The Australian Wine Research Institute

Strategies to manage high alcohol and stuck ferments

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Stuck/sluggish fermentations

Combination of issues
- Yeast
- Nutrients
- Toxic Substances
- Fermentation conditions

Common seasonal problem
- Exacerbated by hot weather

Impacts
- Ties up resources
- Cost energy
- Quality loss/ product downgrades

Stuck ferments - Vic and Yarra 2016

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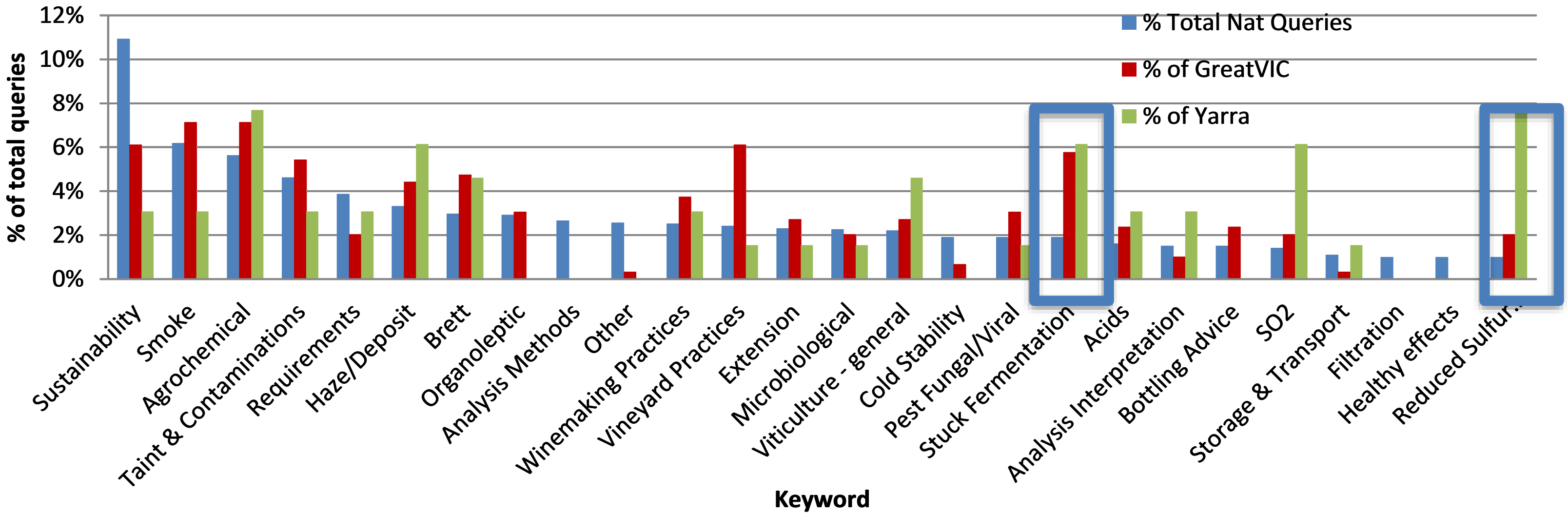
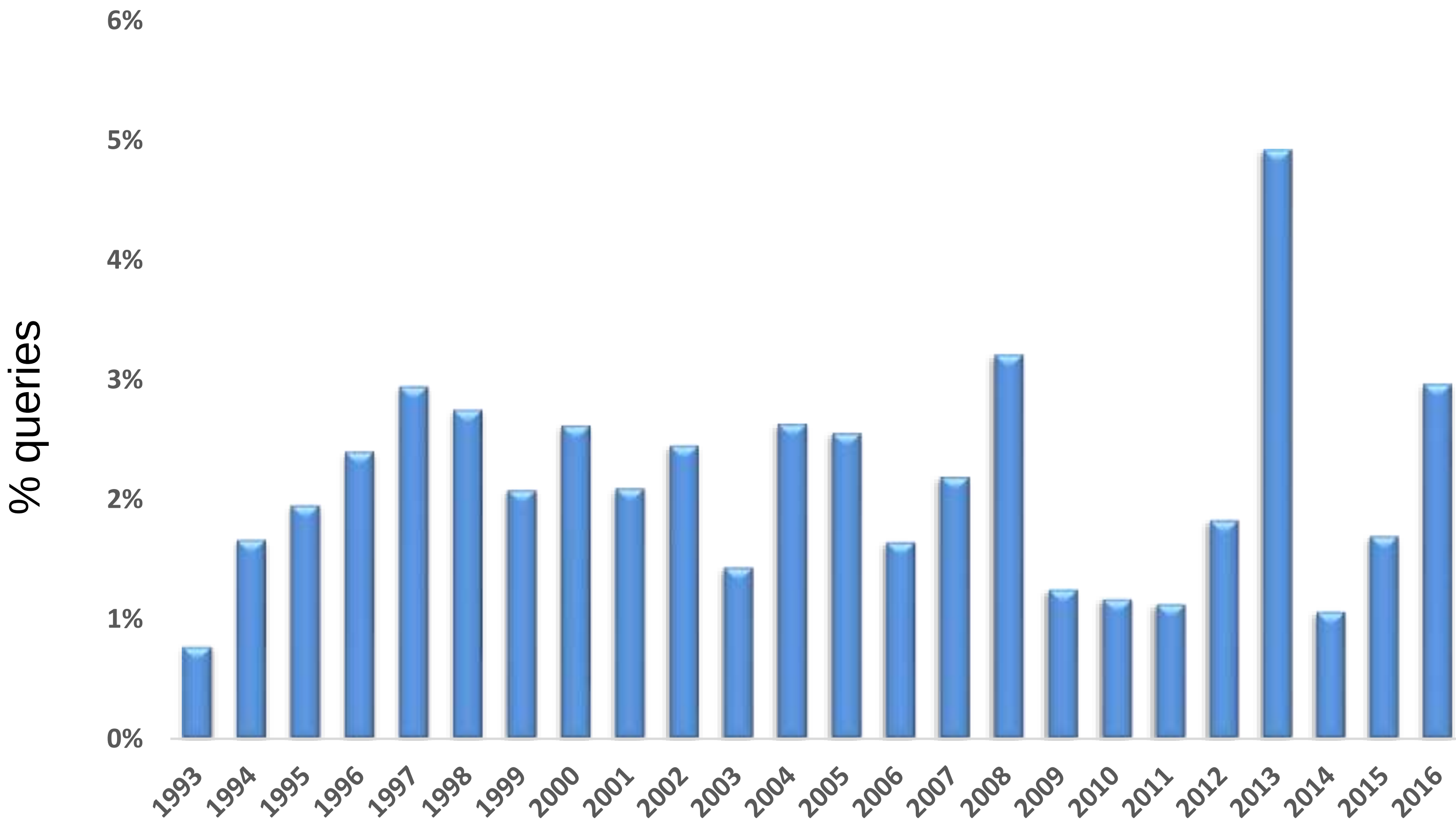
% of Helpdesk queries - National V Greater VIC 2016



- Mostly on trend with national trend (Greater Vic has 15% Total Queries; Yarra 3%) with a few exceptions
- Central and Northern Victoria had greater queries regarding stuck fermentation during 2016 vintage due to the warmest October 2015 on record, that led to an early budburst and harvest and a rapid compressed vintage
- A larger proportion of haze and deposit, Brettanomyces and sulfides issues than usual
- Queries regarding smoke taint regarded smoke drift from Tasmanian Fires and wines affected by 2015 fires
- Less businesses have been involved with Entwine/Sustainability

