Familiarise Yourself With Malolactic Fermentation

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Introduction

Malolactic fermentation is generally considered to be a simple breakdown of malic acid in red wines, and in some white wines, with the accompanying release of CO_2, the formation of lactic acid and a reduction in the total acid content of the wine in question. This is in fact exactly what happens, although the above could be an oversimplification of the process on the whole if it is deemed to be all that occurs.

The breakdown of malic acid to lactic acid imparts microbiological stability, while the formation of various components also has a sensorial impact. It is possible that the overall reduction in acid, together with the accompanying increase in pH, could also result in better and "softer" wines with more body. Commercial bacterial cultures that are used to induce MLF, are able to function under extremely limiting conditions, and have a positive impact on the sensory profile of wine, while also contributing to aspects such as better mouthfeel.

Well-known factors that influence MLF

The best-known limiting factors that restrict successful malolactic fermentation include: SO_2, pH, alcohol and temperature. For the MLF to be successful, winemakers should make their wines in such a way that the analyses of these wines that have to undergo MLF fall within the desired parameters for the chosen bacterial cultures to function successfully. This remains the best approach to ensure successful MLF. It nevertheless happens sometimes that while all factors fall within the desired parameters, the course of MLF could still be problematic (refer to "lesser known factors that influence MLF" below).

Lesser known factors that influence MLF

A number of lesser known factors influence the course of MLF. That they are lesser known does not mean that their impact is less significant. These factors include the following:

The effect of tannins

Recent research has shown that certain grape tannins can have a negative influence on malolactic bacteria, and consequently also on the course of MLF as a whole. For this reason it is clear that certain red cultivars, such as Merlot, can have great difficulty undergoing a successful MLF. A nutrient to support the course of MLF under these circumstances might be considered (see elsewhere for more details regarding the importance of nutrition).

The selection of yeast strain

It has been known for some time that certain yeasts (used to conduct the alcoholic fermentation) combine better with certain bacteria for the successful achievement of malolactic fermentation. Under specific conditions certain yeast strains may for example produce high concentrations of SO_2 which then obviously have a negative influence on the bacterial activity.

Yeast strains that also have a great need for nutrients could exhaust the medium to such an extent that no reserve nutrients are available for the bacteria. This problem can largely be surmounted by implementing a specific nutrition strategy for the particular yeast in the early stages of alcoholic fermentation.

Hydrostatic pressure

As a result of hydrostatic pressure, the lees found at the bottom of a tank can be compacted to such an extent that bacteria and nutrients are "captured" and cannot function properly. The recommendation is for the lees to be stirred regularly (at least weekly) to ensure that bacteria and nutrients are kept in suspension.

Residual lysosyme activity

If lysosyme is used during the production of wine, it could be that residual lysosyme impacts on the successful course of the subsequent MLF. Care must therefore be taken to follow the supplier's prescriptions carefully with regard to the time one should wait after the application of lysosyme, before inoculating the particular wine with a commercial MLF culture.

Excessive amounts of oxygen

Malolactic bacteria are sensitive to excessive amounts of oxygen and for this reason too much oxygen after the completion of alcoholic fermentation should preferably be avoided.

Fungicide residues

Certain fungicide and pesticide residues, especially the former, may have a detrimental effect on the functioning of malolactic bacteria. Winemakers must therefore be familiar with the spraying programmes and products used by their producers and on their farms. Furthermore they must adhere to withholding periods, as prescribed for the various spraying products.

Initial malic acid concentrations

Malic acid concentrations differ from one cultivar to the next and may also differ from year to year in the same variety. For this reason it could happen that, together with other factors, the duration (measured in days) of a MLF might differ from one particular year to the next.

Guidelines for a successful MLF

Guidelines that winemakers may follow in order to ensure a successful MLF, and to obtain a better understanding of the process as a whole, include:

- Following the manufacturer's prescriptions for the correct preparation and inoculation procedure, as well as correct dosages (usually 1 g/hl).
- Ensuring that the limiting factors, as discussed above, fall within the required parameters.
- Making sure that any other factors, as discussed above under "lesser known factors", do not possibly play a role.
- Using commercial cultures to inoculate and thereby ensuring sufficient number of cells/ml (at least 106) to initiate and successfully complete a MLF.
- If the approach is followed whereby MLF is induced after alcoholic fermentation, it is recommended that the temperature that was built up during the fermentation process be used to give the MLF a good kick-start.
- Using the necessary nutrients should circumstances require you to do so (refer to the importance of nutrition for more detail in this regard).
- Inoculation of MLF on the skins must be a calculated approach, seeing that a large number of the bacteria may be lost if the skins are removed shortly afterwards. Ensure proper stirring if this practice is followed.
- Avoiding cold areas in the cellar when inducing MLF, specifically where white wines are fermenting at temperatures of 15°C or even lower.
- Avoiding the use of mother tanks at all cost. By following this approach, the actual number of cells present may not be sufficient to initiate and complete the MLF successfully. The opportunity is also created for the indigenous bacterial population to emerge in greater force if the cell count of the commercial culture is too low, and could therefore be dominated or even take over.
- Making the right choice with regard to the specific bacterial culture that is to be used. (See examples below of a culture that was specifically selected for use on wines with a particularly high alcohol).

