Technical Note

ARC TRAINING CENTRE FOR INNOVATIVE WINE PRODUCTION

Defining and Exploiting the Indigenous Microflora of Grapes

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Background and Aims

Vineyards harbour intricate microbial ecosystems encompassing a vast array of bacteria, fungi, and yeasts. These communities play a critical role in grapevine health and influence the final product – wine. Management practices within the vineyard and subsequent steps in the winery significantly impact the diversity of yeast populations (Fig. 1), which ultimately affects the downstream fermentation process, shaping the sensory characteristics and quality of the resulting wine.

Bioprospecting this rich tapestry of indigenous yeasts offers a compelling approach to uncover novel and valuable yeast strains. By exploring this natural diversity, researchers can identify strains with unique fermentation properties, potentially leading to improved wine quality, aroma profiles, or stress tolerance. Understanding and harnessing the potential of indigenous microflora is a pivotal step towards a more sustainable and terroir-driven winemaking approach.

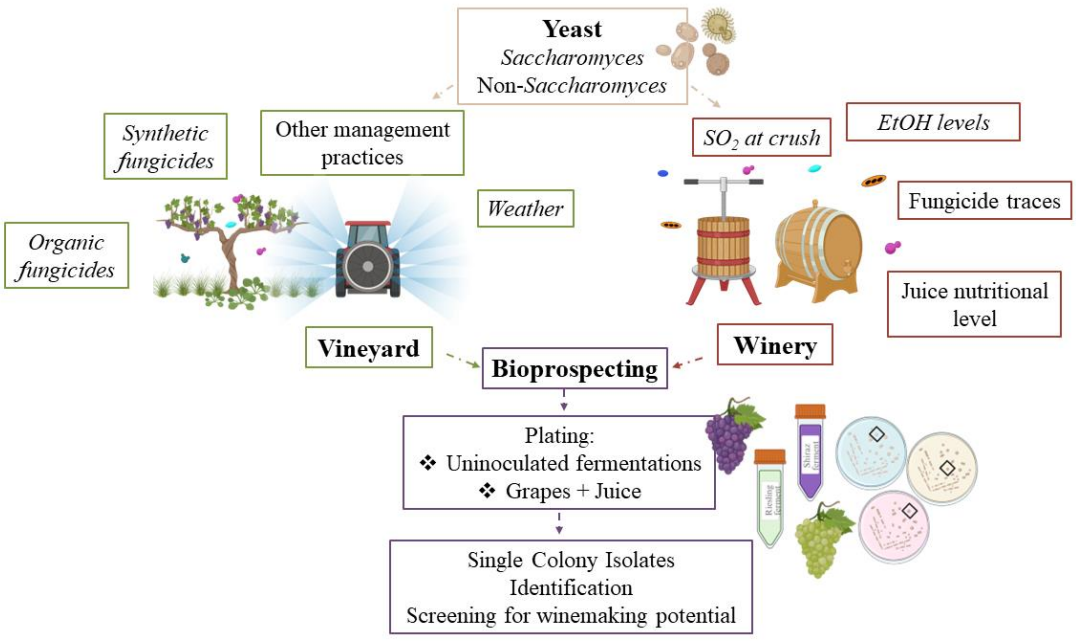

Figure 1: Schematic representation illustrating the interconnected dynamics among yeast, vineyard, and winery, emphasizing the various factors influencing yeast diversity. Bioprospecting within yeast diversity emerges as a crucial tool for unravelling these intricate relationships.

In this context, the main aims of this project were:

- Characterise yeast communities present in biodynamic and conventional Riesling grapes, juice and uninoculated fermentations, and investigate their fungicide tolerance patterns.
- Define yeast communities on unsprayed vs sprayed disease-resistant varieties bred at CSIRO (Australia), along with Shiraz and Grenache from a commercial vineyard.
- Identify yeast strains isolated from Australian vineyards and screen for those with higher ethanol and SO_2 tolerance, studying their volatile compound production in Riesling and Shiraz fermentation.

Key outcomes

- Slight differences in yeast diversity was observed between Riesling biodynamic and conventional juice and fermentations during vintages 2021-2023.
- Unsprayed disease-resistant grapes (CSIRO) did not harbour yeast communities as diverse as expected with *Filobasidium*, *Alternaria* and *Aureobasidium* being the most prevalent fungal genera observed.
- Complex interactions between weather conditions and disease management practices were appreciated during this study.
- Biodynamic and conventional indigenous fungal isolates exhibited similar fungicide resistance to the fungicides used in this study. Nevertheless, it is noteworthy that copper sulfate and copper oxychloride + sulfur exhibited the most toxic effects on yeast, which is crucial for growers planning fungicide spraying strategies.
- Australian vineyards host yeast populations that could be introduced to the wine industry to obtain wines expressing the regional typicity or 'terroir'.

Recommendations

For growers and winemakers:

- Embrace a holistic disease management approach, prioritising preventative measures and integration various tools alongside judicious use of chemical fungicides.
- Integrate the unique yeast strains Australians vineyards harbour into fermentation processes to achieve targeted aroma profiles, enhanced wine quality and typicity, and improved stress tolerance during fermentation.

For researchers:

- Investigate the impact of vineyard chemicals beyond fungicides (e.g., insecticides and herbicides) on the composition and function of microbial communities.
- Investigate the influence of climate change on vineyard microbial populations, especially on what regards to rising temperatures and altered precipitation patterns.
- Integrate research on vineyard microbial diversity with global wine industry practices, fostering a knowledge bridge between microbial communities and global wine production.

What's next?

- Include sensory analyses of uninoculated fermentations and of those conducted using native indigenous yeast strains.
- Investigate the genetic basis of fungicide resistance of non-*Saccharomyces* yeast.
- Evaluate the impact of temperature in fermentations considered with different native *Saccharomyces* and non-*Saccharomyces* yeast species.

Acknowledgements

We would like to acknowledge all the help and support we received from Ms. Louisa Rose, Ms. Brooke Howell and the staff at Hill-Smith Family Estates (https://www.hsfe.com/). We would also like to acknowledge the contributions of Mr Sam Pfeiffer and Mr Adam Hay from Whistler Wines, Dr Ian Dry, Dr Gerhard Rossouw and Mr Roger Maywald from CSIRO from providing with all the samples we requested to run this study. We would also like to thank A/Professor Cassandra Collins, Mr Ben Pike and Dr Renata Ristic from the University of Adelaide, Dr Marlize Bakker from the University of Queensland, and Dr Mariela Assof from INTA Mendoza (Argentina) for their expert advise on how to approach this study and providing insights into data analysis. Additionally, we also make these acknowledgements extensive to Dr Paul Boss and Ms. Emily Nicholson from CSIRO for their help completing the amino acid profiling and quantification of the volatile compound production of the Shiraz and Riesling fermentations conducted in this study.

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Australian Government
Australian Research Council

The ARC Training Centre for Innovative Wine Production is funded by the Australian Government (IC170100008) with additional support from Wine Australia and industry partners.

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