# MALOLACTIC BACTERIA :
## EFFICIENT CONTRIBUTORS TO WINE STYLES

The evidence is stronger than ever. Malolactic bacteria are important tools to influence the sensory profiles of wines. It has been long known that malolactic bacteria (ML) are essential to reduce the acidity of wine through malolactic fermentation. But now, our on-going research is showing their sensory potential as well. Whether a Chardonnay is more or less buttery, or a red wine has intense red berry aromas are now confirmed by numerous trials and research results.

### 1. Accentuate the fruitiness of red wines

The effects of malolactic fermentation (MLF) on wine aroma and chemical properties of Australian Cabernet Sauvignon at the AWRI were explored by inoculation with different selected *Oenococcus oeni*. Significant compositional differences occurred in response to the different MLF treatments and strain dependent changes in volatile aroma compounds were observed. Increases in fruity esters were associated with increases in fruit related sensory attributes. These trends were observed over three vintages in Cabernet Sauvignon fruit sourced from various vineyards (Figure 1).

The impact of the ML bacteria starter is important, but it is also adapted to the different terroir, making the wines all different from one another due to the terroir effect. In all cases, ML bacteria are able to modulate the red berry aromas to different levels.

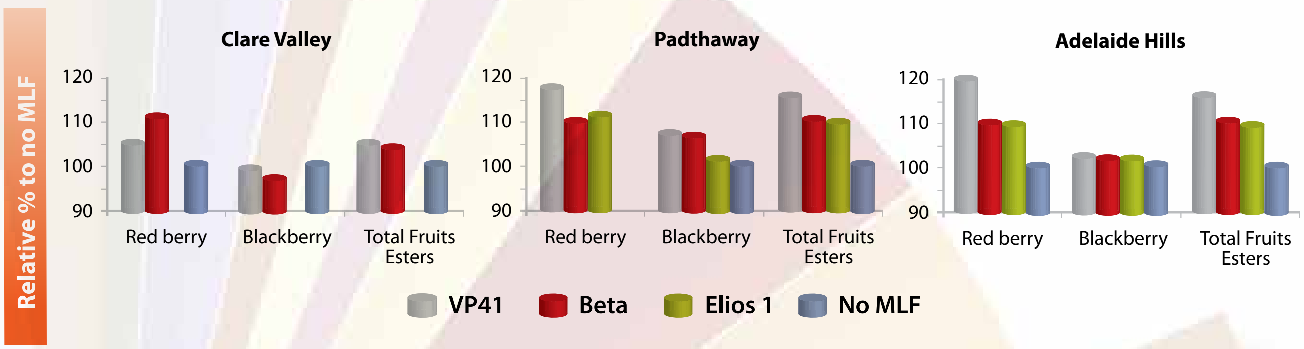


Figure 1: Sum of esters contributing to fruity characters (red berry, blackberry and total fruity esters), expressed as relative percentage to no MLF (100%), in Cabernet Sauvignon wines produced from 3 South Australian viticultural regions (vintage 2008) after malolactic fermentation induced by three *Oenococcus oeni* strains (Bartowsky *et al*, 2011).

*O. oeni* strains VP41 and Beta consistently produced wines with increased concentrations of volatile fermentation-derived compounds which relate to the red fruit aromas of Cabernet Sauvignon wines (Figure 2). In several instances, these Cabernet Sauvignon wines were also described as having higher dark fruit and red berry aromas, increased overall fruit flavour and fruit aftertaste. *O. oeni* strain VP41 consistently produces red wines with certain red fruity sensory characters enhanced.