Helpdesk ‘stuck fermentation’ queries



Stuck ferments occur early in hot/high yield years

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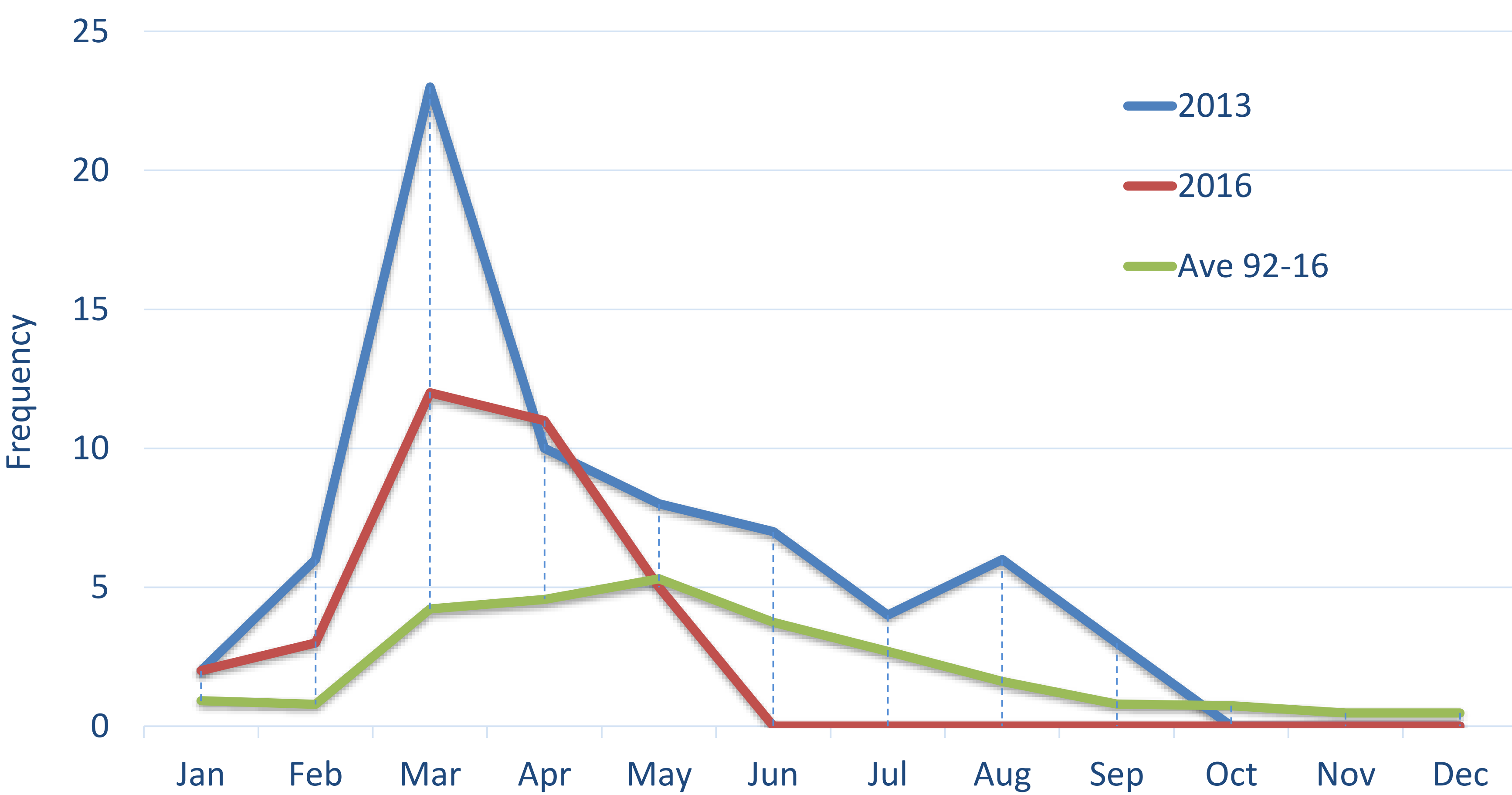
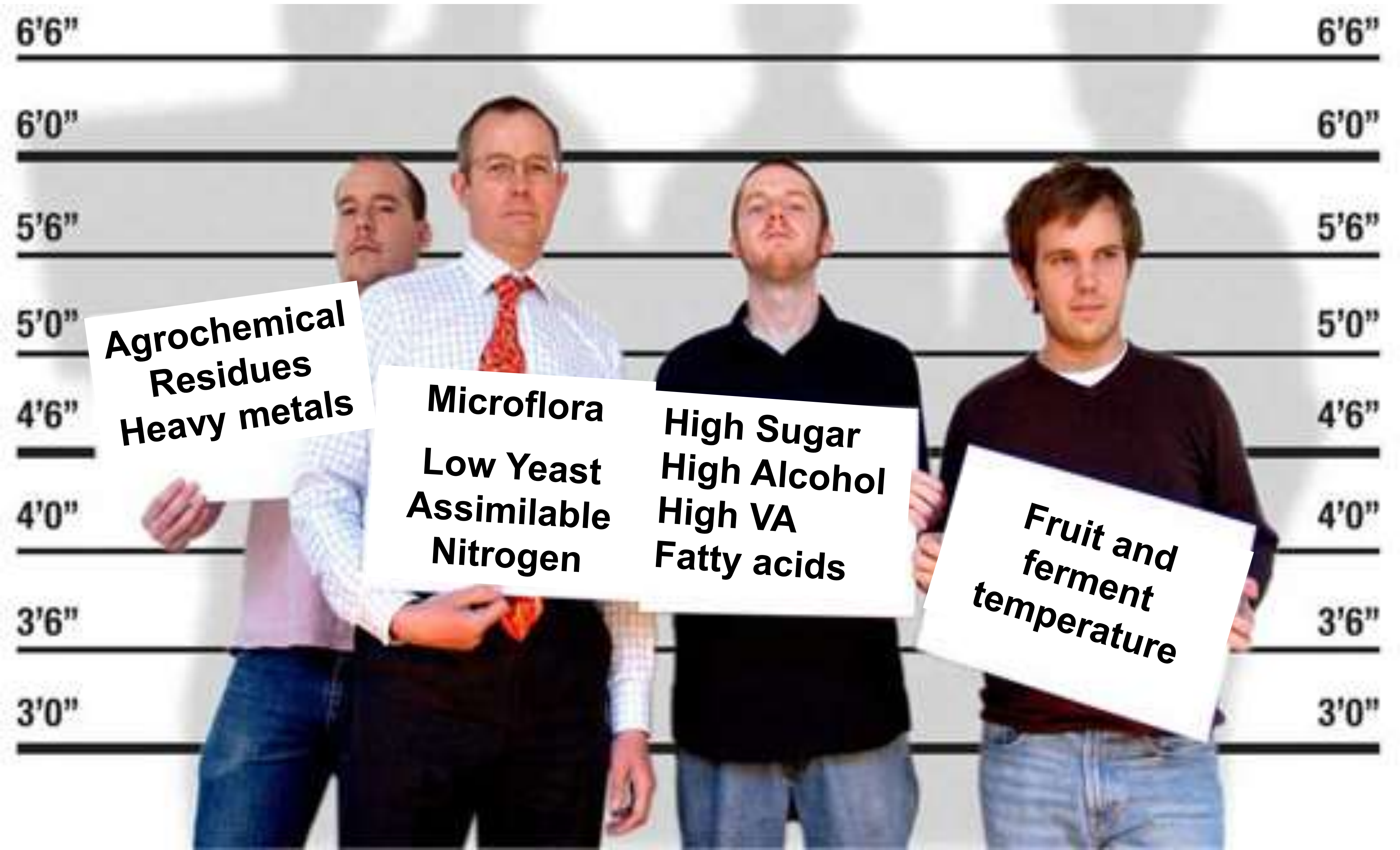


Stuck fermentations – Main ‘micro’ causes



Agrochemical residues

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- Agrochemicals breakdown quickly
- Zn, Mn, Cu, S – agrochemical residue breakdown products
- Elevated levels of sulfur or metal ions usually regarded as a problem in the fermentation process[1]

Individually might only make fermentation lag, but together can lead to stuck ferment

1. Azenha, M., Vasconcelos, M. T., & Moradas-Ferreira, P. (2000). The influence of Cu concentration on ethanolic fermentation by Saccharomyces cerevisiae. *Journal of bioscience and bioengineering*,*90*(2), 163-167.

