The Australian Wine Research Institute

Fact Sheet
WINEMAKING

Malolactic fermentation in white and sparkling wines

Introduction

Malolactic fermentation (MLF) is a secondary bacterial fermentation carried out in most red wines and some white and sparkling wines. It often occurs naturally after the completion of primary fermentation or can also be induced by inoculation with a selected bacterial strain.

Oenococcus oeni, a member of the lactic acid bacteria (LAB) family, is the main bacterium responsible for conducting MLF, due to its ability to survive the harsh conditions of wine (high alcohol, low pH and low nutrients) and its production of desirable wine sensory attributes.

Compared to red wines, the decision to induce MLF in white and sparkling base wines is generally based on stylistic criteria, such as deacidification or to modify flavour complexity and mouthfeel. However, due to their comparatively harsher conditions for malolactic bacteria, inducing MLF in white wines can often be challenging. In these circumstances, it is essential that an appropriate malolactic starter culture is selected. This fact sheet provides some basic criteria to aid in the selection and effective use of malolactic starter cultures for induction of MLF in white and sparkling base wines.

Malolactic fermentation in red wine and flavour modulation by MLF are covered in separate AWRI fact sheets.

Composition of white and sparkling base wines

The chemical composition of white and sparkling wine can provide a difficult or even hostile environment for malolactic starter cultures. Key factors include low pH (2.9 – 3.4), moderate to high concentrations of total SO_2 (up to 50 – 60 mg/L) and lower fermentation temperatures (down to 12°C).

Conditions that are favourable and unfavourable for MLF in white and sparkling base wines are summarised in Table 1. While each parameter is rated separately, it is important to note that there are synergistic inhibitory effects of combinations of two or more of the parameters.

Table 1. Favourable and unfavourable wine conditions for MLF in white and sparkling base wines

Wine parameter	Favourable	Moderate	Difficult	Harsh
Temperature (°C)	18 - 22	15 - 18	12 - 15	< 12
pH	> 3.3	3.2 - 3.3	3.1 - 3.2	< 3.1
Total SO_2 (mg/L)*	< 30	30 - 50	50 - 60	> 60
Alcohol (% v/v)	< 12	12 - 13	13 - 14	> 14

*Note: malolactic bacteria are highly sensitive to the free/molecular form of SO_2, with 0.3-0.5 mg/L molecular SO_2 being a lethal concentration for wine bacteria. However, bound forms of SO_2 are also inhibitory and, while it is ideal for MLF induction in white and sparkling base wines that free SO_2 is not detectable, the total SO_2 content must be considered.

MLF strain selection criteria

1. Bacteria strain tolerance to wine physico-chemical properties

The primary criteria for the selection of an appropriate malolactic bacteria strain generally focus on the strain's ability to tolerate the prevailing wine chemical conditions. This is particularly the case when selecting a strain suitable for inoculation of white and sparkling base wines where, for example, in wines with pH approaching pH 3.1 or lower, the choice of strain becomes restricted to those highly tolerant of low pH. Similarly, as total SO_2 values exceed around 50 mg/L, a highly sulphite-tolerant strain should be selected. The oenological performance limits of commercial malolactic strains can be found on supplier websites and technical data sheets.

2. Yeast strain compatibility and nutritional aspects

The compatibility of the primary fermentation yeast with malolactic bacteria is another major factor that can influence the success or failure of MLF, especially in white and sparkling base wines. Certain yeast strains used to conduct primary fermentation may inhibit MLF through the production of metabolites such as SO_2 and certain fatty acids. Moreover, as a clarified white wine or sparkling base may already be nutritionally limiting, use of a yeast strain with a high nitrogen

demand may further deplete the nitrogen pool available to the fastidious malolactic bacteria. To reduce these potential risks to MLF in white and sparkling base wines, it is therefore important to select a compatible and favourable yeast/bacteria combination.

Acclimitisation of starter cultures

For wines with difficult to harsh conditions, commercial suppliers of bacterial starters may recommend one or two acclimatization steps prior to inoculation. These are generally undertaken for 1-2 days in a volume of the wine to be inoculated, and may improve the ability of the culture to survive and conduct MLF. The acclimatisation procedure recommended by the supplier/manufacturer should be followed.

Inoculation timing

MLF inoculation can be undertaken at several stages during winemaking. Inoculation after the completion of alcoholic fermentation (known as sequential inoculation) is the most common, but more recently there has been a trend to inoculate earlier, a practice that can reduce the overall time for vinification or assist with adapting the bacterial strain to particularly harsh wine conditions. Under this approach, known as co-inoculation, MLF bacteria are usually inoculated 24–48 hours after yeast addition, which helps to alleviate the effects of any free SO_2 arising from harvesting/crushing additions.

The use of co-inoculation can potentially provide an advantage in overall MLF efficiency compared to sequential inoculation. In the case of white and sparkling base wines, several guidelines for co-inoculation should be considered. These include:

i. Ensuring that a suitably compatible yeast - bacteria strain combination is chosen

ii. Allowing 24-48 hours after yeast inoculation before the bacteria culture is inoculated (to ensure binding of free SO_2 by yeast)

iii. If grape must temperature is low (e.g. 12 – 15°C or less), considering inoculation at a later stage when temperatures are above 15°C

iv. Applying appropriate measures to ensure that primary yeast fermentation does not become sluggish or stuck, including optimal nitrogen and temperature regimes. See AWRI fact sheet *Procedure to rescue or restart a slow or stuck fermentation*

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