Novel sparkling winemaking technologies and visualising yeast autolysis

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TIA is a joint venture of the University of Tasmania and the Tasmanian Government

Background

- Complexity in sparkling wine is derived from viticultural practices, base wine composition, winemaking practices and wine maturation (Jones et al., 2014; Kerslake et al., 2013)
- Sensory cues not well understood, distinguished or agreed upon
- Wine Australia priority to identify important compounds contributing to flavour, mouth feel and texture of sparkling wine character

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Autolysis

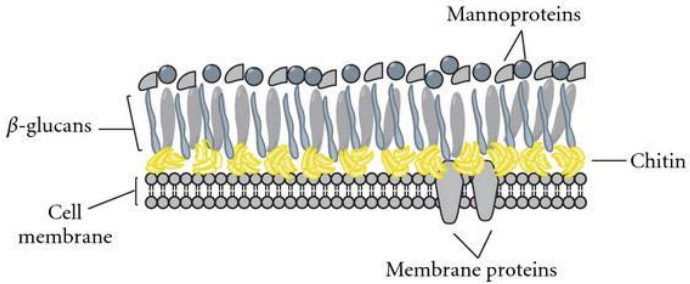
- Enzymatic degradation (hydrolysis) of yeast cell constituents after cell death

Yeast cell structure

- Cell wall mannoprotein, glucan
- Amino acids, Proteins, Peptides

Wine quality

- Yeast cellular components released in wine
- Autolytic character develops slowly



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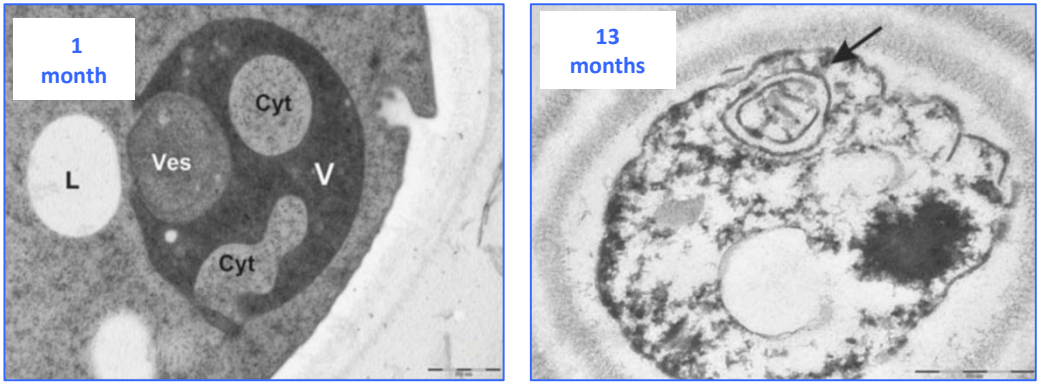
Scientific research

– Changes occur in the lees structure as wine ages



(Tudela et al. 2012)

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Research question & objectives

- Can alternative methods be implemented to artificially induce yeast lysis in sparkling winemaking?
- Application of novel technologies (ultrasound, microwave, enzymes) to break down yeast cells
- Shorter ageing period on lees with developed characteristics for earlier release
- Visualise cell level impact associated with novel-treated lees

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Tasting wine produced using novel technologies

- Participants taste the five different sparkling wines presented
- Make some notes to record impressions of the wines

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Industry trial application

- Hill-Smith Family Vineyards Yalumba, Adelaide
- Saccharomyces cerevisiae IOC 18-2007
- Chardonnay base wine
- Winemaking treatments applied:
  1. Standard tirage wine stored at 15°C (control)
  2. Ultrasound
  3. Microwave
  4. Enzyme
  5. Standard tirage wine stored at 25°C

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Winemakers tasting results

- Sparkling wine at 12 month period (disgorged)

Sparkling Wine Maturation	
Samples	5 treatments
Evaluation	One day
Replicates	3 flights
Scale	20 points, +10 to -10
Assessors	Sparkling winemakers
Assessment Criteria (compared to a control wine)	Autolytic Nutty Toasty Honey Spicy Earthy

