Novel sparkling winemaking technologies and visualising yeast autolysis

Gail Gnoinski, Fiona Kerslake, Dugald Close, Bob Dambergs and Simon Schmidt
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
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
Scientific research

– Changes occur in the lees structure as wine ages

(Tudela et al. 2012)
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
Tasting wine produced using novel technologies

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

- Sparkling wine at 12 month period (disgorged)

<table>
<thead>
<tr>
<th>Sparkling Wine Maturation</th>
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<tbody>
<tr>
<td>Samples</td>
<td>5 treatments</td>
</tr>
<tr>
<td>Evaluation</td>
<td>One day</td>
</tr>
<tr>
<td>Replicates</td>
<td>3 flights</td>
</tr>
<tr>
<td>Scale</td>
<td>20 points, +10 to -10</td>
</tr>
<tr>
<td>Assessors</td>
<td>Sparkling winemakers</td>
</tr>
<tr>
<td>Assessment Criteria (compared to a control wine)</td>
<td>Autolytic</td>
</tr>
<tr>
<td></td>
<td>Nutty</td>
</tr>
<tr>
<td></td>
<td>Toasty</td>
</tr>
<tr>
<td></td>
<td>Honey</td>
</tr>
<tr>
<td></td>
<td>Spicy</td>
</tr>
<tr>
<td></td>
<td>Earthy</td>
</tr>
</tbody>
</table>
Winemakers tasting results

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

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

• The ultrasound and 25°C treatments are perceived as more nutty compared to the control wine
Winemakers tasting results

<table>
<thead>
<tr>
<th></th>
<th>Toasty</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD TIRAGE (15°C)</td>
<td>0.0</td>
</tr>
<tr>
<td>ULTRASOUND</td>
<td>1.8</td>
</tr>
<tr>
<td>MICROWAVE</td>
<td>1.3</td>
</tr>
<tr>
<td>ENZYME</td>
<td>0.3</td>
</tr>
<tr>
<td>STANDARD TIRAGE (25°C)</td>
<td>3.9</td>
</tr>
</tbody>
</table>

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

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

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

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

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