

Practical management of malolactic fermentation for Mediterranean red wines

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This article presents the main points discussed in a paper presented by D. Delteil at a Lallemand Symposium in Madrid (in September 2004).

Malolactic fermentation (MLF) is one of the main aspects to winemaking

The work undertaken with red wines from devatting is a key element in winemaking and is one the main routes of progression for Mediterranean wineries following the giant steps taken in the knowledge of maturation and maceration.

Malolactic fermentation (MLF) is one of the main aspects of winemaking and today both our knowledge and means of control, allow complete management of this process.

The essential points of alcoholic fermentation, today common knowledge, can be applied exactly in the same way for malolactic fermentation:

- Technical and economic risk management
- Development of the potential of the grapes and the wines regarding market goals, also by the choice of selected lactic bacteria strains.

1. Foreseeing MLF management when preparing for harvest

- The maturity of Mediterranean grapes has a positive influence on MLF : bacteria prefer low acidity and are not hampered by high Brix and then ethanol levels. Merlot is the exception : advanced ripeness often results in nutritional deficiencies for the lactic bacteria. This was frequent between 1999 and 2003 in Languedoc (main Mediterranean grape area in France).
- The sulfur atom of the SO₂ added to the grapes is later on still found in the wine under various forms, which are not included in the Total SO₂ : sulphates, thiosulphates, etc. All these forms have a negative impact on the lactic bacteria. For example : despite the same amount of SO₂ in two finished wines (10 mg/liter), the one made from a harvest sulfited with 30 g/ton finished its MLF within 12 days, while the one sulfited with 100 g/ton finished its MLF 21 days after the direct inoculation of the wine with selected bacteria. See figure 1.
- The choice of the selected yeast is also a tool for MLF practical management. Since the early 90's, it has been shown in Languedoc that the enological yeast may have an impact on the growth of the lactic bacteria. The production of SO₂ by the yeast may be the main key point when a difference exists between yeasts. But other elements may also interfere as shown in figure 2. In this example, before bacteria inoculation, the residual SO₂ levels are equal in both wines. In the case of these two particular enological yeasts, the difference in the MLF completion duration could be due to their different polysaccharides production during fermentation (Delteil and Jarry, 1992). These compounds are known to be favorable for lactic bacteria.
- Macerating for a long period creates a favorable environment for lactic bacteria, especially by further combining the SO₂ and by increasing the pH, especially when using maceration techniques well adapted for Mediterranean red wines (Delteil, 1998). This was confirmed in 1999 and 2000 in Languedoc, in particular on the more sulfited grapes.
- Sluggish alcoholic fermentations create problems for the MLF : either too early accompanied by a lactic disease, or too late. Both problems are frequent in wineries with insufficient fermentation management and unsuitable yeast inoculation techniques (Delteil and Aizac, 1988).
- The addition of sulfites to finished wine is well known for stifling lactic bacteria. It is useful when the alcoholic fermentation stops to avoid lactic disease. Under normal fermentation and cellar hygiene conditions, it needs to be avoided in order to progressively continue winemaking.

2. Two fundamental principles in managing major risks

- Finishing the sugars : most lactic bacteria produce volatile acidity when they consume sugar.

- Racking immediately after dryness : with only one racking before MLF there is still a lot of yeast biomass left in the wine. This has to be actively worked on : restricted to wines that have been immediately barreled or those matured with skilful microoxygenation and lee stirring. Two early, aired rackings represent the correct balance for most wines, especially after a well managed short maceration (Delteil, 2000).

3. Rapidly putting favorable MLF conditions into place

The conditions linked with a wine's composition depend on the mastering of its vinification. When the wine has reached its correct lee level, the main factor then becomes its temperature.

Maintaining the right temperature without variation : between 20°C and 22°C immediately after devatting.

