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ENARTIS NEWS
MALOLACTIC FERMENTATION SCENARIOS: WHEN TO PROMOTE, DELAY OR PREVENT IT

Depending on the desired wine style, we may want to promote, prevent or delay malolactic fermentation (MLF). Here are some practical tips on how to handle these situations.

PREVENT MLF

For young, fresh, easy-to-drink style wines, MLF may not be desired. Lactic acid bacteria activity is generally controlled by using SO_2 but in many situations, especially in the case of high pH wines, its addition is not always enough and spontaneous fermentation can occur. In the case of SO_2-free or low-SO_2 wines, base wines for sparkling production for example, the risk of an unwanted malolactic fermentation onset is obviously even higher. In critical conditions, 10-20 g/hL of an activated chitosan-based product such as EnartisStab Micro M (Figure 1) can be used to reinforce SO_2 antibacterial activity and reduce the number of bacteria to below the risk threshold thus preserving wine acidity.

EnartisStab Micro M can be added to wine, stay in contact for a couple of days, then racked or filtered off. This method is recommended when wine needs to be cleared quickly, knowing that once chitosan is removed, wine is unprotected from new potential contamination.

Alternatively, EnartisStab Micro M can remain in contact with wine and be periodically resuspended to reactivate its antimicrobial protective effect in the full wine volume. This way of operating is highly recommended especially in cases of SO_2-free or low-SO_2 wines.

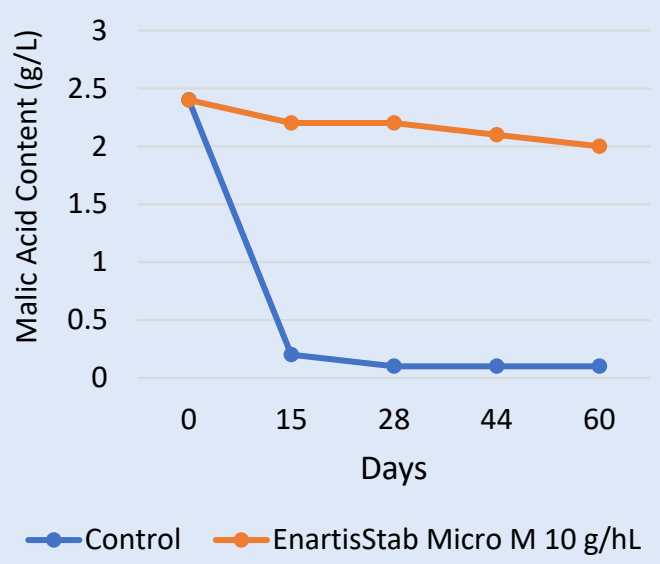

Figure 1: EnartisStab Micro M inhibiting effect on MLF. The graph shows the variation of malic acid concentration over time in a control wine versus wine treated with EnartisStab Micro M.

	ACTIVATED CHITOSAN	LYSOZYME	SO_2
Origin	*Aspergillus niger*	Egg Albumen	Sulfur
Allergenic		✓	✓
Suitable for Vegetarians	✓	✓	✓
Suitable for Vegans	✓		✓
Effective Against Lactic Bacteria	✓	✓	✓
Effective Against Acetic Bacteria	✓		✓
Effective Against *Brettanomyces*	✓		✓
Effectiveness at High pH	Good	Good	Limited
Positive Side Effects	• Antioxidant (removes Cu and Fe) • Minimize laccase activity • Improve wine clarity • Remove sulfur off-aroma		• Antioxidant
Negative Side Effects		• Strips color	• Discoloration • Interferes with the color stability process

DELAY MLF

Most red wines go through MLF and, for the majority of winemakers, the sooner it happens, the better. The time frame between alcoholic fermentation (AF) and MLF is the best stage to apply macro-oxygenation to encourage anthocyanin-tannin polymerization via acetaldehyde bridge formation. Having a 5-10 day interval offers the opportunity to effectively improve wine color stability due to the fact that the following factors converge during this period:

- Wine temperature is relatively high and promotes fast reactions.
- Free anthocyanin and grape tannin concentrations are at a maximum.
- SO_2 content is close to zero and cannot hinder ethanol oxidation or bind with acetaldehyde and anthocyanins, thus inhibiting polymerization and condensation reactions.

Oxygen added in a relatively high quantity per day (hence the term "macro-oxygenation") induces the oxidation of ethanol into acetaldehyde. This compound acts as a bridge in polymerization reactions involving tannins and anthocyanins, creating stable color compounds that contribute to a deep mauve color and soft tannin structure. The addition of tannins specifically designed for this application such as **EnartisTan E** (grape seed extract rich in monocatechins) or **EnartisTan Microfruit** (blend of oak tannin and condensed tannins extracted from grape seeds and wood of red fruit trees) amplifies the effect of macro-oxygenation increasing the fraction of anthocyanins converted to more stable compounds (Figure 2). Consequently, wine will not only keep more intense and fresher color, a characteristic especially desired in varieties naturally poor in color such as Pinot noir, Sangiovese and Nebbiolo, but it will also have a fuller and softer body due to the contribution of this greater content of pigments.

