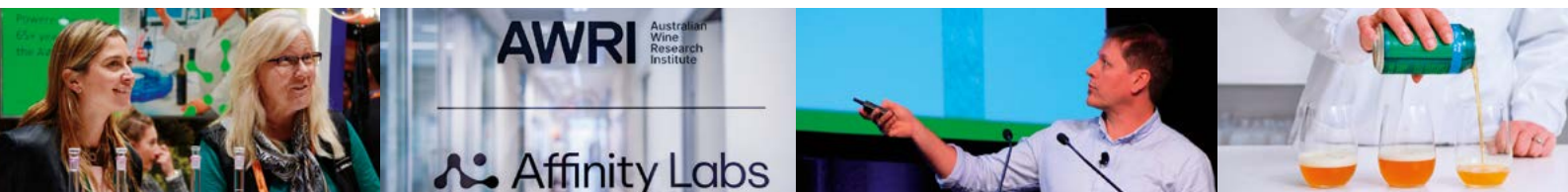
TECHNICAL TRENDS FROM THE AWRI HELPDESK

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. Hail events affected regions across multiple Australian states between October 2021 and January 2022. The wetter winter, generally mild seasonal conditions, and a warmer than average autumn resulted in a slow ripening season and reports of exceptional fruit quality in many regions. 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. Key topics where questions were raised with the helpdesk during the year included vineyard pests (in particular scale insects), smoke taint/planned burns and winemaking practices relating to NOLO products, fortified wines, vinegar and tank method sparkling wine.

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 suggest that winter and spring rainfall are very likely to remain higher than average for much of mainland Australia, but lower for Western Australian regions and south-western Tasmania.

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.



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 48 member states.

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 for hydrolysis-based methods for measuring bound smoke compounds in wine than for the direct LCMS method developed at and used by the AWRI.

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.

ASSESSMENT OF 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

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.

PODCAST LAUNCH

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.



AWRI
DECANTED

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 requests compared to the previous year.

NEW DIGITAL TOOLS

A new decision tool was developed to help growers make decisions about which non-chemical weed control options are best suited to their vineyard environment and to develop a 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.

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.

BLENDING WITH PROLINE-RICH WINES

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

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 potential 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 should provide winemakers with increased confidence in using the more efficient and cost-effective flotation method for white juice clarification.

ALTERNATIVE HEAT AND COLD STABILISATION OPTIONS

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.

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 gas flow rates advised for aeration of white ferments, complex sparger arrangements may not be necessary for effective aeration, especially for longer duration treatments.

UNDERSTANDING 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. Marc-derived glycoside extracts were found to be useful in NOLO wines.

GENETIC BASIS OF LOW-ACETATE-PRODUCING YEAST

Genetic analysis of a previously developed *S. cerevisiae*-*S. 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 acetate 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

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 YEAST INTERACTIONS

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 *Torulaspota 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 *M. 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 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 SO₂-TOLERANT STRAINS OF BRETTANOMYCES

Industry isolates of *Brettanomyces* were screened for the ability to consume *p*-coumaric acid, the precursor of the wine spoilage compound, 4-ethyl phenol. There was no significant difference in the ability of SO₂-tolerant strains to consume coumaric acid compared to their SO₂-susceptible counterparts. This indicates that the SO₂-tolerant strains retain the potential to spoil wine at a level similar to susceptible strains. The SO₂-tolerant strains were also tested for susceptibility to the antimicrobial agents dimethyl dicarbonate and chitosan. Both agents demonstrated effectiveness against these isolates.

UNDERSTANDING '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 H₂S and SO₂. The ability of non-*Saccharomyces* yeast to contribute to PMT formation was also investigated, with nine *Hanseniaspora vineae* and *Hanseniaspora osmophila* strains evaluated. The *H. vineae* strains produced higher levels of benzaldehyde and benzyl alcohol, but did not increase the formation of PMT. The *H. osmophila* strains produced high levels of PMT.

SMART SURFACES REMOVE 'REDUCTIVE' COMPOUNDS

The effectiveness of smart surfaces in removing 'free' H₂S, methanethiol (MeSH), and ethanethiol (EtSH) from wines was compared with the common practice of copper fining. The concentrations of H₂S, 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, SO₂ did not interfere with the ability of the smart surfaces to remove H₂S and the treatment did not remove 'tropical' thiols.

MINIMISING THE RISK OF 'REDUCTIVE' CHARACTERS IN CANNED WINES

Wine compositional factors including pH, free SO₂, copper, oxygen, chloride and elevated temperatures have been shown to influence the migration of aluminium into canned wines and the subsequent formation of H₂S. 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 H₂S.

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 grape and wine concentrations that are likely to result in smoky wines.

BACKGROUND DATABASE OF SMOKE MARKER COMPOUNDS

Comprehensive data 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

WIC WINEMAKING SERVICES ACHIEVES 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 *Torulaspota* 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 *Torulaspota* 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.

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

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.

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

The AWRI is working with school students around Australia on a citizen science project 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.



Readers are encouraged to read the annual report in detail rather than relying on the brief details provided here. The full report can be found on the AWRI website: www.awri.com.au.

Acknowledgements: The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australian grapegrowers and winemakers through their investment body, Wine Australia, with matching funds from the Australian Government. The contribution of collaborators in Australia and overseas is gratefully acknowledged.

Photography: Jacqui Way Photography

Tel: (08) 8313 6600 | www.awri.com.au