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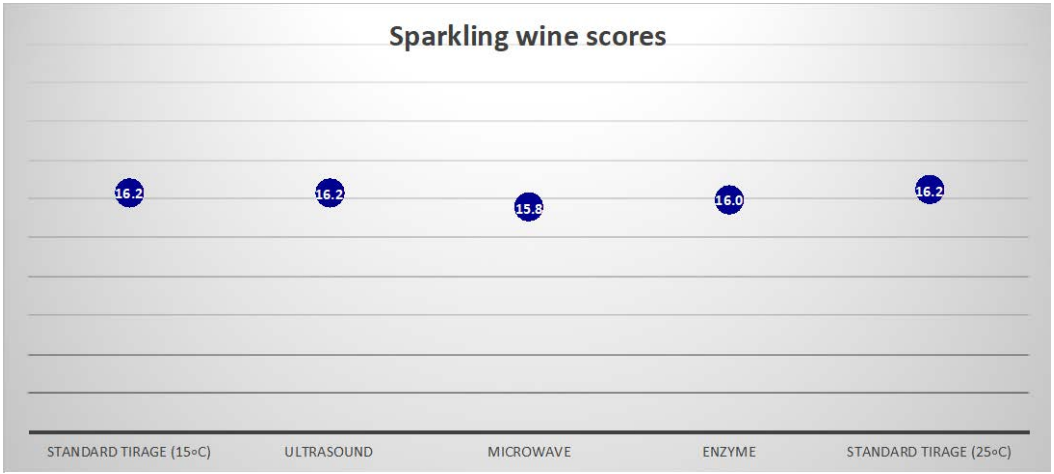
Winemakers tasting results



- Average wine show scores for three flights
- The treatment wines exhibit similar scores to the control

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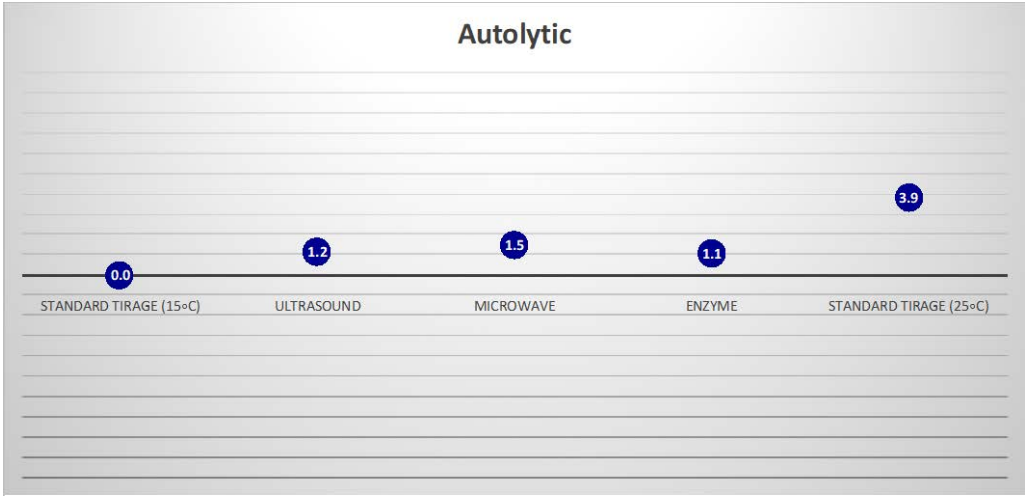
Winemakers tasting results



- The 25°C treatment is more autolytic compared to the control
- Autolytic character is present in the treatment wines