High temperature and high microbial load

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- Damaged berries: berries split due to dehydration, or leakage of sugar from the berries due to loss of turgidity
- can expect higher than usual microbial load

Indigenous Microbiological growth

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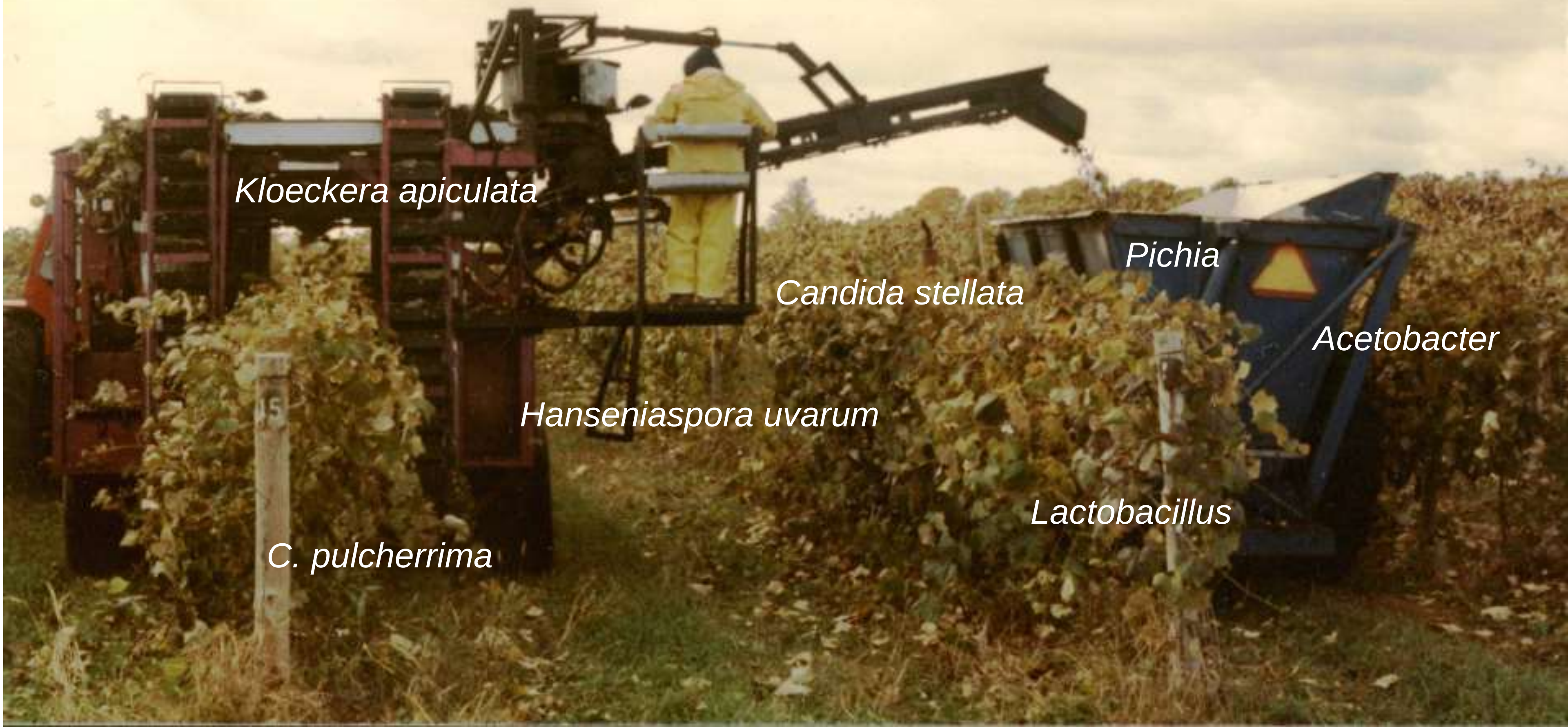
- Mechanical harvesting causes further damage of the fruit
- stimulates further growth of indigenous microorganisms during transport to the winery, unless preventative action is taken



Native microorganisms

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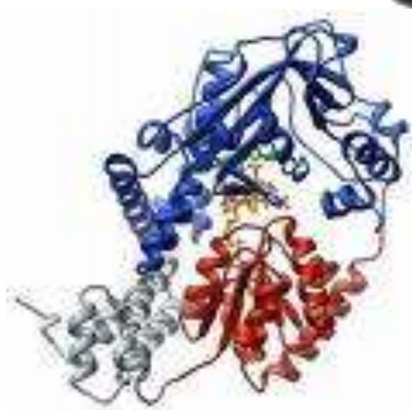
- ❖ Increased toxins
- ❖ Depleted nutrients

❖Cover bins to
↓ heat/light

❖ Clean grape bins between loads

SO_2



❖ Lysozyme

- Kills LAB, but not yeast, AAB

Acid at hopper

Prepare a healthy yeast culture

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- Re-hydration medium:
  - Mineral water/rain water/clean tap water (remove Chlorine)
  - Mineral water with grape sugar
  - Diluted preservative-free (SO_2) grape juice (sterile)
  - Proprietary nutrients (inactive yeast) for difficult musts
- Temperature - 38-40° C
- Stand 15-20 min
- Lower temp/Add grape juice
- Stand 15-20 min, repeat
- Add to tank at similar temperature