Wines at 15°C or less may have a MLF, which is long in starting :

- The wine's work schedule is disturbed : stagnating wine with the high risk of developing smells of sulfur and hardening, metal tannins. This is illustrated in figure 3.
- The risk of a springtime MLF with all the negative commercial implications.

A reminder : Certain EDF (French power company) tariffs triple as of November 1st. The cost of a late wine reheating is a real handicap : up to 250 Euros/month for a 400 hl stainless steel vat.

4. Inoculation with selected bacteria

In light of the actual cost of 1,5 Euros/hectoliter the inoculation of the wine should take into account the technical and economic implications in order to make this direct cost profitable.

This implies numerous objectives :

- Managing a short MLF completion duration
- Limiting direct contamination from germs causing spoilage
- Managing lactic bacteria strains

Inoculation with selected bacteria is a well-mastered technique, which is now very reliable when winegrowing has been properly carried out with Mediterranean grapes. For example, in 1999, in the R&D Department's experimental winery, 90% out of 189 different wines completed MLF in less than 20 days, and only 6% of the wines had to be inoculated a second time. See figure 4.

- Managing a short MLF completion duration
- ✓ By limiting the period during which the wine is in a media favorable for the growth of spoilage anaerobic yeast and bacteria (*Brettanomyces*, *Pediococcus*, *Lactobacillus*). This period of the year is a critical point in the management of long term risks. A couple of days at 20°C without sulfiting or racking can be critical.
- ✓ Managing the schedule and frequency of work procedures related to the polyphenolic system of red wines.
- ✓ Limiting the direct heating costs by inoculating when the wine's temperature is still naturally favorable.

These three above outlined points are also valid for a rapid, spontaneous MLF or for the propagation of MLF from one vat to another. The following elements are more specific to direct inoculation using a selected bacteria strain.

- Limiting direct contamination of germs causing spoilage.

Propagation of wine from one vat to the other spreads malolactic bacteria as well as yeast and spoilage anaerobic bacteria. This is true as of the first propagation. For premium wines, where the objective is mastering SO₂, managing the risk of contamination is a priority. To this end, direct inoculation is a useful tool, completed by an irreproachable standard of hygiene.

- Managing the strain of lactic bacteria.

A well-known strain ensures the microbiologic purity of the bacterial population and the reliability of its behavior. The different strains of selected bacteria on the market express analytical, aromatic and tasting differences.

Original characteristics can directly participate in the mastering of a wine's profile.

The mastering of Mediterranean red wines profiles was the goal of ICV's lactic bacteria selection program, from 2000 to 2003. The first result was the selection of the malolactic ferment ELIOS-1. To be sure that the selected malolactic ferment will fit wine market demands, experimental wines made with the new isolates were presented to wine marketers. Their opinion was taken in count in the final choice of the most interesting malolactic ferment : ELIOS-1.

Original characteristics brought by specific strains are elements that are now taken into consideration by vintners, who use all the techniques at their disposal in making a preconceived product. See figure 5. The wine made with strain ELIOS-1 has obviously a more interesting profile for international markets.

5. Mastering the completion of the MLF

When the lactic bacteria have consumed all the malic acid, their metabolism can continue on other compounds : citric acid, sugar etc.

It is during this phase that increases in volatile acidity take place and violent lactic aromas are produced. If this phase continues without proper control, the wine becomes vulnerable to the development of spoilage germs : *Brettanomyces*, *Lactobacillus*, *Pediococcus*. These germs are capable of producing extremely unpleasant, horsy aromas and biogenic amines (compounds which could cause the allergic reaction of certain people). See figure 6. It is obvious that few consumers will appreciate the wine that had a development of *Brettanomyces* yeast.

It is therefore important to eliminate lactic bacteria once the MLF has finished to avoid contamination by spoilage germs. Aired racking followed by homogeneous sulfiting respecting the adapted SO₂ quantities are the basic winemaking procedures to follow.

6. Answering consumer demand

As well as having an immediate technical and economic impact on the cellar, a well-mastered MLF is one of the steps having the most impact on consumers.