Example 1 – A 2003 Pinotage with an alcohol of

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15,5% was inoculated with Lalvin VP41 after alcoholic fermentation. After just one month the MLF was completed successfully. Table 1 gives an indication of the analyses of this specific wine before and after the completion of the MLF.

Example 2 – Step 1 – Inoculate a 2003 Pinotage (see Table 2 for complete analysis) with Lalvin VP41 culture. Initial temperature just after completion of alcoholic fermentation was approximately 23°C in order to best support the initiation of MLF. The wines were pumped to barrels where the temperature decreased gradually to about 17°C.

Step 2 – On day 2 OptiMalo© bacterial nutrient was added at 20 g/hl.

Step 3 – The course of MLF was monitored on a regular basis. After approximately 15 days 30% of the MLF was completed.

Step 4 – The MLF was approximately 60% completed after 42 days.

Step 5 – After only 56 days the MLF was completed successfully. Under these extremely prohibitive conditions this is indeed an exceptional achievement.

Lalvin VP41 has the advantage of functioning successfully under very high alcohol concentrations and contributes to a full-bodied, complex wine with good mouthfeel.

The importance of nutrition during MLF

For a malolactic fermentation to complete its course successfully under specific limiting conditions, sufficient nutrition for the bacteria is of the utmost importance.

The critical role that nutrition is able to play during MLF is explained in the light of the following example.

Step 1 – A 2003 Pinotage was inoculated with a commercial malolactic culture on 27/02/03 following the completion of alcoholic fermentation.

Step 2 – On 17/06/03, in other words, about 110 days later, still only 40% of the MLF was completed. A comprehensive microscopic analysis of the wine was done.

Step 3 – OptiMalo©, a nutrient, was added on 27/06/03, and the MLF was completed on 08/07/03, only 11 days after the addition.

It is obviously important to ensure that the process is undertaken under hygienic conditions right from the start, and that the necessary additions of sufficient amounts of SO_2 take place to limit the numbers of undesirable micro-organisms. Furthermore it is important to ensure that the specific wine is indeed inoculated with a commercial culture, so that sufficient "good" bacteria are present for the MLF to be completed successfully when the nutrient is added.

The importance of inoculating for MLF

The importance of using commercial cultures for the inoculation of malolactic fermentation cannot be emphasised enough. The occurrence of biogenic amines in wines is a reality, and wines that do not comply with the prescribed standards and minimum quantities will not be purchased by the specific supermarket groups or wine buyers. Several overseas countries, including Switzerland, have already established certain maximum acceptable levels (10 mg/l histamine). Experts are of the opinion, that several European countries will soon follow this example.

TABLE 1. *Analyses of 2003 Pinotage (example 1) before and after completion of MLF*

Analysis	Before MLF	After MLF
Alcohol (%)	15,5	15,5
Total acid (g/l)	7,4	5,1
Volatile acid (g/l)	0,25	0,31
pH	3,6	3,74
Malic acid (g/l)	>3,0	0,1 (MLF completed)

TABLE 2: *Analyses of 2003 Pinotage (example 2) before and after completion of MLF*

Analysis	Before MLF	After MLF
Alcohol (%)	15,62	15,62
Total acid (g/l)	7,5	5,62
Volatile acid (g/l)	0,49	0,59
pH	3,7	3,73 (after acid adjustment)
Malic acid (g/l)	2,13	0,1 (MLF completed)

A number of South African wines were referred back from overseas destinations in the course of 2003 as a result of biogenic amine levels being too high. These excessive levels of histamine in particular, which could possibly cause certain allergies, may largely be ascribed to spontaneous MLF that occurred in the wines. For this reason the use of commercial MLF cultures is strongly recommended. This approach will also ensure that biogenic amine levels remain low and within acceptable norms. Please refer to Table 3 for more details.

From the table above it is clear that various wines had histamine levels in excess of the acceptable guideline of 10 mg/l. What is more, this table only provides the picture regarding the histamine levels. There are several other biogenic amines such as e.g. tyramine, putrasine and cadavarine that each may have a detrimental effect on wine quality individually, but may also have an influence in conjunction with others.

Conclusion

Many winemakers are not yet familiar with the process of malolactic fermentation, and for this very reason the process remains a mystery and quite often a problem. However, as soon as the process of MLF is understood in its entirety, as well as the wonderful contribution that it makes to overall stability, complexity and better wine quality, winemakers will be more comfortable with the process. What is more, winemakers will also have a better understanding of why MLFs differ so distinctly from each other from year to year, and possibly be more patient with its overall progress.

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TABLE 3: *Histamine analyses of various local and overseas wines**

Wine	Cultivar	Country of origin	Histamine concentration (mg/l)
1	Unkown	South Africa	21,25
2	Unkown	South Africa	9,33
3	Unkown	South Africa	16,59
4	Unkown	South Africa	21,42
5	Pinotage	South Africa	23,7
6	Merlot	South Africa	13,1
7	Cab. Sauvignon	South Africa	7,9
8	Cab. Sauvignon	Chile	9,07
9	Shiraz	France	14,44
10	Shiraz	France	10,82

**Analytical data provided by Distell*