### Barrel reclamation: everything that's old can be new again

**Kerry Wilkinson, Sijing Li, Paul Grbin and Peter Warren**

**Summary**

During barrel maturation, the volatile compounds extracted from oak wood can contribute to a wine’s overall aroma and flavour, enhancing its character and complexity. However, barrels have a finite pool of extractable material and the amounts of oak derived volatile compounds available for extraction diminish over time. As a consequence, barrels are typically decommissioned after five to six years. This study investigated whether or not decommissioned barrels represent a previously untapped source of high quality oak that can be ‘reclaimed’ for use in wine maturation.

- Decommissioned French and American oak barrels were ‘reclaimed’ to produce oak battens from the unused portion of oak wood.
- Oak extracts were prepared from toasted reclaimed oak battens and analysed by gas chromatography-mass spectrometry to determine the concentrations of important oak volatiles.
- The levels of cis- and trans-oak lactone, guaiacol, 4-methylguaiacol, vanillin and eugenol present in reclaimed oak were similar to that of new oak, demonstrating its suitability for wine maturation.

**Introduction**

During barrel maturation, a range of volatile compounds are extracted from the oak wood and can contribute to a wine’s overall aroma and flavour, enhancing its character and complexity (Rodríguez-Rodríguez and Gómez-Plaza, 2011).

These compounds include, but are not limited to, cis- and trans-oak lactone, guaiacol, 4-methylguaiacol, eugenol, vanillin, furfural and 5-methylfurfural (Figure 1). cis-Oak lactone is perhaps the most important oak volatile due to its abundance in oak-aged wine and relatively low detection threshold. Both cis- and trans-oak lactone impart coconut aroma and flavour characters to wine (Maga 1996), while guaiacol and 4-methylguaiacol exhibit smoky attributes, and vanillin and eugenol afford distinctive vanilla and clove characters, respectively (Spillman et al. 2004).

The furanones are thought to make less significant contributions to aroma due to their considerably higher aroma detection thresholds, but they may influence the perception of oak lactone (Spillman et al. 2004).

The extractable levels of oak volatiles can vary significantly from barrel to barrel, largely due to variation in oak composition associated with species, origin (i.e. French or American oak) and the seasoning and toasting processes of cooperage (Campbell et al. 2005, Rodríguez-Rodríguez and Gómez-Plaza, 2011).

However, the pool of extractable compounds in a barrel is finite and so the rate of extraction decreases as a function of time (Pérez-Prieto et al. 2002). As a consequence, barrels are typically decommissioned after five to six years.

Used barrels can be rejuvenated by scraping a thin layer (up to 5 mm) from the barrel’s interior to expose fresh, unextracted wood (Mosedale et al. 1999). Sometimes the rejuvenated barrel will also be re-toasted. While this practice can prolong the life of a barrel, rejuvenated

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**Table 1. Concentration of oak volatiles in new and reclaimed samples of toasted oak.**

<table>
<thead>
<tr>
<th>Oak Samples</th>
<th>cis-oak lactone</th>
<th>trans-oak lactone</th>
<th>guaiacol</th>
<th>4-methyl guaiacol</th>
<th>eugenol</th>
<th>Vanillin</th>
<th>furfural</th>
<th>5-methylfurfural</th>
</tr>
</thead>
<tbody>
<tr>
<td>new French oak</td>
<td>nd–11.4</td>
<td>nd–6.8</td>
<td>2.3–18.5</td>
<td>1.3–10.2</td>
<td>0.7–2.3</td>
<td>53–190</td>
<td>108–963</td>
<td>14–148</td>
</tr>
<tr>
<td>reclaimed French</td>
<td>nd–33.4</td>
<td>nd–73.1</td>
<td>1.5–11.6</td>
<td>0.8–4.9</td>
<td>2.7–7.7</td>
<td>58–115</td>
<td>786–1376</td>
<td>54–213</td>
</tr>
<tr>
<td>new American oak</td>
<td>12.3–47.9</td>
<td>3.3–5.3</td>
<td>4.2–13.5</td>
<td>0.9–7.9</td>
<td>4.2–6.1</td>
<td>42–140</td>
<td>55–1539</td>
<td>6–237</td>
</tr>
<tr>
<td>reclaimed American</td>
<td>nd–65.5</td>
<td>nd–9.1</td>
<td>0.8–12.3</td>
<td>0.6–5.6</td>
<td>2.3–6.2</td>
<td>70–137</td>
<td>412–1134</td>
<td>41–136</td>
</tr>
</tbody>
</table>

nd = not detected

bValues are means from 24 replicates; cValues are means from 22 replicates.