It helps limit chemical elements, by optimizing the dosages of SO₂ and their efficiency.

It limits the apparition of risky compounds, such as biogenic amines.

Well prepared, properly managed, before and after, it helps limit curative treatments : violent fining, the addition of tannins etc.

All this helps uphold a respect for wines and respect for consumers and their health.

It also helps immediately develop and stabilize the quality of aromas and tannic expression. These sensorial characteristics participate in directly satisfying consumer hedonistic demand.

The hygienic quality of wines coming from naturally ripened grapes, innovative winemaking and gentle sensorial pleasures are the winning characteristics of red Mediterranean wines in France and abroad.

The thorough handling of the MLF totally fits into a reasoned approach to winemaking, built on scientific foundations and orientated towards consumers.

Within this context, a mastered MLF should participate in consolidating the positioning of red Mediterranean wines. Logically, the cellars that are the most implicated with the market are the first to integrate it into their winemaking.

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Figure 1. The effect of the SO₂ addition to the fresh harvest on the MLF completion duration.

Legend. Cabernet Sauvignon 1995. A grape batch was split into two equal batches. One batch was sulfited with 30 g/ton. The other batch was sulfited with 100 g/ton. After 3 weeks' maceration the two wines were inoculated with the same lactic bacteria. Total SO₂ in both wines before inoculation : 10 mg/liter.

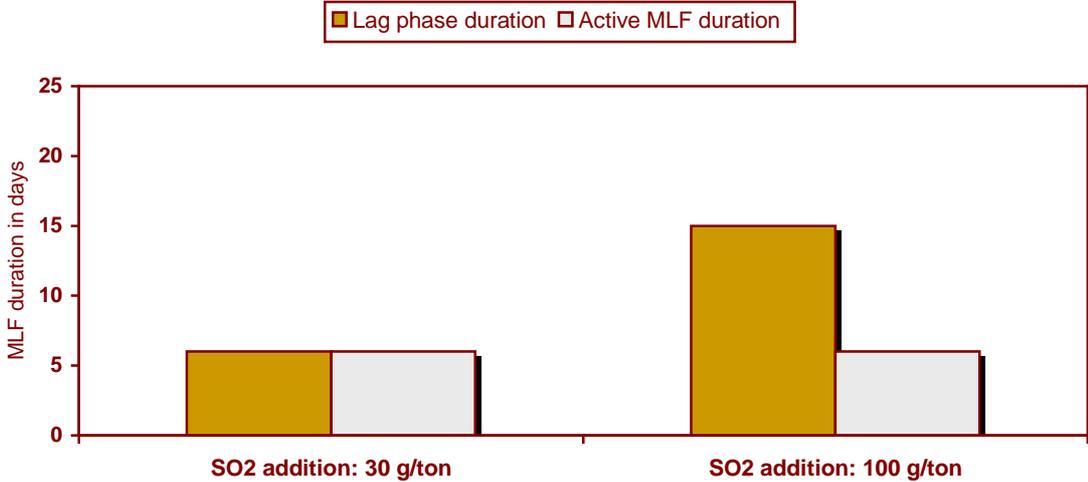


Figure 2. The effect of the enological yeast on the MLF completion duration.

Legend. Chardonnay 1990. A juice batch was split into two equal batches inoculated with two different enological yeasts. The two respective wines were inoculated with the same lactic bacteria. Total SO₂ in both wines before inoculation : 10 mg/liter.