Correct

Incorrect

Shelf life ~2 years

Yeast storage ~4ºC

Nitrogen availability affects fermentation kinetics

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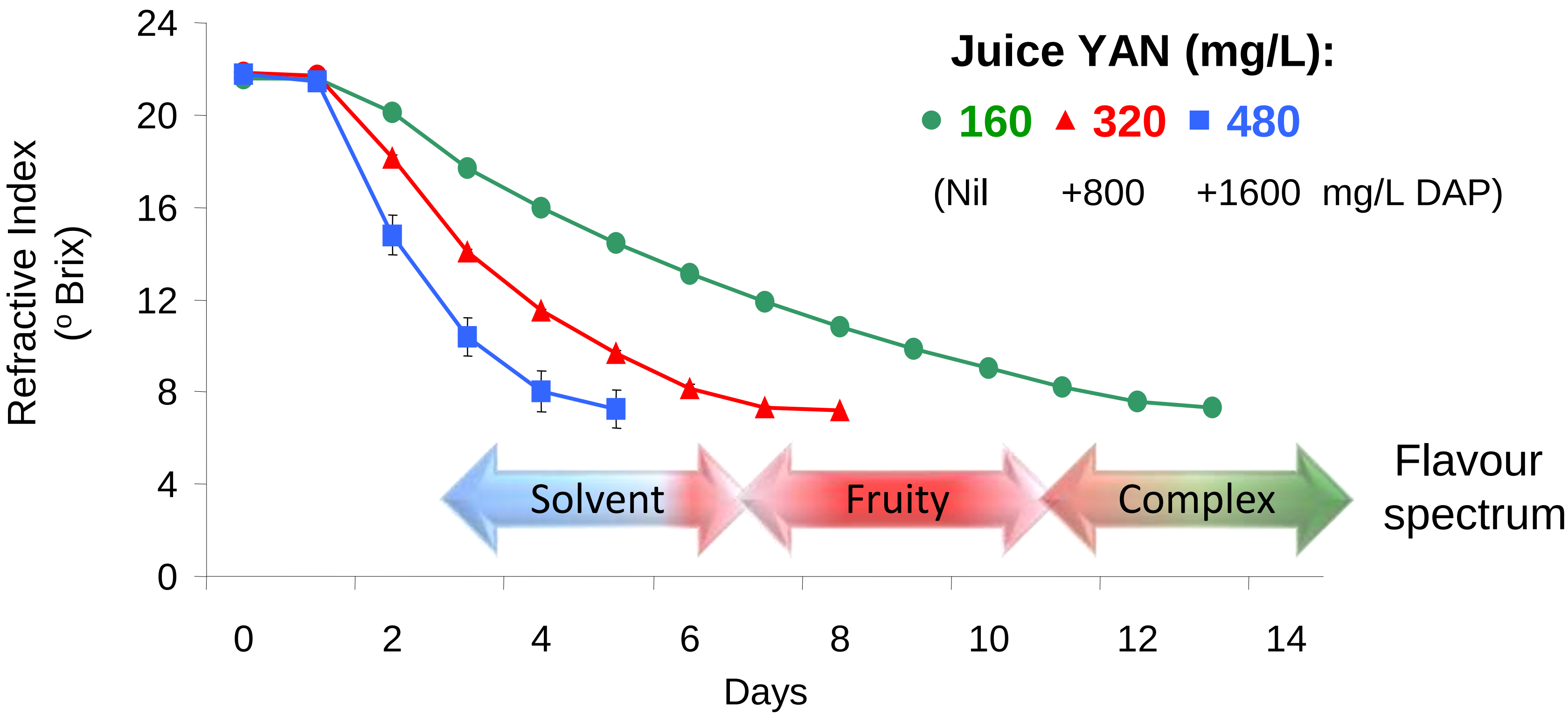
Chardonnay (filtered), Yeast: AWRI 796, 18°C



Torrea, D et al (2011) Food Chemistry **127**, 1072–1083.

YAN requirement

Minimum YAN requirement

Whites – approx. 150 mg/L

Reds – approx. 100 mg/L

Optimum flavour/prevent H2S

Whites – approx. 250–350 mg/L

Reds – approx. 250 mg/L

Fermentation response to Oxygen & Nitrogen

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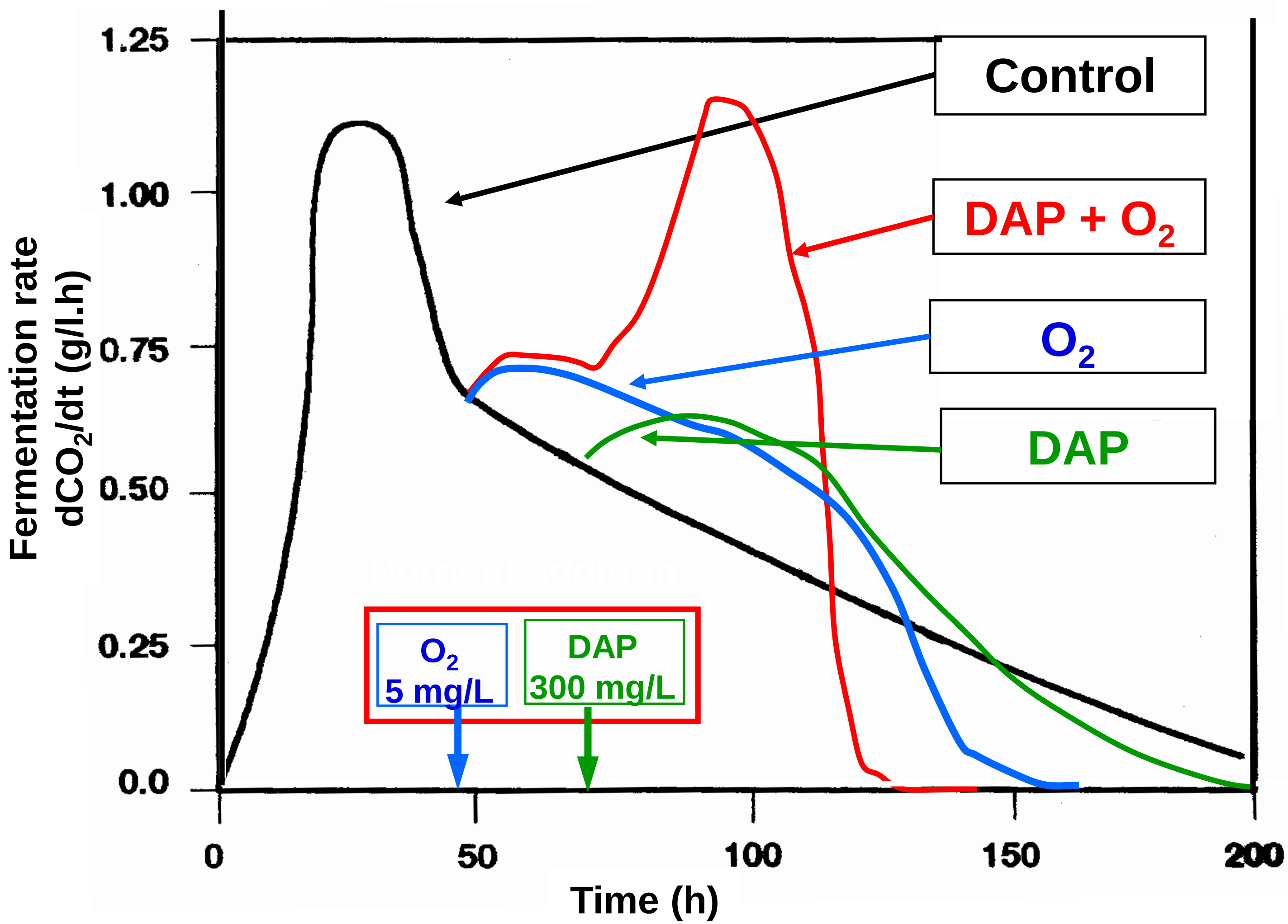
Nutrient strategy for reinvigorating fermentation



(**Sablayrolles, Dubois,** Manginot & Barre 1996 *J. Ferment. Bioeng.* 82:377-381)

