Press fractions, timing of bentonite addition on Ontario sparkling wine quality and gushing.

Belinda Kemp
Email: bkemp@brocku.ca
1. Press fractioning on a commercial scale - project summary
2. Preliminary press fraction results
3. Summary of the preliminary study of the bentonite/ protein/foaming sparkling wine trial
4. Gushing: Reasons & remedies
5. Gushing project summary
6. Acknowledgements
Background to studies

Applied scientific research studies that benefit Ontario sparkling winemakers

What is applied research?

- It is a discipline of science that uses existing scientific knowledge to devise solutions to specific problems.
- Applied scientific research is valuable and essential in our competitive global wine environment.

- Dedicated CCOVI research trials specific to Ontario sparkling wines
- Requested by Ontario sparkling winemakers
- Fizz Club: 38 sparkling wine producers attended in 2014 (increase in 2015)
Sparkling wine trials

Continuation and expansion of trials i.e. *dosage* trial funded by NSERC Engage grant in collaboration with Trius at Hillebrand winery.
Press fractioning options

Without press fraction separation

All press fraction juice combined to produce one, low quality sparkling wine

With press fraction separation

Press fractioning options

First fraction (F1)

Quality base wine, more blending options, aging

Second fraction (F2)

2nd label, more blending options, could be used in dosage, lower quality than F1

Third fraction (F3)

2nd label, more blending options, could be used in dosage, lower quality than F2

Fourth fraction (F4)

Sell to local distillery for distillation $$$
Press fractions

Champagne

- **Cuvee** = 20.5hL
- **Tailles** = 5hL (1\(^{st}\) taille -3hL + 2\(^{nd}\) taille 2hL)
- **3\(^{rd}\) taille** 1-2hL distillation

- Press fraction volume and composition depends on press pressure of each cycle, type of press, length of each press cycle, grape variety, wines style and vintage
Press fractions
Press fractions

CLONE 115 (Dijon clone)

BUCHER
CHAMPAGNE

E - END OF CYCLE
P - POMACE BREAKUP
C - CUVEE CYCLE TIME
1T - 1ST TAILLE CYCLE TIME
2T - 2ND TAILLE CYCLE TIME
3T - 2.0 BAR CYCLE TIME

Selectable 0 to 9 times

Pressure (bars)

Time (minutes)
Experimental winemaking method

- Pinot noir - Clone 115
- Whole bunch pressed
- Wine taken from tap before hitting the tray - middle of each cycle
- No enzymes added
- 30 ppm SO2
- Winemaking in triplicate - no MLF
- Chemical analysis of juice & wine pH, TA (g/L), Brix, fre & total SO2, ethanol, Nitrogen, turbidity, glucose, fructose, residual sugar, malic acid, heat stability, tartrate stability, total phenolics, conductivity & potassium.
- EC118 both fermentations
- *Tirage* same for all fractions (calculated on residual sugar & target of 24 g/L for 2\textsuperscript{nd} fermentation
Press fraction juice and wine composition

(Analysis at every stage of winemaking but pre-fermentation and pre-bottling data presented today)

**Table 1. Press fraction juice analysis**

<table>
<thead>
<tr>
<th>Press Fraction</th>
<th>Brix</th>
<th>TA (g/L)</th>
<th>pH</th>
<th>Total YAN (mg/L)</th>
<th>Glucose (g/L)</th>
<th>Fructose (g/L)</th>
<th>Malic acid (g/L)</th>
<th>Turbidity (NTU)</th>
<th>Acetic acid (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF1</td>
<td>18.5</td>
<td>8.3</td>
<td>3.12</td>
<td>153</td>
<td>82</td>
<td>78</td>
<td>3.9</td>
<td>267</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>PF2</td>
<td>18</td>
<td>7.5</td>
<td>3.19</td>
<td>154</td>
<td>83</td>
<td>77</td>
<td>3.6</td>
<td>297</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>PF3</td>
<td>18</td>
<td>6.3</td>
<td>3.39</td>
<td>160</td>
<td>83</td>
<td>78</td>
<td>3.4</td>
<td>261</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Significance: NS < 0.0001 < 0.0001 < 0.0001