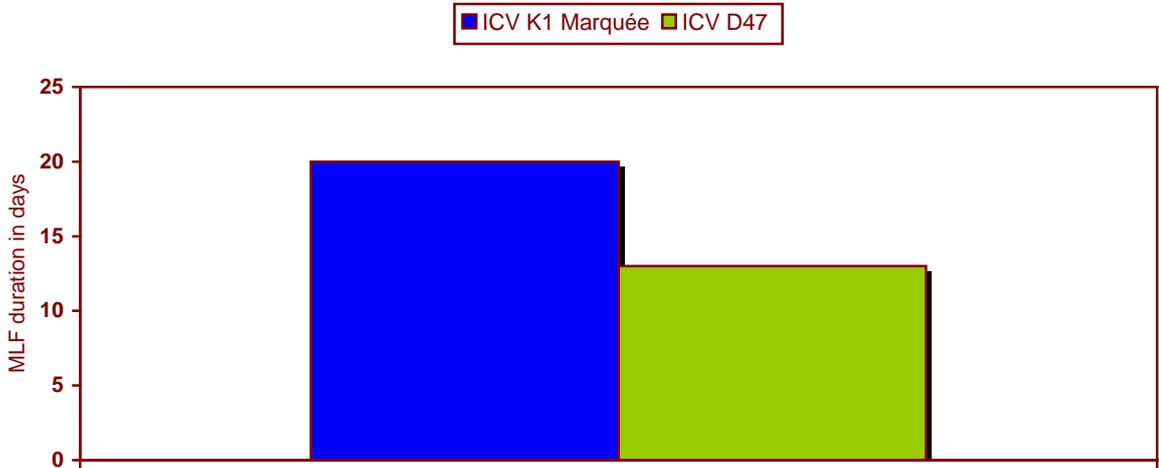


Figure 3. The effect of the duration of MLF lag phase on the sensory profile of red Mediterranean wines.

Legend. A Syrah wine batch was split into two equal batches. One batch was immediately inoculated with a lactic bacteria. The other batch was left for 23 days at the same temperature, and then inoculated with the same lactic bacteria.

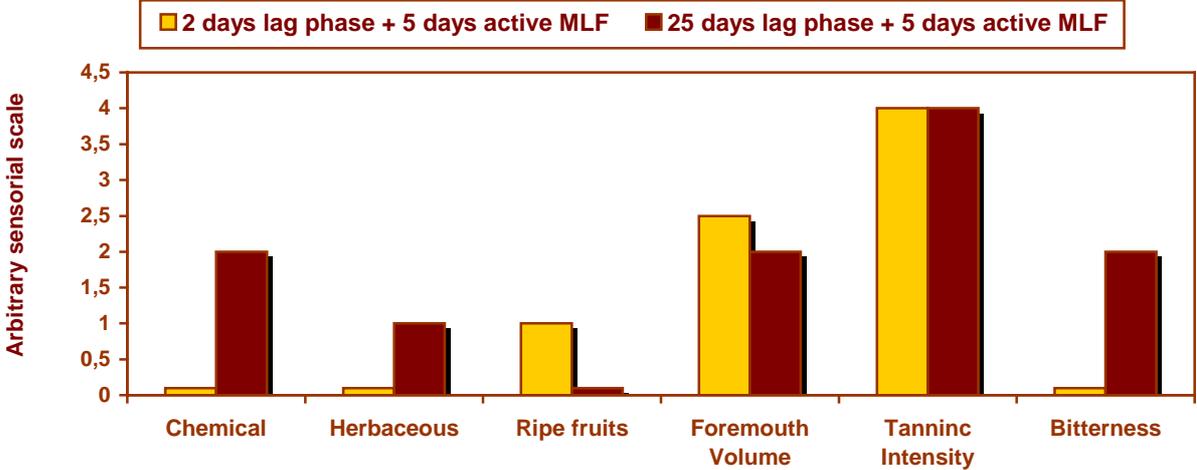


Figure 4. The effect of direct lactic bacteria inoculation on the MLF completion duration.

Legend. The 189 wines were raked two times : 24 hours and 72 hours after the completion of alcoholic fermentation and immediately inoculated with the same lactic bacteria.