Toxins – VA decreases fermentation rate

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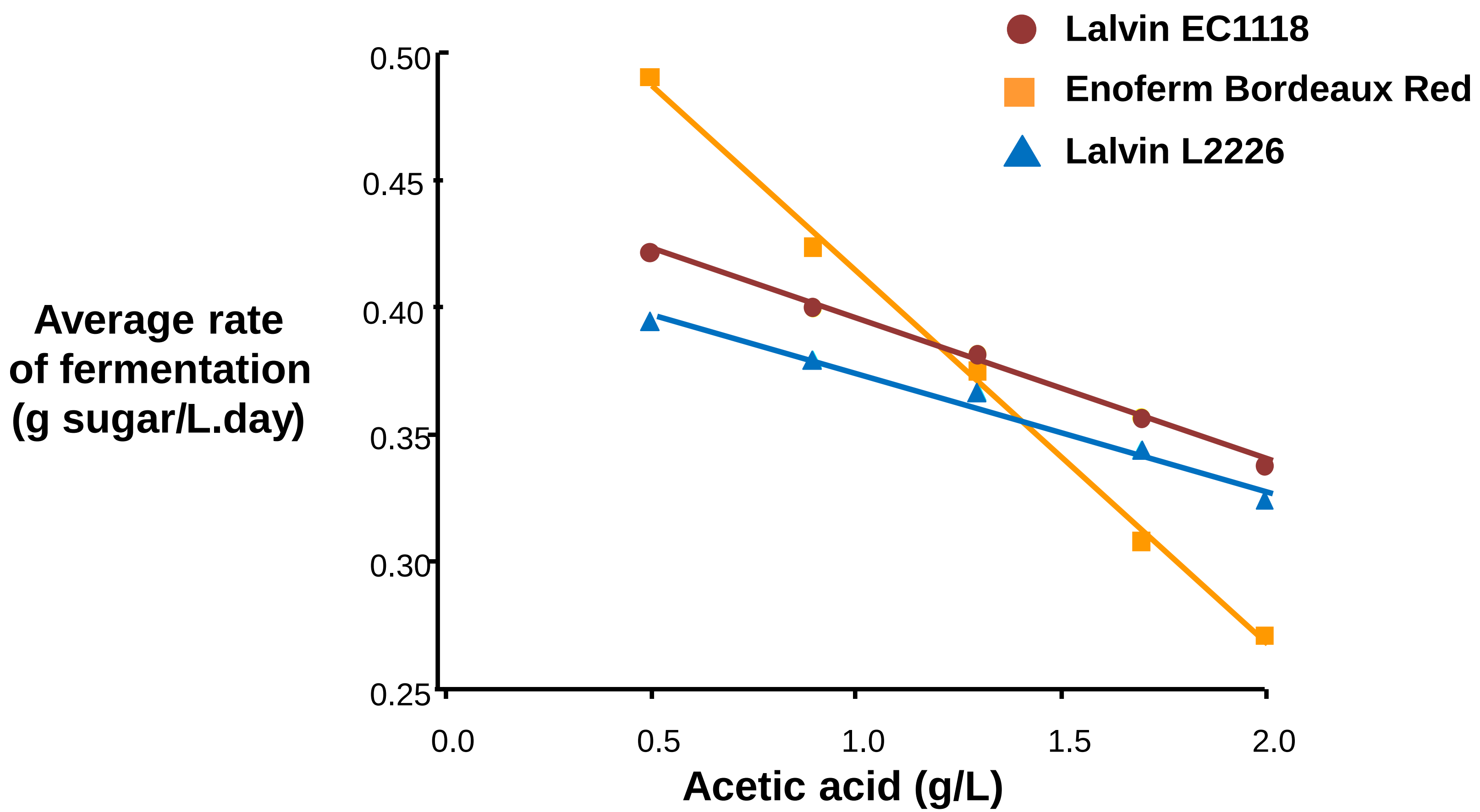
- Effect of acetic acid concentration



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Agitation aids fermentation

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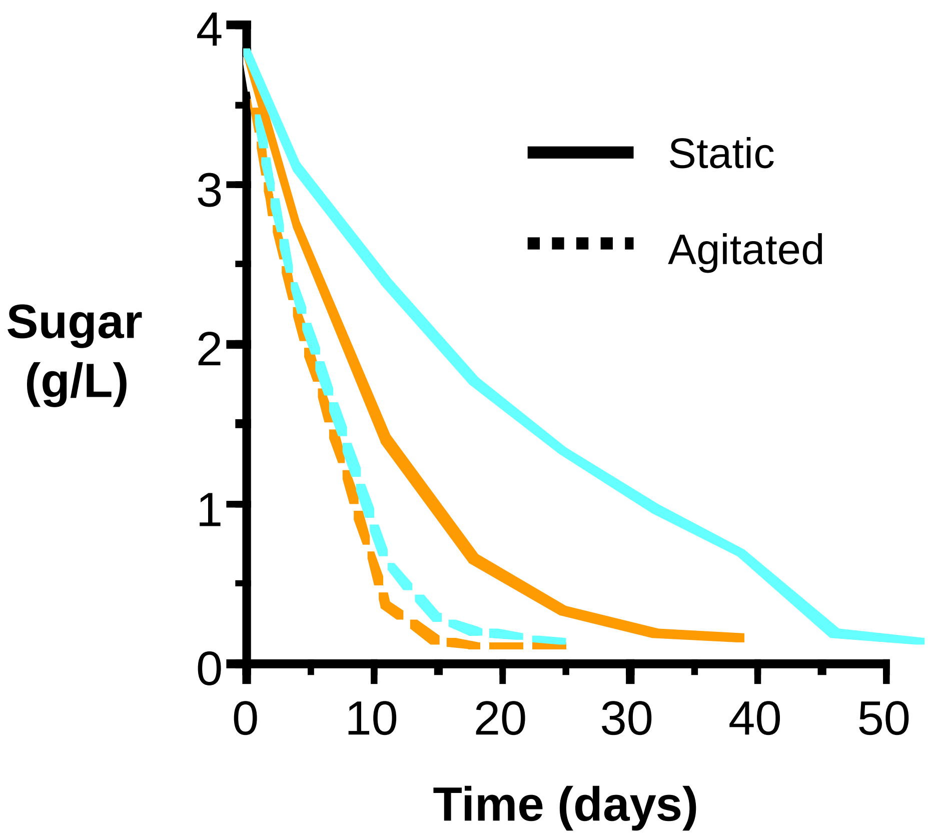

- Ferment CO_2 keeps yeast in suspension and assists fermentation circulation
- Yeast sedimentation occurs in low vigour ferments
- Physical stirring can help prevent sedimentation

Eglinton & Henschke (1999) *Aust. J. Grape Wine Res.* 5:71-78

Fermentation temperature stress

- Chill hot juice before inoculation
- Start ferments at “warm” temps to facilitate acclimatization
- Avoid excessive temperatures (>32°C especially towards end of fermentation)
- Excess cooling or heating using heat exchangers (keep within 5°C range)

Stuck ferments - Choice of rescue procedure

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If ferment stops with <10 g/L residual sugar and the alcohol content is <12 % v/v:

- **Then recommend**
  - Starter culture in grape juice with a recommended yeast
  - Or fresh yeast lees from active ferments
- **Otherwise**
  - Rack off existing yeast lees
  - Use a rescue culture prepared by stepwise acclimatisation of a recommended rescue yeast
  - This procedure builds tolerance to the toxic substances present in the problem ferment

How can you reduce alcohol in the winery?