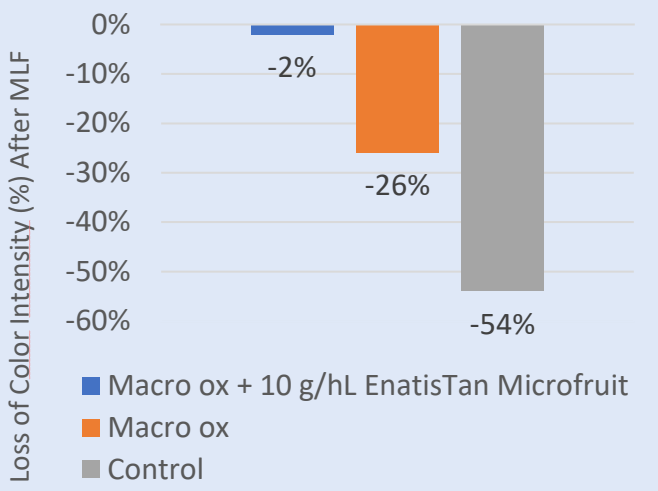

Figure 2: Macro-oxygenation plus tannin addition reduces the loss of color caused by MLF.

Promote MLF

Due to the tendency of wine pH to increase and reducing the use of sulfur dioxide, spontaneous MLF can easily occur. Spontaneous MLF is a risk for wine and consumer health.

Controlling MLF with selected strains of *Oenococcus oeni* helps control the timing of malic acid degradation and ensures the production of healthy, high-quality wine by preventing the production of biogenic amines and off-flavors, contributing positively to aroma complexity.

It is well-known that the success of a controlled MLF depends on wine parameters (mainly ethanol content and pH), choosing the most suitable strain and correct handling of the product (Figure 3). Nevertheless, even with all wine parameters and the MLB strain selection seeming correct, MLF may struggle to start. This is due to the presence of inhibiting factors in wine which are not easily detected. Residual copper or pesticides, low-molecular weight fatty acids and some proteinaceous compounds produced by yeast and high levels of polyphenols can alter bacteria cell membrane permeability or inhibit malolactic enzymatic activity and prevent MLF onset. Occasionally, the lack of nutrients, namely nitrogen in organic form, is the main obstacle for MLF success.

Naturally, dealing with a microbiological unprotected, warm wine for one or two weeks can create some anxiety. This is when activated chitosan can help winemakers reach the goal safely. The addition of 10 g/hL of EnartisStab Micro M towards the end of AF, when there is still 10 -15 g/L residual sugar, or 5 g/hL right after racking off, will delay the onset of MLF and support macro-oxygenation treatment without interfering with the color stabilization process while controlling lactic acid bacteria, acetic acid bacteria and *Brettanomyces* at the same time. Once macro-oxygenation is completed, removing EnartisStab Micro M with a rack off is enough to recreate the favorable condition for the onset of MLF with selected bacteria inoculation.

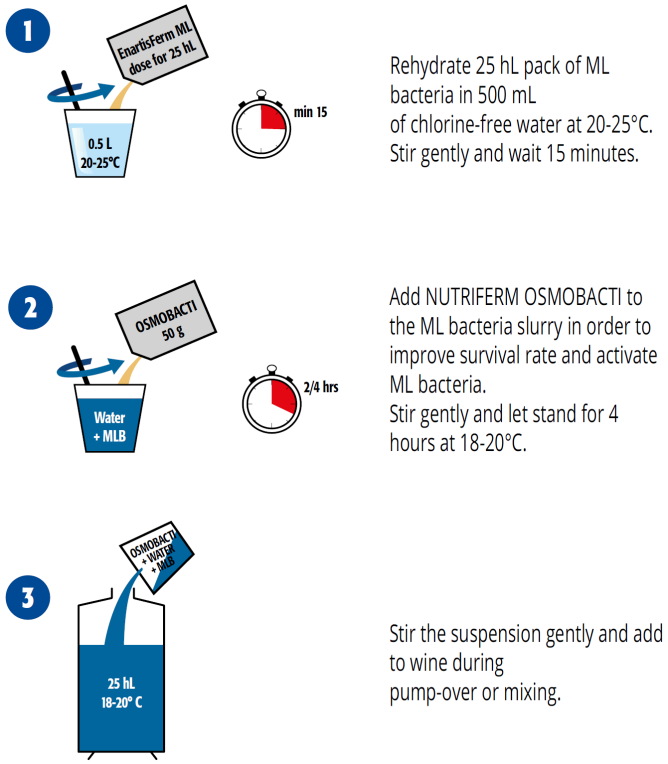

Figure 2: Protocol for malic acid bacteria preparation and inoculation. Direct addition, 25 hL.

In these instances, the addition of a yeast derivative product such as **Nutriferm ML** helps to detoxify the environment by absorbing the inhibiting factors and providing amino acids for bacteria nutrition.

Principal Factors	EnartisML MCW	EnartisML Silver	EnartisML UNO
Species	*Oenococcus oeni*	*Oenococcus oeni*	*Oenococcus oeni*
pH Tolerance	>3.1	>3.1	>3.3
Free SO_2 Resistance (mg/L)	<10	<10	<10
Total SO_2 Resistance (mg/L)	<40	<45	<40
Alcohol Tolerance (% v/v)	>15	>15	<15
Speed	Moderate/High	High	Moderate/High
Sensory	Contributes buttery character, aroma complexity, softness and broadness of wine flavors.	Clean, floral, fruity and complex aromas; respects color; improves structure, volume and aromatic intensity.	Maintains color intensity; respects varietal aroma and olfactory cleanliness.

For more information, please call Enartis USA's technical services at (707) 838-6312.

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