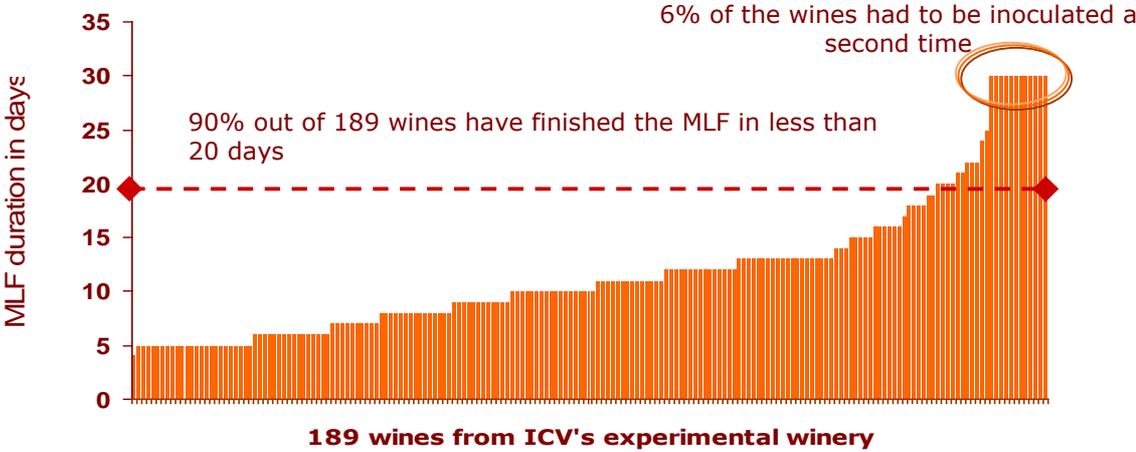


Figure 5. The effect of the strain of lactic bacteria on the sensory profile of red Mediterranean wines.

Legend. A Syrah wine batch was split into 2 equal batches. One batch were immediately inoculated with the malolactic ferment ELIOS-1. The other batch was not inoculated. MLF completion durations were respectively 8 days for strain ELIOS-1 and 12 days for the non-inoculated batch.

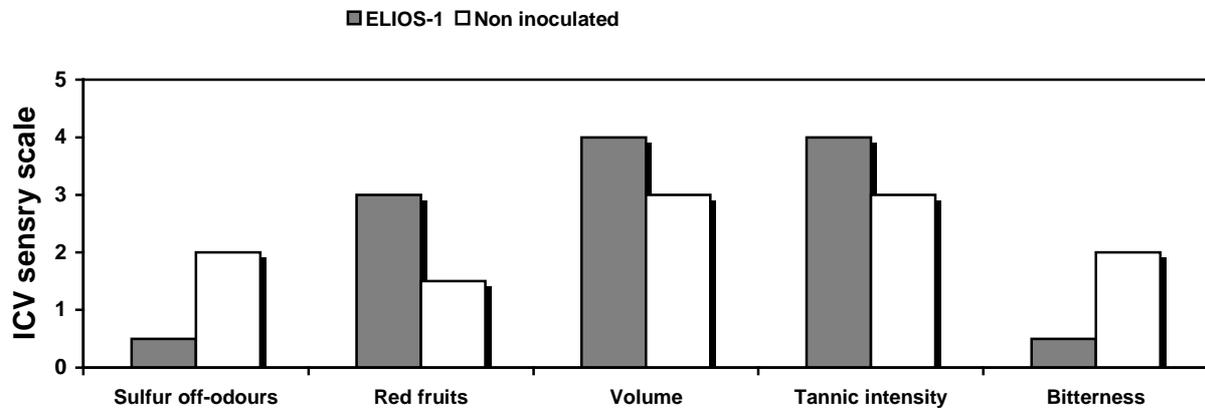


Figure 6. The effect of the growth of a *Brettanomyces* yeast on the sensory profile of red Mediterranean wines.

*Legend. A Merlot wine batch was split into two equal batches. One batch was inoculated with a culture of *Brettanomyces*. Both wines were left at 18°C for 4 weeks.*