Winemaking practices

- Remove sugar
- Dilute sugar /add water

Yeast

- Use inefficient yeast
  - *S. cerevisiae*
  - Non-*Saccharomyces*
- Convert sugar to something else
  - Isolate new yeast
  - Make new yeast

Fermentation practices

- Evaporate alcohol

Post-fermentation technologies

- Remove alcohol

Water addition to prevent ferment issues

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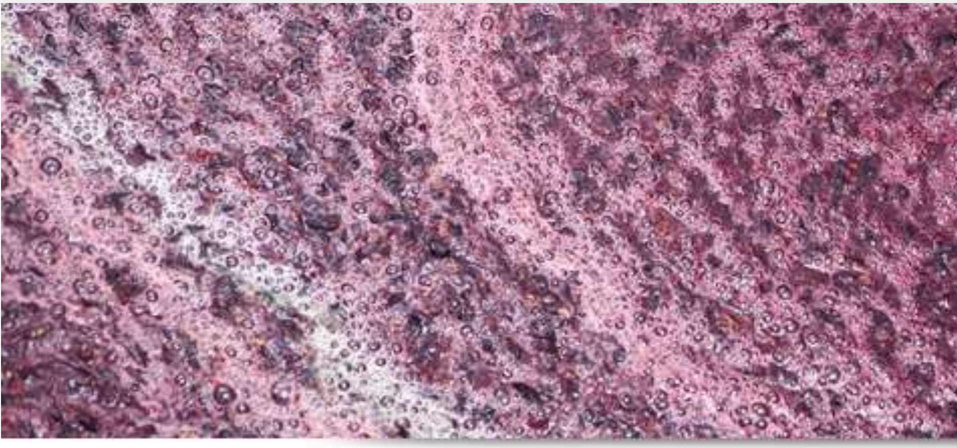

THE AUSTRALIAN WINE RESEARCH INSTITUTE > EBULLETIN > CHANGE TO FOOD STANDARDS CODE REGARDING AI

EBULI

« TECHNICAL REVIEW FEBRUARY 2017 ISSUE AVAILABLE ONLINE

Change to Food Standards Code regarding addition of water to high sugar must/j

On 9 February, an amendment was made to standard 4.5.1 of the Australia New Zealand I
sugar must and juice to reduce the chance of problems arising during fermentation.
The original application was made by the Winemakers' Federation of Australia following ex
view of removing the ambiguity as to when water additions are permitted under the FSC.
The amendment establishes that water *may* be added to grape juice or must to reduce th
This is in addition to the maximum 70 mL/L currently allowed under the FSC to allow the i
to the winemaking process.
Notwithstanding the above, additions of all permitted additives and processing aids, incluc
added being the very minimum required to achieve the desired effect.
The change will ensure that Australian winemakers are able to ameliorate the sugar level c
faults.

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RESEARCH & DEVELOPMENT | SERVICES TO INDUSTRY | COMMERCIAL SERVICES | ABOUT THE AWRI

THE AUSTRALIAN WINE RESEARCH INSTITUTE > SERVICES TO INDUSTRY > WINEMAKING > WINEMAKING CALCULATORS AND APP > WATER ADDITIONS

WATER ADDITIONS

Suggestions / questions / comments? email the calculator services staff

WHITE JUICE/MUST

Initial volume of juice/must		L
Initial Baumé of juice/must		°Bé
Desired Baumé after dilution		°Bé

CALCULATE LITRES OF WATER

Volume of water to be added		L
Volume of final blend		L
Percentage dilution		%

RED JUICE/MUST

Initial weight of Must in tank		Tonnes
Expected volume extracted per Tonne Fruit		L
Initial Baumé of juice/must		°Bé
Desired Baumé after dilution		°Bé

CALCULATE LITRES OF WATER

Initial volume of juice/must		L
Volume of water to be added		L
Volume of final blend		L
Percentage dilution		%

Practical considerations

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- Red musts should use an appropriate juice extraction rate (eg 0.8)
- Ensure the tank has the capacity to take extra volume post addition
- Water can be added by measuring the tank dip pre- and post-water addition or by flow meters if available
- Ameliorated must should be mixed thoroughly
  - re-analysed to obtain a starting Bé/Brix, pH and titratable acidity
  - Make any adjustments on this data not the initial juice parameters
  - Option of adding acidified pH 3.5 water
- Water should be added using food grade hoses and equipment

ask the AWRI

Adding water to high sugar must

In February, an amendment was made to the Australia New Zealand Food Standards Code (FSC) to allow limited addition of water to high sugar must and juice to reduce the chance of fermentation problems. Previously water had not been allowed as a direct additive to grape juice, must or wine, with a maximum (cumulative) addition of 70 mL/L water allowable only for the incorporation of permitted additives or processing aids during the winemaking process.

How much water can be added?

Water may be added to juice or must to reduce the sugar level to no less than 13.5° Baumé (Bé) (equivalent to 24.3°Brix). This means that the amount of water allowed will depend on the initial sugar level of the juice or must. An additional 70 mL/L (7%) of water can then also be added to incorporate additions.

How can I calculate how much water to add?

While sugar levels in juice or must are usually measured as Bé or Brix, these measures represent density of the must rather than actual sugar concentration. In addition, because the density of must changes with the amount of solids present, the conversion between Bé or Brix to g/L sugar is not linear; that is, the conversion factor changes with the Bé of the must. This means that calculating the amount of water needed to decrease the Bé to a particular value is not as simple as one might think. As such, the AWRI is working on a water addition calculator, which will be accessible via the AWRI Winemaking Calculators App or from the calculators page on the AWRI website. (https://www.awri.com.au/industry_support/winemaking_resources/calculators/)

Are there risks associated with water additions?

Chlorine and chlorophenol taints

Mains/potable water is often treated with chlorine, chlorine dioxide, chloramines, ozone and hydrogen peroxide, combinations of these and other minor disinfectants. Chlorination is used in metropolitan areas and chloramines are more commonly used in regional areas where the water has longer to travel. Information about the disinfectants and levels used in local mains water can be sourced from local water authorities. Chlorine-containing disinfectants have potential to introduce chlorine-like or chlorophenol taints into treated must.

Olaf Schelezki webinar

The Australian Wine Research Institute

https://www.awri.com.au/industry_support/courses-seminars-workshops/webinars/

How can you reduce alcohol in the winery?

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Winemaking practices

- Remove sugar Nanofiltration
- Dilute sugar /add water

Yeast

- Use inefficient yeast
  - *S. cerevisiae*
  - Non-*Saccharomyces*
- Convert sugar to something else
  - Isolate new yeast
  - Make new yeast