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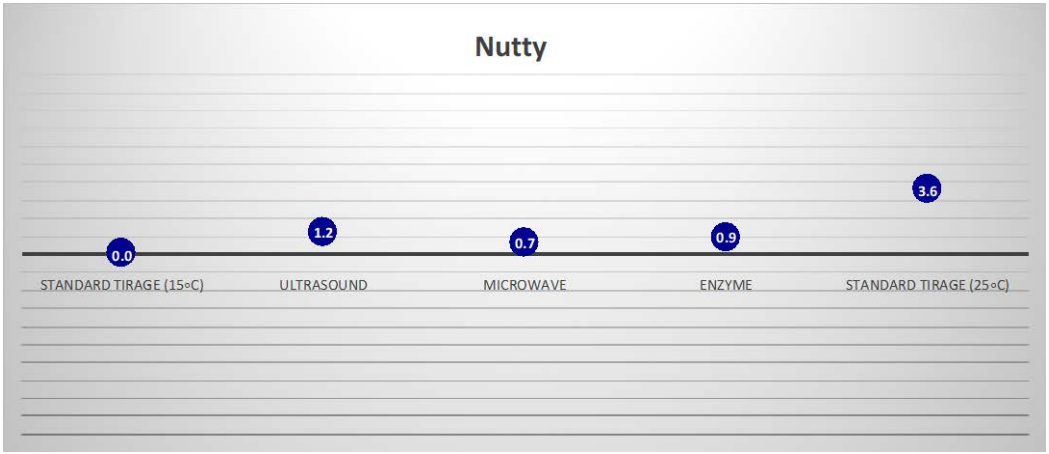
Winemakers tasting results



- The ultrasound and 25°C treatments are perceived as more nutty compared to the control wine

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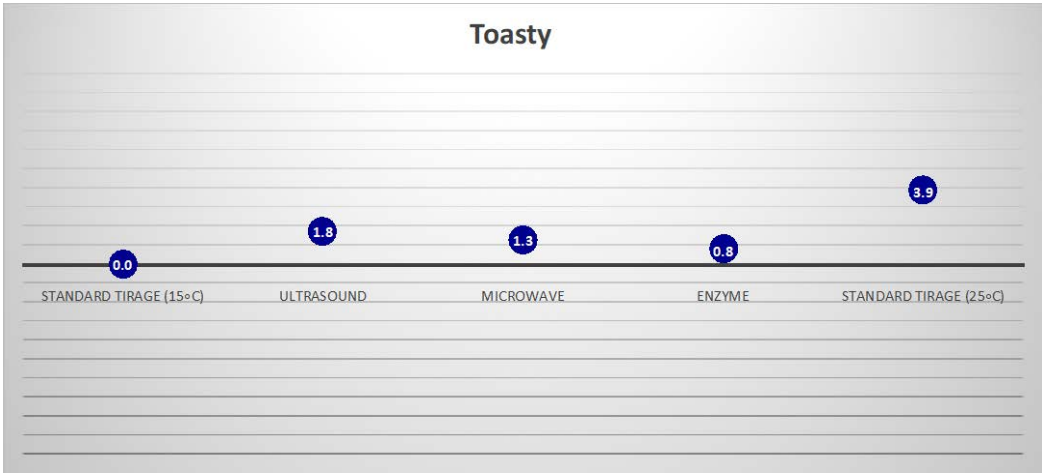
Winemakers tasting results



- The 25°C treatment exhibits a more toasty character compared to the rest

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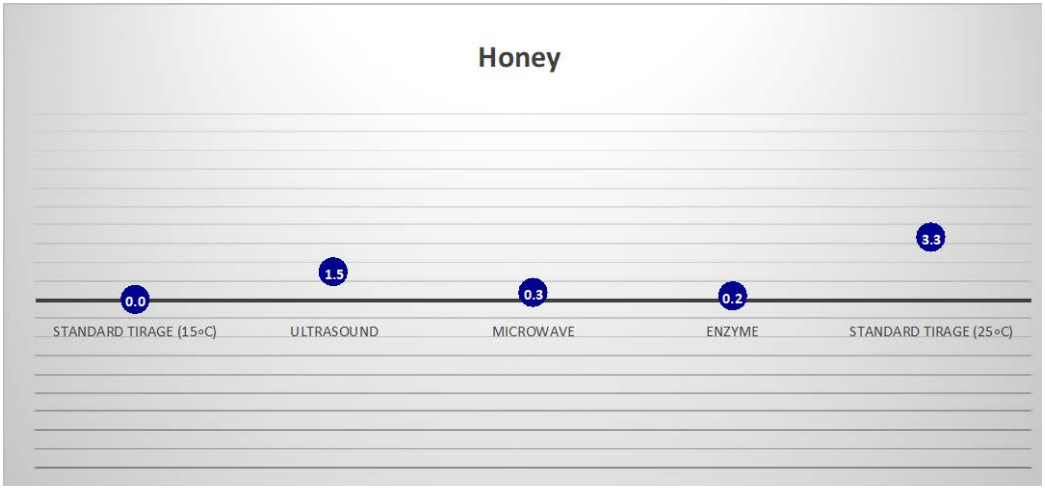
Winemakers tasting results