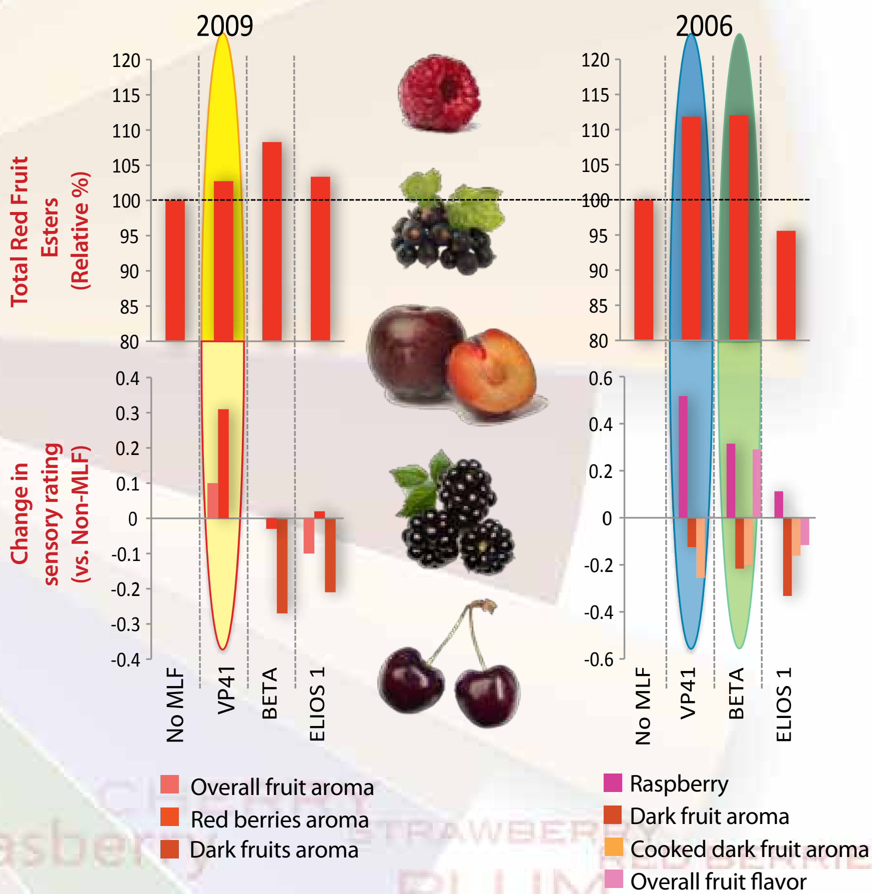


Figure 2: Comparison of Cabernet sauvignon wines after malolactic fermentation with three *Oenococcus oeni strains*: total red fruits esters and sensory descriptors. Fruit was sourced from the same vineyard over 2 vintages (Clare Valley, South Australia)

## 2. Malolactic bacteria and timing of inoculation: two keys for the buttery attribute

Diacetyl, also known as 2,3-butanedione, is associated with the 'buttery' character of wine and is formed as an intermediate metabolite in the reductive decarboxylation of pyruvic acid to 2,3-butanediol. It is closely linked to the growth of ML bacteria such as *Oenococcus oeni* and the metabolism of sugar, malic acid and citric acid. When present at a high concentration in wine, diacetyl will be perceived as overtly 'buttery' and can be regarded as undesirable by consumers. Whereas, lower concentrations and depending on the style and type of wine, it is considered to contribute a desirable 'buttery' or 'butterscotch' flavor character.

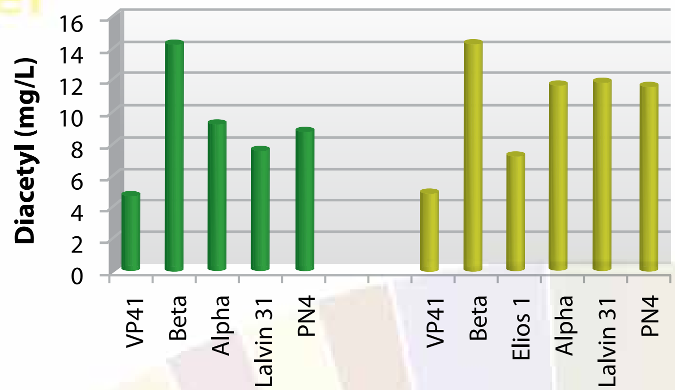


Figure 3: Diacetyl concentration of Cabernet Sauvignon wines from Clare Valley on left side and Adelaide Hills on right side (Australia) –that had undergone post-AF MLF with different selected MLB (Bartowsky, AWRI results).

