Bacterial nutrition – essential for successful malolactic fermentation

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Introduction

The important role played by malolactic fermentation (MLF) during the vinification process, as well as its sensorial impact on and contribution to stability, are widely recognised. Various factors which include pH, SO2, alcohol concentration and temperature have a direct influence on the extent to which the bacteria will grow and multiply to ensure the successful completion of MLF. In order to prevent problematic or a lagging MLF, it is important for bacteria to have sufficient nutrients at their disposal to grow and function optimally so as to successfully complete the MLF.

The effect of must and wine composition on bacterial growth

The well-known limiting factors which include alcohol, pH, temperature and SO2 have a determining effect on the successful completion or not of MLF. Furthermore it should be taken into account that the specific factors mentioned above work synergistically. In addition to the above-mentioned limiting factors, other lesser-known limiting factors that include, inter alia, polyphenols, spraying residues and possibly residual lysozyme, may also have an inhibiting influence on the successful completion of MLF. Likewise the availability of sufficient amounts of specific nutrients plays an important role to ensure a successful MLF.

It is widely known that Oenococcus oeni has very specific and at times very fastidious nutritional requirements to support good growth and development of the bacteria. This includes a carbon source or sugar in the form of fructose, pentose sugars, glucose and organic acid, as well as a source of organic nitrogen such as e.g. amino acids and peptides. Inorganic nitrogen, supplied in the form of the well-known di-ammonium phosphate (DAP), cannot be used by the bacteria.

Vitamins, specifically from the B-group, as well as pantothenic acid, are required. Certain trace elements, including magnesium and manganese, also form part of the very specific nutritional requirements of Oenococcus oeni.

When specific shortages of some of the above-mentioned nutrients are experienced, specifically when wine conditions are very limiting (see table 1), it may have an extremely negative impact on the growth and development of the bacteria.

The importance of bacterial nutrition

In recent years research by Lallemand and associated institutions has provided better insight into and understanding of the specific nutritional requirements of MLF cultures, specifically the requirements caused by a limiting wine environment.

For example, a wine that has been fermented using a yeast strain that has an inherently high nutritional requirement, will obviously be more lacking in nutrients that are able to support the bacteria in the subsequent MLF. In such circumstances the addition of a MLF nutrient will be beneficial, so as to counter problems that may potentially arise as a result of nutritional deficiencies. This addition may be especially important in instances where must and wine initially had low levels of nutrients.

The fermentation of musts that are inherently poor in nutrients may cause the yeast used for the primary fermentation to produce significantly higher levels of SO2, which in turn may hamper the course of MLF. Under said conditions it may therefore also be beneficial to use bacterial nutrients.

From a vinification and wine quality point of view it is therefore important to: (1) apply good nutrition management during alcoholic fermentation, (2) inoculate MLF with selected commercial bacterial cultures, and (3) use bacterial nutrients should conditions require this. Under specific limiting circumstances the addition of bacterial nutrients ensures not only a quick onset and completion of MLF, but also prevents delayed and/or stuck MLFs. Here specific reference is made to the possible development of Brettanomyces/Dekkera and the negative influence this may have on wine quality, should a MLF be slow in getting started.

Example – The importance of sufficient nutrition may be illustrated by the following example.

A Pinotage 2003 was inoculated with commercial bacterial culture during February of that year. In June 2003, after about 110 days, the MLF was still not successfully completed (only 40% according to the analyses). The wine was analysed and found suitable for the addition of bacterial nutrients. Only 11 days after addition of the nutrients, the MLF had completed successfully. It is therefore clear that in this specific instance, a nutrient deficiency had been the cause of the unsuccessful MLF.

TABLE 1. *Various beneficial and unfavourable categories for the course of MLF.*

Wine environment	Alcohol (%)	pH	Free SO_2 (mg/l)	Total SO_2 (mg/l)	Temperature (°C)
Beneficial	<13	>3.4	<8	<30	18–22
Difficult	13–15	3.1–3.4	8–12	30–40	14–18
Very restrictive	15–17	2.9–3.1	12–20	40–60	10–14
Impossible	>17	<2.9	>20	>60–80	<10

What kind of nutrients should be used?

In order to address the specific nutrient requirement of the bacteria, Lallemand recently introduced two new bacterial nutrients namely ActiML and OptiMalo Plus to international markets. ActiML was formulated in such a way that commercial bacteria may be rehydrated in a water/ActiML solution before the wine is inoculated. This approach will assist the rapid onset and successful completion of MLF (see figure 1 for more detail). OptiMalo Plus, also formulated by Lallemand, is recommended as nutrient to help bacteria survive and support their activity during MLF (see figure 2 for more detail). In addition to using OptiMalo Plus to overcome potentially difficult circumstances for the bacteria, it may also be used when the MLF has already been induced, but good MLF activity has not yet been observed, as well as when a MLF that has already started, has begun to lose its tempo.