Fermentation practices

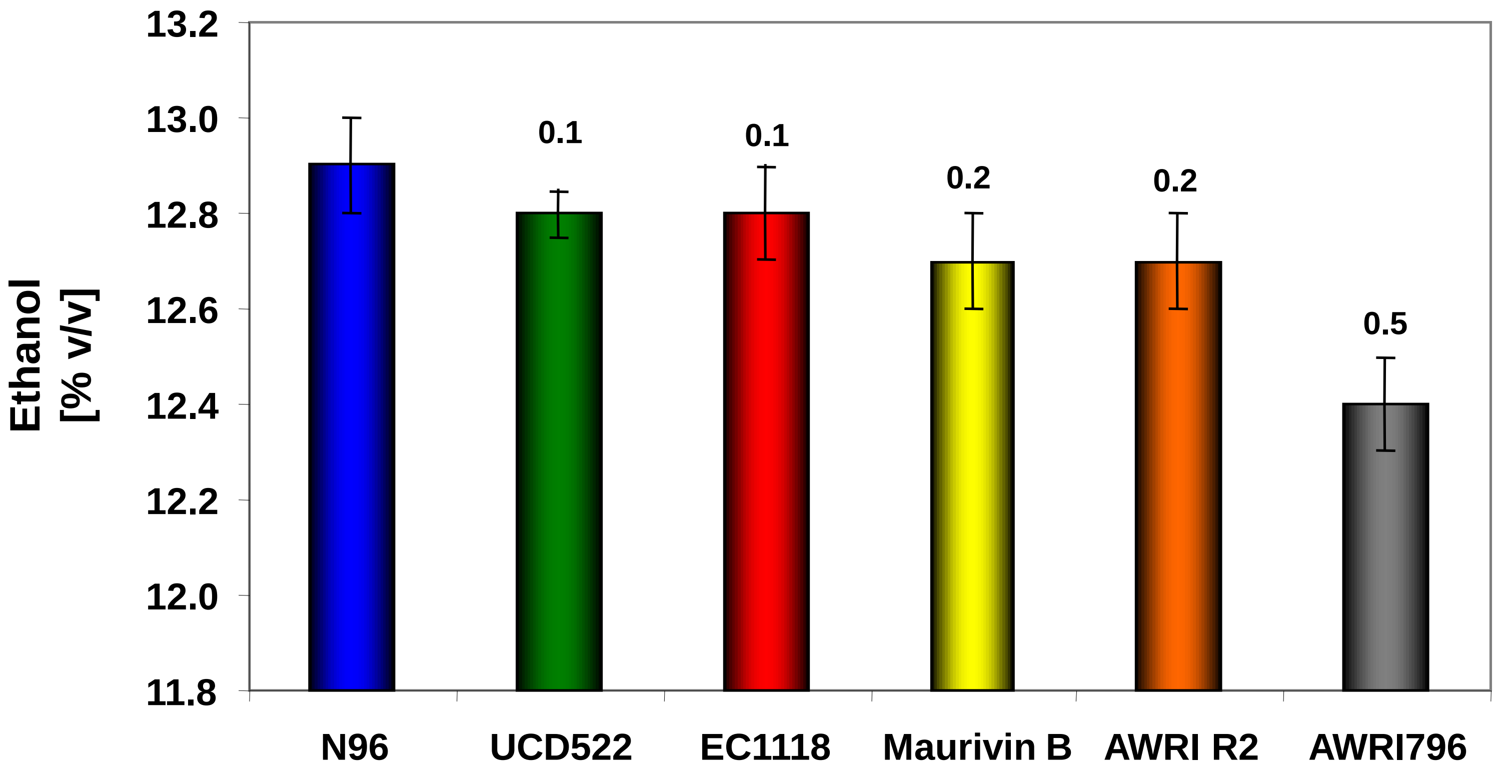
- Evaporate alcohol

Post-fermentation technologies

- Remove alcohol

Choose a low alcohol producing yeast

Existing fermentation efficiency variation between wine yeasts

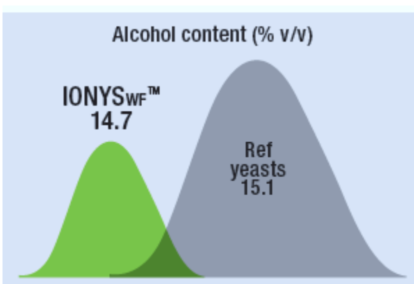


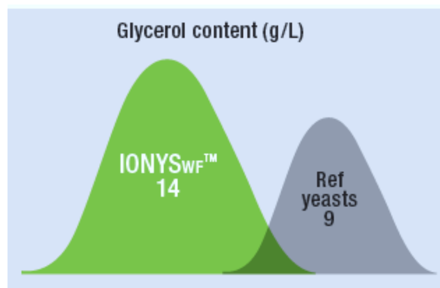
Yeast (e.g. 796) to ensure complete fermentations with high baume fruit

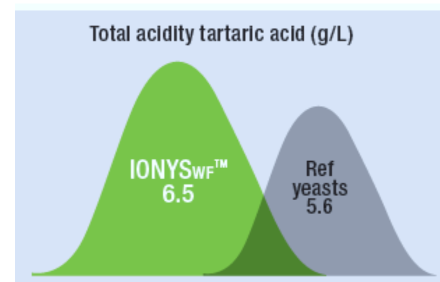
Novel *S. cerevisiae* yeast strains produced

IONYS$_{WF}$™ obtained by adaptive evolution in Montpellier, France
Commercialised by INRA France and Lallemand 2017

Decreases ethanol and increases glycerol and acidity



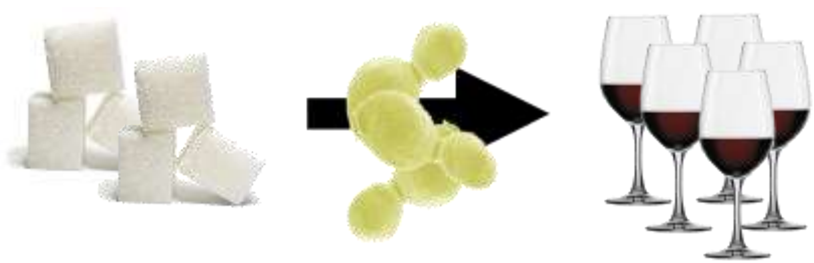




Difference observed:
0.4 % v/v to 0.8 % v/v

* average results from over 30 French wineries, figures and data from Lallemand technical datasheet