- The honey character is most perceived in both the ultrasound and the 25°C treatments

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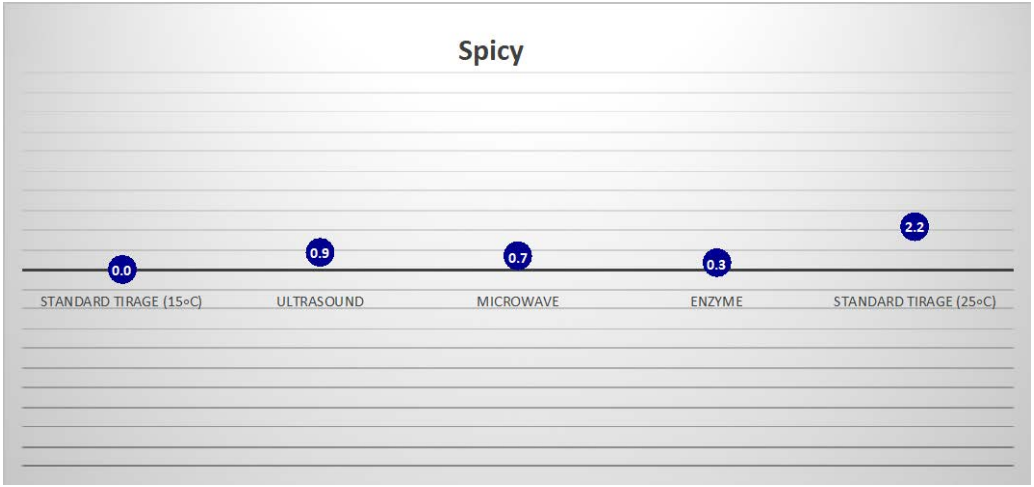
Winemakers tasting results



- The spicy character is perceived more in the 25°C treatment

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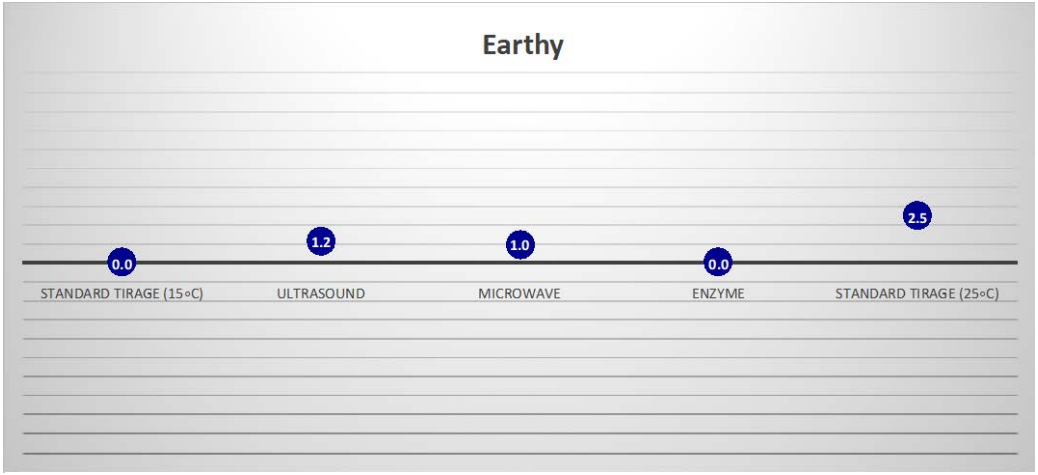
Winemakers tasting results



- The earthy character is perceived more in the 25°C treatment

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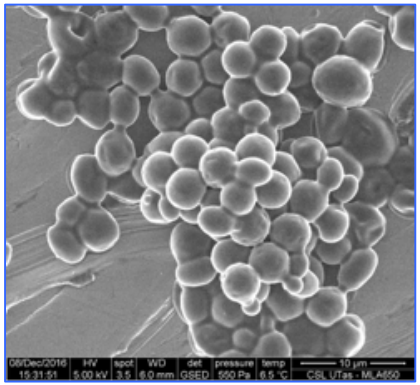
Visualising autolysis

