MALOLACTIC FERMENTATION BEHAVIOUR IN LOW MALIC ACID WINES.

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INTRODUCTION

L-malic acid is the most obvious substrate utilized by lactic acid bacteria in wine. O. oeni is the main malolactic (MLF) performing species in an enological context. It’s transport within the cell through a monooanionic form and decarboxylation to lactate enables the consumption of protons, thus generating a protomotive force and indirectly providing energy to the cell by enabling the ATP synthase to function1. Hence, while for the winemaker MLF is a way to gain in softness, enhance aromas and stabilize microbiologically wines, for O. oeni it is mostly an energy provider. However, other molecules can be used in that perspective, such as citric acid and pentoses.

The aim of this work is to better understand the impact of different malic acid concentrations on the fate of MLF. Indeed with climate change and/or extention of grape maturation before harvest, L-malic acid concentration tend to be lower in wines2, hence questionning the MLF performances in such context.

MATERIALS AND METHODS

Two red wines containing initial low L-malic acid concentrations where spiked in order to habor wines within a range of malic acid concentrations. Importantly, the pH of wines was also adjusted so that pH variations due acid additions did not interfere on the bacteria behaviour. Wines were then inoculated with different O. oeni preparations (Lactoenos®87 Direct, Lactoenos® SB3 Direct) and MLF was monitored through L-malic acid measurements.

Non inoculated controls were also performed to make sure no L-malic acid measurements. Direct, Lactoenos®87 inoculated with different adjusted so that pH variations due acid additions did not acid concentrations.

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Two red wines containing initial low L-malic acid concentrations.

RESULTS

WINE A : Is the MLF behaviour different according to the initial L-malic concentration ?

<table>
<thead>
<tr>
<th>Malic acid degradation rate on total MLF (mg/L/day)</th>
<th>Initial malic acid (g/L)</th>
<th>SB3 Direct</th>
<th>B7 Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.63</td>
<td>34.4</td>
<td>45.4</td>
</tr>
<tr>
<td></td>
<td>1.83</td>
<td>110.9</td>
<td>128.5</td>
</tr>
<tr>
<td></td>
<td>4.00</td>
<td>167.0</td>
<td>195.5</td>
</tr>
<tr>
<td></td>
<td>6.30</td>
<td>208.3</td>
<td>210.2</td>
</tr>
</tbody>
</table>

The lower the initial L-malic acid concentration, the earlier MLF finishes. However, the MLF rate declines with lower initial malic acid concentrations.

WINE B : In a low malic acid context, is the fermentation rate decline due to a lower cell specific activity ?

Wines containing low initial L-malic acid concentrations are a concern to winemakers that fear that the lack of substrate for lactic acid bacteria might be a limiting factor to achieve or even start malolactic fermentation. Our results show that for concentrations as low as 0.5 g/L, this is not the case.

However in low initial malic acid situations, malolactic fermentation rates are lower and are directly linked to a tempered cell population development. On the other hand, specific rates calculation show that per cell malic acid is taken up and metabolized quicker when initial L-malic acid is low.

The duality between lower population levels and higher malic acid transformation rates per cell still remains to be investigated. It may be due to lactic acid, a well known inhibitor towards lactic acid bacteria, that alters the cells as it accumulates. The latter being tempered in a low malic acid context, cells could be preserved from this inhibitor.

CONCLUSION

Similarly to wine A that has a lower initial L-malic acid concentration, MLF finishes earlier but the MLF rate (mg/L/day) is lower. Population monitoring showed that the multiplication of the inoculated bacteria is less important in a low malic acid context, explaining the slower global fermentation rates. However, the calculation of the specific MLF rates, corresponding to the malic acid transformation rate per cell (or CFU), indicates that this rate is higher with lower initial malic acid, suggesting that each cell is able to metabolize more malic acid in low malic acid situations than with high initial concentrations.

REFERENCE