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Figure 1. Chemical structures and aroma descriptors of oak-derived volatiles studied.
wood contains reduced amounts of extractable material, so contributes less flavour than new barrels.

Furthermore, any wine which remains in the wood can be caramelised during re-toasting, with a risk of developing unpleasant ‘burnt’ characters.

The increased microbial load and potential for Brettanomyces spoilage can also discourage barrel rejuvenation. For these reasons, most winemakers favour replacement of old barrels.

In this study, we investigated the potential for decommissioned barrels to be ‘recycled’ as a source of high quality oak for the preparation of new oak battens, i.e. the flavour potential of reclaimed oak and its suitability for oak maturation of wine.

The potential for contamination by the spoilage yeast Brettanomyces to be carried over into reclaimed oak was also investigated.

### Flavour potential of reclaimed oak battens

Several used French and American barrels were ‘reclaimed’ (Figure 2). This involved barrels being broken down into their individual staves and the wine-affected portion of oak removed and discarded.

The remaining oak was then split lengthways into battens and processed to remove barrel grooves and to expose the fresh grain of the wood.

Pressure and far-infrared (FIR) heat were then applied to the resulting oak battens, to simultaneously straighten them and to generate oak volatiles.

In this way, the 2.1m² internal surface area of a 225L barrel yields approximately 8m² of reclaimed oak battens, substantially increasing the volume of wine which can be matured using the same oak wood.

To evaluate the flavour potential of the new oak battens, shavings (1 mm thickness) were taken from a number of samples (24 reclaimed French oak battens and 22 reclaimed American oak battens) and soaked in model wine (20 per cent alcohol by volume) for seven days at room temperature. The extracts were then analysed by gas chromatography-mass spectrometry to determine oak volatile concentrations.

Comparable levels of important oak-derived volatiles were observed in (i) reclaimed French oak battens and new French oak, and (ii) reclaimed American oak battens and new American oak (Table 1); albeit the concentrations of oak volatiles differed between French and American oak battens, in agreement with previous studies (Campbell et al. 2005; Pérez-Prieto et al. 2002; Alañón et al. 2012).

In particular, reclaimed French oak contained higher proportions of the transisomer of oak lactone rather than the cis-isomer; whereas reclaimed American oak predominantly contained cis-oak lactone.

These results demonstrate reclaimed oak is capable of imparting oak aroma and flavour to wine and is therefore suitable for use in winemaking.

### Potential carryover of Brettanomyces spoilage

To investigate the potential carryover of Brettanomyces spoilage, the concentrations of 4-ethylphenol and 4-ethylguaiacol...
were measured in reclaimed oak. 4-Ethylphenol was not detected in any of the reclaimed oak samples and only trace levels of 4-ethylguaiacol i.e. ≤ 5.1 μg/g were observed (Table 2). These results indicate there was no carryover of Brettanomyces-derived volatile phenols during the barrel reclaim process, however, this may simply reflect the absence of spoilage in the first place so a spoilage trial was undertaken to investigate Brettanomyces viability under FIR toasting conditions.

This involved an untoasted reclaimed oak batten being soaked in yeast peptone dextrose (YPD) medium inoculated with a Brettanomyces culture, for four days. The batten was then subjected to FIR toasting, after which shavings were collected and soaked in YPD media for seven days.

The resulting media was streaked onto agar plates and incubated for 14 days. Where yeast growth occurred, the genomic DNA was extracted for molecular identification. The results indicated a 99 per cent match to Hanseniaspora guilliermondii, a strain of yeast likely to be a media contaminant (Barnett et al. 2000); i.e. there was no evidence to suggest the presence of Brettanomyces yeast following FIR toasting.

These results suggest the temperatures achieved during FIR toasting, i.e. between 200°C inside the batten and 250°C on the surface of the batten (data not shown), were not only sufficient to generate oak volatiles, but to also reduce microbial load, thereby preventing the carryover of spoilage yeast and/or bacteria.

Conclusion
The barrel reclaim process converts each used barrel into approximately 60 reclaimed oak battens, which can then be added to wine to impart oak characters. The reclaim process costs approximately $2.50 per batten, or $150 per barrel, significantly less than a new barrel. In this study, reclaimed oak battens were found to contain similar levels of important oak volatiles to those reported in new oak wood, thereby demonstrating the suitability of reclaimed oak for wine maturation. Furthermore, there was no evidence to suggest any risk of carryover of Brettanomyces yeast.

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References


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