**Table 2. Press fraction base wine analysis (prior to bottling)**

<table>
<thead>
<tr>
<th>Press fraction</th>
<th>Alcohol (% v/v)</th>
<th>TA (g/L)</th>
<th>pH</th>
<th>Total YAN (mg/L)</th>
<th>Glucose (g/L)</th>
<th>Fructose (g/L)</th>
<th>Residual sugar (mg/L)</th>
<th>Malic acid (g/L)</th>
<th>Turbidity (NTU)</th>
<th>Free SO2 (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF1</td>
<td>10.6</td>
<td>7.7</td>
<td>2.9</td>
<td>10.3</td>
<td>0.02</td>
<td>0.10</td>
<td>0.12</td>
<td>3</td>
<td>0.1</td>
<td>19</td>
</tr>
<tr>
<td>PF2</td>
<td>10.6</td>
<td>6.8</td>
<td>3.1</td>
<td>11.6</td>
<td>0.02</td>
<td>0.10</td>
<td>0.12</td>
<td>3</td>
<td>1.5</td>
<td>23</td>
</tr>
<tr>
<td>PF3</td>
<td>10.7</td>
<td>6.0</td>
<td>3.4</td>
<td>14.5</td>
<td>0.02</td>
<td>0.21</td>
<td>0.23</td>
<td>3</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Significance: NS < 0.0001 < 0.0001 < 0.0001 NS < 0.0001 < 0.0001 NS < 0.0001 < 0.0001

*Turbidity decreased in other studies but increased in our wines*
Press fraction primary fermentation

Press fraction primary fermentation rates at 16 °C
Relevance of results to wine?

- TA (g/L) increases & pH decreases
- Phenolic concentration influence on flavour and foaming (increase during pressing)
- Higher level of residual sugar in 2\textsuperscript{nd} taille due to higher fructose levels
- Turbidity increase in 2\textsuperscript{nd} taille
- Foaming?
- Flavour?
- Sparkling wine quality
Press fraction trial: Next steps

- Further chemical analysis i.e. phenolic analysis
- Further statistical data analysis
- Foam analysis of the final disgorged wines before and after dosage
- Tasting with Ontario sparkling winemakers at Fizz Club
Sparkling wine project: OMAFRA-U OF G PARTNERSHIP
Bentonite, protein & bubbles!

Preliminary investigation trial vintage 2014:
REGIONAL SPECIFIC STUDY
• Pinot noir Mariafeld

Mariafeld is a group of clones of Pinot noir. Vigorous, long & loose bunches, high disease resistance, big berries & high acidity. Planted in Germany from the beginning of the 90s.

Experimental design
• Two base juices of 200L each
  1. No bentonite treatment
  2. 1g/L Vitiben bentonite added to juice but removed prior to 1st fermentation

✓ Contribution of grape proteins to foaming
Pinot noir Mariafeld, juice after pressing, SS tank & enzyme addition (200L)

First fermentation

Second fermentation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>No bentonite, EC118 yeast 30L</td>
</tr>
<tr>
<td>T2</td>
<td>No bentonite, Brock Isolate yeast 30L</td>
</tr>
<tr>
<td>T3</td>
<td>+ bentonite 2nd ferment only, EC118 yeast 30L</td>
</tr>
<tr>
<td>T4</td>
<td>+ bentonite 2nd ferment only, Brock isolate yeast 30L</td>
</tr>
<tr>
<td>T5</td>
<td>+ bentonite 1st ferment only, EC118 yeast 30L</td>
</tr>
<tr>
<td>T6</td>
<td>+ bentonite 1st ferment only, Brock isolate yeast 30L</td>
</tr>
<tr>
<td>T7</td>
<td>+ bentonite 1st &amp; 2nd ferment, Brock isolate, EC118 yeast 30L</td>
</tr>
<tr>
<td>T8</td>
<td>+ bentonite 1st &amp; 2nd ferment, EC118 yeast 30L</td>
</tr>
</tbody>
</table>

*Bentonite used: Vitiben pre-fermentation and Inoclar 2 at tirage*
A pyramidal winemaking design

Stage 1: 200L juice

Stage 2: Juice: 1 treated bento & 1 no bento

Stage 3: Divided into 4 fermentation reps first fermentation EC118 yeast

Stage 4: Blended into 1 x bento & 1 x no bento in juice

Stage 5: Subdivided into 8 x treatments of bottled wines (bottle replication bento timing x 2 vs yeast type x 2)
Bentonite trial winemaking

- Whole bunch pressed at winery (Bucher press)
- Pectic enzymes added to tank & settled
- First fermentation x 2 with EC118 yeast & nutrients (+ bento & no bento)
- No MLF
- Cold stabilised with seeding to -4 °C
- Sheet & plate filtration to 0.45
- *Tirage*/bottled at Fielding Estate Winery
- 2nd fermentation/Storage
## Juice analysis