- UTAS CSL ESEM (FEI MLA650, 5kV, 5°C, 0.1 mL sample)
- Impact on saccharomyces cerevisiae lees with wine maturation

Control untreated yeast



- Budding cells are primary growth features
- A smooth and uniform cell appearance

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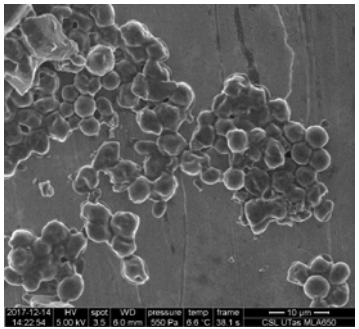
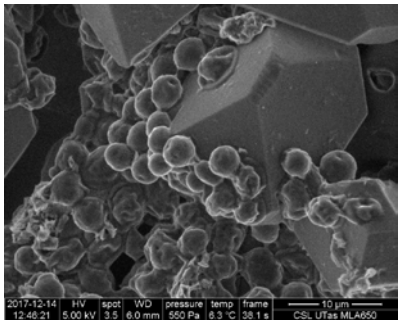
Visualising autolysis features on wine yeast

- Adjuvant impedes the clear visualisation of yeast cell surfaces
- Impact features observed on external cell surfaces
- Cells exhibit cavitation, indentation, breakage, shrinkage

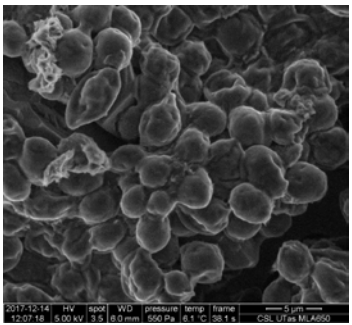
Enzyme



Ultrasound



Microwave



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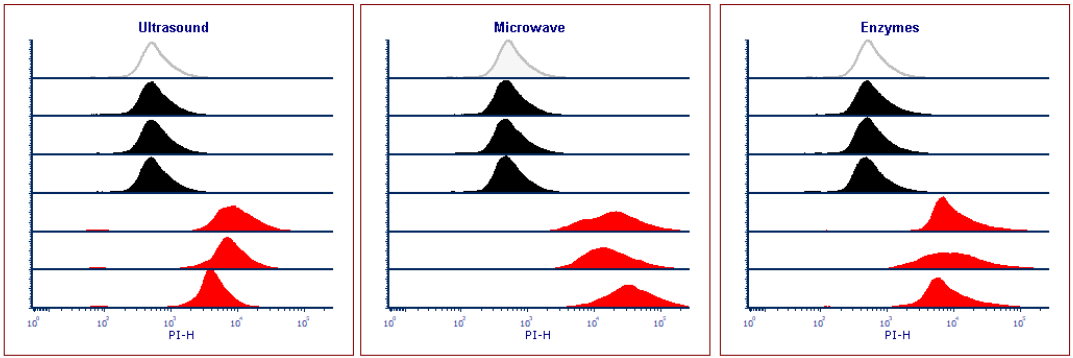
Cell viability

- Cell viability measured using flow cytometry and PI staining
- Damaged cells absorb Propidium Iodide (PI)
- Quantify impact on lees (lysis) with wine maturation



Untreated cells

Treatments applied

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Conclusions

- Treatment wines perceived as more autolytic than control wine at 12 months
- Standard tirage wine stored at 25°C exhibit a greater autolytic character
- Bevscan analysis discriminate the 25°C treatment from the others
- SEM visualisation of yeast show cell surface modifications
- Flow cytometry support cell damage from treatments
- Novel technologies have impact on yeast cells with perceived effects on wine texture (e.g. creamy descriptions for microwave and ultrasound treatments)

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Next steps

- A bench top trial using no adjuvant for better yeast visualisation is underway
- Different yeast types and enzymes in sparkling wine production are being investigated

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