Strategies for reducing alcohol concentration in wine

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Alcohol in Australian wine

Godden et al. 2015
Why is alcohol increasing?

Grape maturity enhances rich, ripe fruit flavour, and colour intensity.

Decreases the unripe green and vegetal flavours.

Greater maturity leads to higher sugar content.

Higher sugar equals higher alcohol levels.
Why reduce alcohol?

Too much!

Ethanol content

15% 14% 13% 12%

Alcohol abuse

Wine & society

Normal

Sluggish

Stuck

Baume

Time
How to reduce alcohol in wine?

Viticultural practices

Winemaking practices

Fermentation practices

Post-fermentation technologies

Varela et al. 2015
Viticultural practices

Reducing leaf area

Decreasing leaf area reduces sugar accumulation from other ripening changes.

Several red varieties have small reductions in ethanol, leaf removal of Tempranillo results in a 2% v/v less ethanol, leaf removal of Sangiovese results in a small reduction in TSS.

Some have reported a decrease in anthocyanin concentration.

Harvesting earlier

Harvesting earlier decreases TSS, theoretically 2% v/v less ethanol.

Tempranillo reduction of 15% in TSS, theoretically 2% v/v less ethanol.

Sangiovese small reduction in TSS.

Some have reported a decrease in anthocyanin concentration.
Harvesting earlier: does alcohol matter?

Observed changes in sensory profile during ripening Cabernet Sauvignon

Site/Season 1
Site/Season 2
Site/Season 3

Fresh Green/Vegetal    Red fruit/Fresh Green    Red fruit    Dark fruit    Over-ripe Fruit

Ripening

Alcohol concentration from: 11.8 % v/v to 15.5 % v/v
Wines harvested earlier

- High methoxypyrazine and C6 compounds
- Low extractable tannin, seed tannin > skin
- Low tannin polymerisation
- High grape-derived polysaccharides

- Low esters
- Low anthocyanin
- Low glycerol and alcohol
- High methoxypyrazine and C6 compounds

Bindon et al. 2013
Wines harvested later

High esters
High anthocyanin
High glycerol and alcohol
Low methoxypyrazine and C6 compounds
High extractable tannin, higher mDP, skin > seed
Low grape-derived polysaccharides
High mannoproteins

Dark Berry
Hot/Pungent
High astringency
High viscosity

Bindon et al. 2013
Some sensory data – palate attributes

Bindon et al. 2014
Harvesting earlier could deliver a wine that consumers prefer or like just as much and contains up to 2 % (v/v) less alcohol.

Caution: One trial – one variety – one vintage
Winemaking practices

Blending

Fermentation design

Choice of yeast strain

Verdelho and Petit Verdot grapes harvested at two maturities for each variety wines differed. Wines mixed in equal volumes final wine 1.5% v/v less alcohol similar sensory composition to 'mature' wines.

Longo et al. 2017a
Choice of wine yeast

Not much variation in ethanol yields for commercial wine yeast strains

Palacios et al. 2007
Low-ethanol wine yeasts

Genetically modified (GM) strains

S. cerevisiae

Generation of new strains (nonGM) mutagenesis, adaptive evolution

Isolation and characterisation of strains

Non-Saccharomyces
Non-GM techniques

- Mutagenesis
- Screen of low alcohol phenotype
- Mutant yeast
- Adaptive evolution
- Selective pressure that drives alcohol down
- Low alcohol yeast
- Wine yeast
Novel *S. cerevisiae* yeast strain

IONYS\textsuperscript{WF}\textsuperscript{TM} obtained by adaptive evolution in Montpellier, France
Commercialised by Lallemand
Decreases ethanol and increases glycerol and acidity

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

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

Lab-scale
Chardonnay
Anaerobic conditions
22°C

S. cerevisiae
LE1
LE2
LE3
LE4

↓ 2.1%
Non-\textit{Saccharomyces} strains

- 50 Non-\textit{Saccharomyces} strains
- Sequential inoculation
- Aerobic and anaerobic conditions
Sequential inoculation

S. cerevisiae

Non-Saccharomyces

S. cerevisiae
Lab-scale trial - aeration

Contreras et al. 2015a

Pilot-scale trials in Shiraz performed last vintage
Lab scale trial - anaerobic

Contreras et al. 2014
Contreras et al. 2015b

Chardonnay
(sterile)

<table>
<thead>
<tr>
<th></th>
<th>S. cerevisiae</th>
<th>M. pulcherrima</th>
</tr>
</thead>
</table>
| Ethanol [% v/v] | 16 | 15.1 | ↓ 0.9%

Shiraz
(non-sterile)

<table>
<thead>
<tr>
<th></th>
<th>S. cerevisiae</th>
<th>M. pulcherrima</th>
</tr>
</thead>
</table>
| Ethanol [% v/v] | 16 | 14.4 | ↓ 1.6%
Lab-scale trial - Shiraz

*M. pulcherrima* (Shiraz)

Contreras et al. 2015b
Shiraz trial - coinoculation

Lab-scale
Sterile Shiraz
Anaerobic conditions
22°C

Varela et al. 2016
Pilot-scale trials – sensory profile

Velcorin®-treated Merlot 30L 22 °C

- S. cerevisiae
- M. pulcherrima/S. cerevisiae
- S. uvarum
- Uninoculated

Ethanol [% V/V]

- S. cerevisiae: 15%
- M. pulcherrima/S. cerevisiae: 14%
- S. uvarum: 13%
- Uninoculated: 12%

↓ 1.0%
↓ 1.7%
↓ 0.7%

Varela et al. 2017
Post-fermentation technologies

Physical removal of alcohol

• Membrane-based systems
  – reverse osmosis
  – evaporative perstraction
• Vacuum distillation
• Spinning cone column

These provide effective and precise control of alcohol reduction

All affect volatile composition and depending on ethanol removal they also affect sensory profile and potentially wine style
## Sensory effects - summary

<table>
<thead>
<tr>
<th>Variety</th>
<th>Method</th>
<th>Ethanol removed</th>
<th>Sensory impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aglianico</td>
<td>EP</td>
<td>2% - 5%</td>
<td>Decrease fruity and flowery notes, increase astringency and acid</td>
</tr>
<tr>
<td>Chardonnay</td>
<td>SCC</td>
<td>2%</td>
<td>Decrease overall aroma intensity and hot mouthfeel</td>
</tr>
<tr>
<td>Merlot</td>
<td>RO</td>
<td>2% - 3%</td>
<td>Decrease heat and texture, increase astringency and acid</td>
</tr>
<tr>
<td>Shiraz</td>
<td>RO</td>
<td>2% - 5%</td>
<td>Decrease balance, persistency and heat</td>
</tr>
<tr>
<td>Sauvignon blanc</td>
<td>RO</td>
<td>1% - 3%</td>
<td>Decrease overall aroma, heat, balance and persistency</td>
</tr>
</tbody>
</table>
• Several strategies available for managing alcohol concentration in wine.

• Different strategies may impact on wine aroma, flavour and/or style.

• Fundamental to understand alcohol preferences by consumers.

• Combination of strategies will most likely affect wine attributes significantly.
Acknowledgements
References

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