<table>
<thead>
<tr>
<th>Production stage</th>
<th>Treatment</th>
<th>Titratable Acidity (g/L)</th>
<th>pH</th>
<th>°Brix</th>
<th>Total N (mg/L)</th>
<th>Amino N (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-bentonite treatment</strong></td>
<td>No bento</td>
<td>14 ±0.01</td>
<td>3.1 ±0.01</td>
<td>19 ±0.0</td>
<td>298 ±0.1</td>
<td>215 ±0.0</td>
</tr>
<tr>
<td></td>
<td>Bento</td>
<td>14 ±0.01</td>
<td>3.1 ±0.02</td>
<td>19 ±0.0</td>
<td>291 ±0.1</td>
<td>208 ±0.1</td>
</tr>
<tr>
<td><strong>After bentonite treatment</strong></td>
<td>No bento</td>
<td>13 ±0.03</td>
<td>3.1 ±0.03</td>
<td>19 ±0.1</td>
<td>284 ±2.0</td>
<td>211 ±0.1</td>
</tr>
<tr>
<td></td>
<td>Bento</td>
<td>12 ±0.02</td>
<td>3.1 ±0.04</td>
<td>19 ±0.0</td>
<td>304 ±3.0</td>
<td>216 ±0.0</td>
</tr>
</tbody>
</table>
Primary fermentation
Base wines

**Figure 1a.** Base wine produced from bentonite treated juice prior to bottling

**Figure 1b.** Base wine produced from untreated juice prior to bottling
Protein concentration($\mu$g/mL) by the Bradford Assay during sparkling winemaking

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: No bento + EC1118</td>
<td>No bentonite treatment/racking/pre-ferment only</td>
</tr>
<tr>
<td>T2: No bento + Brock yeast</td>
<td>No bentonite treatment/racking/pre-ferment only</td>
</tr>
<tr>
<td>T3: + bento 2nd ferment only EC1118</td>
<td>Post ferment/Pre-bottling only</td>
</tr>
<tr>
<td>T4: + bento 2nd ferment only Brock yeast</td>
<td>Post ferment/Pre-bottling only</td>
</tr>
<tr>
<td>T5: + bento 1st ferment only EC1118</td>
<td>Bottled Wine</td>
</tr>
<tr>
<td>T6: + bento 1st ferment only Brock yeast</td>
<td>Bottled Wine</td>
</tr>
<tr>
<td>T7: + bento 1st &amp; 2nd ferment Brock yeast</td>
<td>Bottled Wine</td>
</tr>
<tr>
<td>T8: + bento 1st &amp; 2nd ferment EC1118 yeast</td>
<td>Bottled Wine</td>
</tr>
</tbody>
</table>
### Table 1. Wine analysis prior to subdividing into 2nd fermentation treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vol (L)</th>
<th>pH</th>
<th>TA (g/L)</th>
<th>Ethanol (% v/v)</th>
<th>Free SO₂ (ppm) {after cold stab &amp; filtering}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>144</td>
<td>3.0</td>
<td>11</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Bentonite added to juice</td>
<td>134</td>
<td>3.0</td>
<td>11</td>
<td>11</td>
<td>24</td>
</tr>
</tbody>
</table>