Conclusion

From the above data it is clear that bacterial nutrition is an aspect that should not be disregarded. It definitely contributes to the successful and complete course of MLF, and consequently a balanced and sensorially pleasant wine. It does not make economic sense, therefore, to undertake the entire vinification process according to good

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practice and accepted guidelines, and then allow the process to derail by not exercising sufficient control to ensure a successful MLF. To ensure the successful completion of MLF, it is therefore important to inoculate with proven commercial bacterial cultures, monitor it closely, and make the necessary nutritional adjustments should circumstances require to do so.

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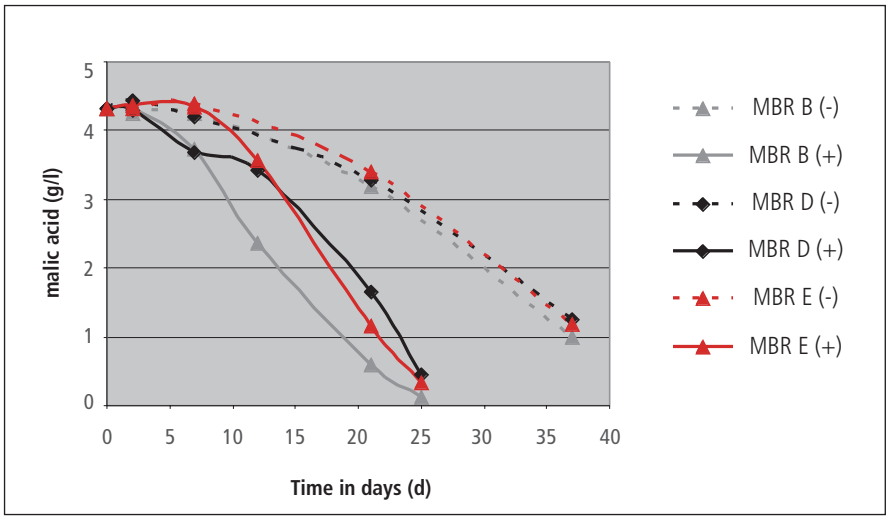

FIG 1: *The progress of MLF in a 2003 Chardonnay wine (alcohol 14,1% vol, TSO2 - 14 mg/l, MLF induced with various commercial bacterial cultures. With(+) and without (-) the adding of ActiML nutrients.*

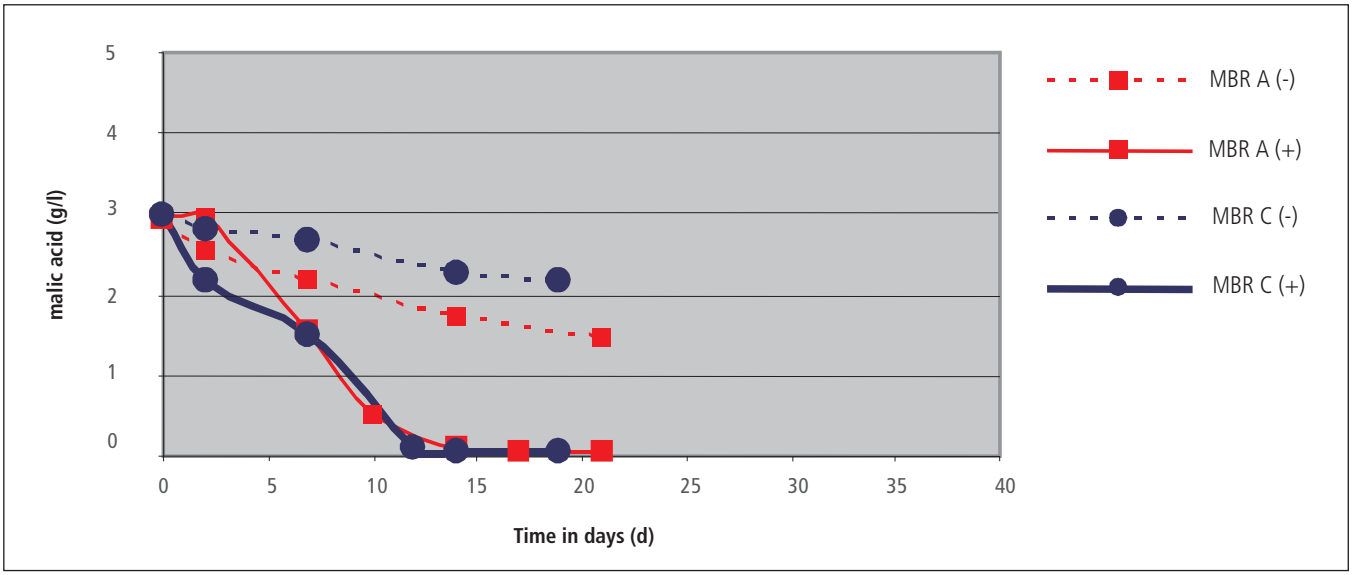

FIG 2: *The progress of MLF in a 2003 Cabernet Sauvignon wine (alcohol 13,0% vol, TSO2 - 35mg/l, pH 3,68) MLF induced with various commercial bacterial cultures. With(+) and without (-) the adding of OptiMalo Plus nutrients.*