### POST-AF INOCULATION

Certain malolactic ML bacteria strains have been observed to produce a higher residual concentration of diacetyl (Beta) in wines, principally when post-AF inoculation strategies are applied. In a study done at the AWRI by Bartowsky (2011) in Cabernet Sauvignon wines in Southern Australia, the results show that some ML strains will produce significant different concentration of diacetyl during sequential inoculation (figure 3). We can see that in both cases, in two different Cabernet Sauvignon, the ML bacteria produced different levels of diacetyl, ranging from 4 to 14 mg/L. In both cases, the wines that had undergone MLF with VP41 had the lowest levels of diacetyl, whereas Beta had the highest.

### CO-INOCULATION

Co-inoculation of selected yeast and MLB also has important stylistic implication in terms of diacetyl production. Whether or not co-inoculation is to be used for malolactic fermentation is probably the most important decision during this step of winemaking.

Our studies have shown that co-inoculation often result in more fruit-driven wine styles as opposed to lactic, buttery, nutty styles that result when MLF starts upon completion of alcoholic fermentation (sequential inoculation). For example, Figure 4 shows diacetyl concentrations in a 2010 Chardonnay from Val de Loire (France). Beta produces significantly less diacetyl in co-inoculation (48h) than in early inoculation (2/3 AF) or sequential inoculation (post AF). The impact of the ML strain on diacetyl production is not as strong in co-ino-culation since the wines will show repeatedly low level of diacetyl with this technique with different ML, no matter which strain is used.

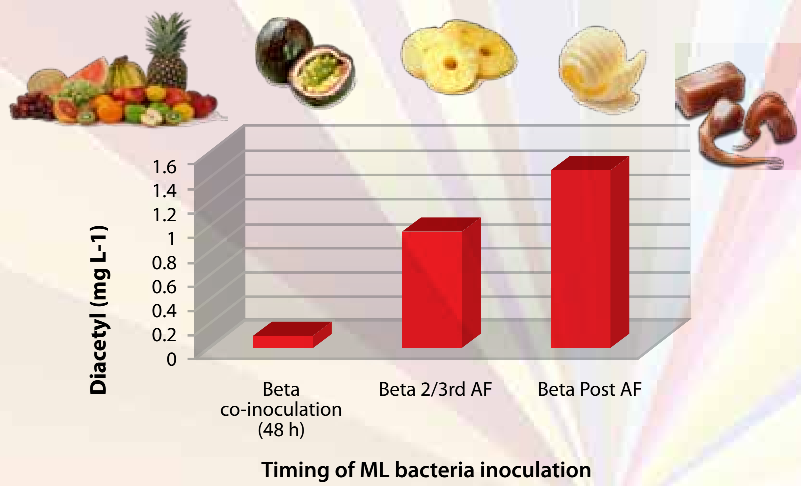


Figure 4: Diacetyl concentration in a 2010 Chardonnay (Val de Loire) with different timing of inoculation for MLF with Beta

Malolactic bacteria can be a powerful tool to shape the style of wines. The level of diacetyl can be controlled depending on which winemaking techniques are used, and the choice of not only the selected ML bacteria but also the type of fermentation (co-inoculation or post-AF) becomes key points. The following recommendations summarize the actions that can be undertaken to shape the diacetyl content of wines.

| Buttery aroma | Fruit driven style |
|---|---|
| ✓ Post-AF inoculation with strains Beta<br>✓ Eliminate as much as possible yeast lees<br>✓ Allow growth of ML bacteria in wine<br>✓ Lower temperature during MLF<br>✓ Quick stabilization with $SO_2$ at end of MLF | ✓ Co-inoculation with e.g. Alpha, **VP41**, Beta and early stabilitzation<br>✓ Post-AF inoculation with Lalvin 31, **VP41** and PN4 with yeast contact & stirring/delayed $SO_2$ addition<br>✓ 18-20° C fermentations<br>✓ Yeast lees contact & stirring<br>✓ Delayed $SO_2$ addition (minimum 1 week, or if pH allows two weeks) |

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