### Table 2. Metabolite analyses pre-bottling of Bentonite/Yeast Trial wines

<table>
<thead>
<tr>
<th>Trial</th>
<th>1st Treatment</th>
<th>Yeast</th>
<th>2nd Treatment</th>
<th>pH</th>
<th>TA (g/L)</th>
<th>Residual Sugar (g/L)</th>
<th>Amino N (mg/L)</th>
<th>Malic acid (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Control</td>
<td>EC1118</td>
<td>-</td>
<td>3.0</td>
<td>11</td>
<td>26 ±0.7</td>
<td>31 ±0.1</td>
<td>7 ±0.1</td>
</tr>
<tr>
<td>T2</td>
<td>Control</td>
<td>S. bayanus</td>
<td>-</td>
<td>3.0</td>
<td>11</td>
<td>27 ±0.1</td>
<td>31 ±0.4</td>
<td>6 ±0.0</td>
</tr>
<tr>
<td>T3</td>
<td>Control</td>
<td>EC1118</td>
<td>Inoclair</td>
<td>3.0</td>
<td>11</td>
<td>25 ±0.2</td>
<td>31 ±0.9</td>
<td>7 ±0.0</td>
</tr>
<tr>
<td>T4</td>
<td>Control</td>
<td>S. bayanus</td>
<td>Inoclair</td>
<td>3.0</td>
<td>11</td>
<td>26 ±0.2</td>
<td>31 ±1.0</td>
<td>7 ±0.0</td>
</tr>
<tr>
<td>T5</td>
<td>Bentonite</td>
<td>EC1118</td>
<td>-</td>
<td>3.0</td>
<td>11</td>
<td>25 ±0.0</td>
<td>28 ±0.2</td>
<td>7 ±0.0</td>
</tr>
<tr>
<td>T6</td>
<td>Bentonite</td>
<td>S. bayanus</td>
<td>-</td>
<td>3.0</td>
<td>11</td>
<td>25 ±0.1</td>
<td>26 ±1.1</td>
<td>7 ±0.1</td>
</tr>
<tr>
<td>T7</td>
<td>Bentonite</td>
<td>EC1118</td>
<td>Inoclair</td>
<td>3.0</td>
<td>11</td>
<td>25 ±1.1</td>
<td>27 ±2.3</td>
<td>7 ±0.0</td>
</tr>
<tr>
<td>T8</td>
<td>Bentonite</td>
<td>S. bayanus</td>
<td>Inoclair</td>
<td>3.0</td>
<td>11</td>
<td>27 ±0.7</td>
<td>27 ±0.5</td>
<td>7 ±0.0</td>
</tr>
</tbody>
</table>

*Higher malic acid than clone 115
Next steps....

- Monitoring wines
- Disgorging & *Dosage* x 8 (with sugar addition after a *dosage* sugar trial)
- 2 months on cork
- Protein analysis (concentration and identification)
- Chemical analysis before disgorging, after disgorging without *dosage* & with *dosage*
- Foaming analysis & correlation to protein content & type of proteins
- Sensory analysis at Fizz Club
To bento? When to bento? or not to bento?

• Grape proteins affected by variety, vintage, grape maturity, pH and processing techniques.

• Protein composition and concentration differences between varieties and impact i.e. Chardonnay, Sauvignon blanc, Pinot noir and Riesling

• Sodium bentonite affects Chardonnay & Sauvignon Blanc foam more than Pinot noir. Calcium bentonite affects Pinot noir foam more than Chardonnay.

• Combination of both? Timing of addition? Vintage, variety & production style dependent
Next stage of variety x clone x soil type x bentonite trial 2015

Varieties: Pinot noir, Pinot gris, Chardonnay and Riesling

Clones: Clones on two soils on two sites

Soil types: Sandy & clay

Bentonite types: Na, Ca & mixture
Bentonite timing: base wine and tirage
Bentonite type and timing trial
(using bentonite concentrations used by wineries)

In collaboration with Chateau des Charmes Winery and Trius at Hillebrand Winery

*Boxes denote wines at *tirage*/bottling  
**Circles denote base wine fining
# Gushing Trial

## Bottle Handling & Disgorging Environment
- Light (UV)
- Ambient temperature
- Seasonal timing of disgorging
- Rough handling before disgorging
- Angle of the bottle
- Neck freezing too fast
- Rapid movement of wine from cold room to warm room

## Wine Composition
- Grape variety
- Vintage variation
- Protein instability
- Wine temperature and dosage temperature
- High bottle pressure
- Tartrate crystals
- Inconsistent mixing during tirage
- Undissolved sugar in the dosage
- Yeast (from inadequate riddling/disgorging)
- High phenolic concentration
- Turbidity
- Malolactic fermentation in bottle

## Packaging Materials
- Cork dust
- Glass imperfections in the bottle
- Dust in the bottle
GUSHING: Ambient temperature, bottle temperature and wine loss
Gushing
GUSHING: Further analysis

- Pressure
- Yeast count
- Malic acid
- Protein concentration
- Tartrate stability
- Heat stability
- Phenolic concentration

- Standard parameters - pH, TA (g/L), alcohol, residual sugar (g/L), free & total SO₂,
Acknowledgments

• Lisa Dowling (Oenology Research Assistant), Esther Onguta (MSc student) & Ben Wiles (OEVI)
• Trius at Hillebrand Winery, Tawse Winery & Chateau des Charmes for their collaboration and co-operation.
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• Ontario Centres of Excellence (OCE) VIP grant for funding the press fraction study
• Natural Sciences and Engineering Research Council (NSERC) Engage grant for funding the Dosage study
THAT'S ALL FOLKS!
Any questions?