Sequential inoculation



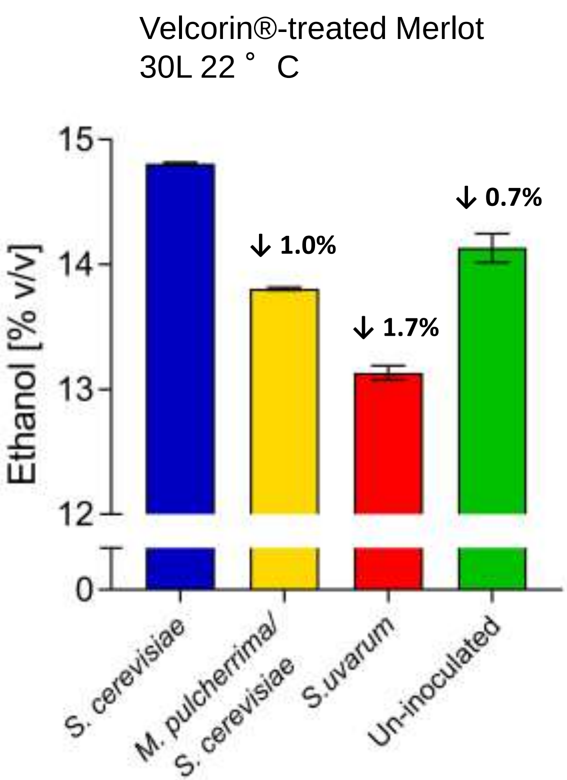
S. cerevisiae

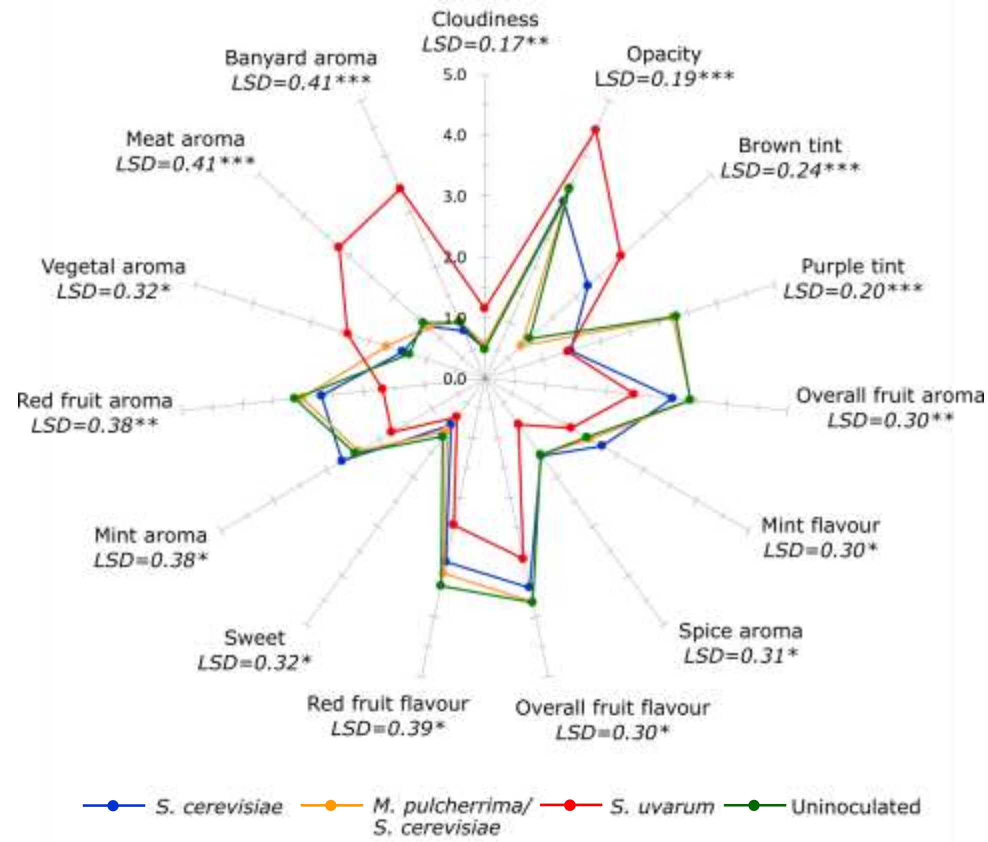
Non-*Saccharomyces*
Eg Metschnikowia pulcherrima

Lallemand Flavia

S. cerevisiae

Pilot-scale trials – sensory profile





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Fermentation practices

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Post-fermentation technologies

- Remove alcohol

Evaporation of alcohol

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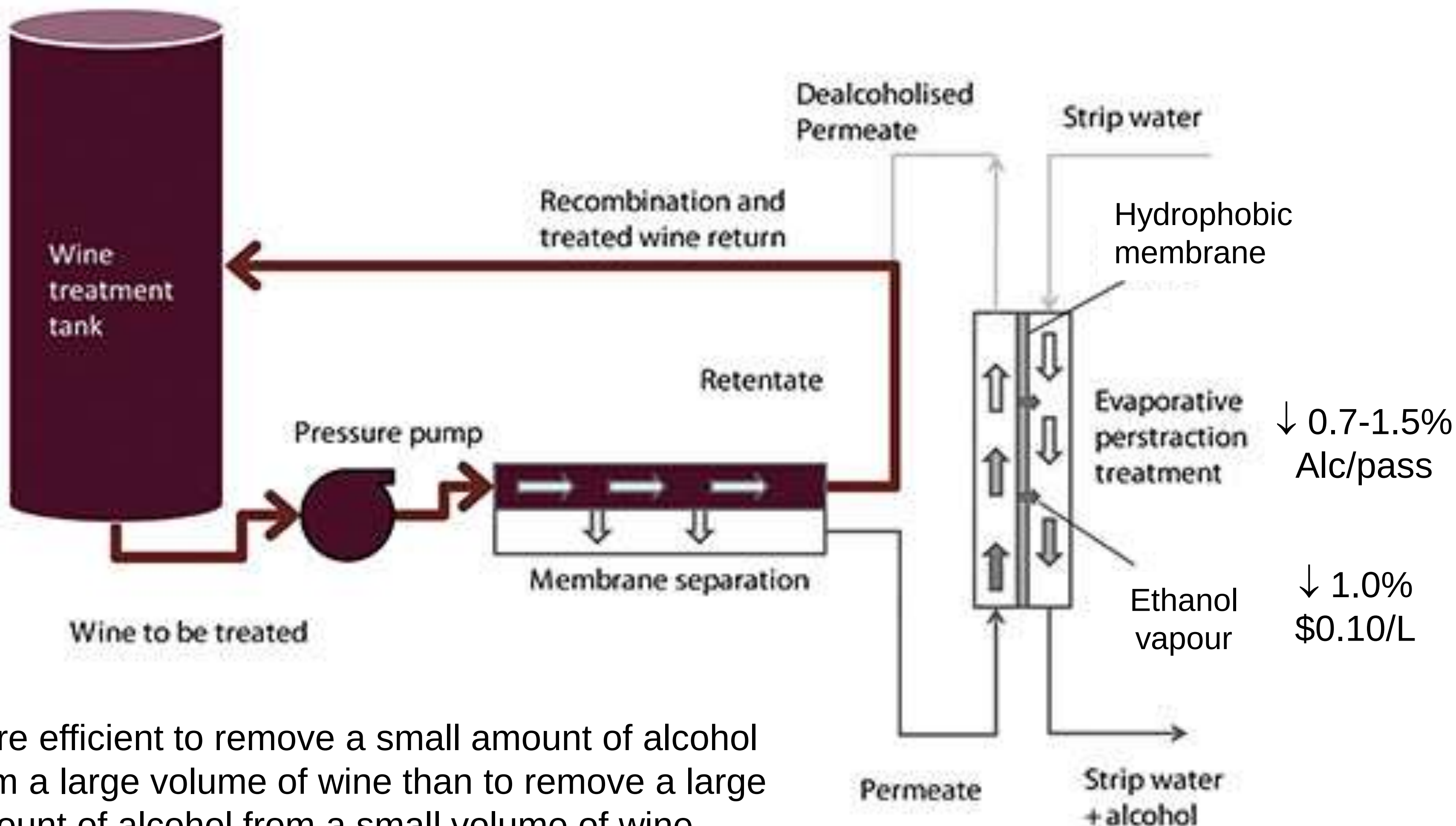
Open top fermenters
Warm ferments

Humidity > 70% ↑ ethanol loss
0.2% after 12mths at 90% humidity

Reverse osmosis + evaporative perstraction



- more efficient to remove a small amount of alcohol from a large volume of wine than to remove a large amount of alcohol from a small volume of wine (Wollan 2010)

Further information – AWRI.com.au

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WINE FERMENTATION

This page provides information on preparation of juice and wine for primary and secondary fermentation, preparation of yeast and bacteria cultures and inoculation, calculators and graphing tools for monitoring fermentation performance, and restart procedures for stuck fermentations.

PRIMARY FERMENTATION

Yeast and must preperation

- Active Dry Yeast (ADWY) rehydration procedure
- Optimal conditions for a successful yeast culture
- Yeast Assimilable Nitrogen (YAN)
- Diammonium phosphate (DAP) addition calculator

Stuck primary fermentation management

- Procedure to rescue or restart a slow or stuck fermentation
- AWRI's 12 top tips for low risk wine fermentation and processing
- Heatwaves and stuck fermentations
- Botrytis-infected fruit and fermentation management
- What are the impacts of elemental sulfur residues on fermentation?

SECONDARY FERMENTATION/MALOLACTIC FERMENTATION (MLF)

- MLF influence on wine style
- MLF Coinoculation
- MLF eBook

Stuck MLF fermentation management

- Procedure to restart a stuck malolactic fermentation (MLF)
- MLF Information Pack

Fermentation Monitoring

- Electronic fermentation graphing tools -plot Temperature & Baume or Brix result/hr
  - Baume
  - Brix
- AWRI Fermentation Simulator a spreadsheet-based tool for monitoring & predicting fermentation performance
- Yeast cell counts
- Microbiological plating for viable yeast

Acknowledgements

The Australian Wine Research Institute

AWRI staff and students

Wine Australia for Australian Wine