TIMING OF MALOLACTIC FERMENTATION

Reasons for Malolactic Fermentation (MLF):

1. Soften, naturally de-acidify.
2. Flavor: loss of malic acid, addition of lactic acid, diacetyl (butter).
3. Stabilize wine microbially.

Traditional method: MLF in spring as the weather warms.

Advantages:

Stronger bacteria due to acclimation (Ribereau-Gayon).
More stable color (V. Gerbaux).

Disadvantages:

Extended time without SO2.
Risk of Brettanomyces or bacterial infection.
Mixed culture; potential for biogenic amine formation.

Sequential Inoculation vs. Co-Inoculation

Timing can affect flavor, microbial impact and stability.

Sequential Inoculation: inoculation at completion of alcoholic fermentation.

1. Higher diacetyl; more complexity (?).
2. Longer, slower MLF.
3. Adding culture to alcoholic environment is hard on bacteria.
4. Longer time without SO2; risk of infection.
5. Risk of mixed bacterial culture with unknown strains.

Co-Inoculation: inoculation 12-24 hours after yeast inoculation.

1. Lower diacetyl; consumed by the yeast.
2. More fresh fruit characters in the wine.
3. Faster, shorter MLF.
4. Added to juice; acclimates during alcoholic fermentation (AF).
5. Shorter time without SO2; less risk.
6. Less risk of mixed strains, biogenic amines.
7. Risk of acetic acid formation if alcoholic fermentation sticks.

Recent Research:

*Long gap between alcoholic and ML fermentations favors Brettanomyces growth and ethyl phenol (barnyard) formation.

*Short or no gap favors beneficial added bacteria.

*ML bacteria preferentially consume organic acids before consuming sugar and forming acetic acid (S. Krieger-Weber).

*Recommendation for sequential ML: inoculate at 0 Brix by hydrometer. Wine is still warm from AF and as the yeast dies, added bacteria fill the microbial void (V. Renouf).

*Protocol for co-inoculation:

1. Keep SO2 addition $\leq$30 ppm.
2. Control temperature: too cool and bacteria becomes sluggish; too hot and bacteria dies.
3. Add bacteria 24 hours after yeast.
4. Use yeast with low nutrient demands and low SO2 production.
5. Proper bacteria rehydration: use only non-chloronated water; rehydrate at 20C; rehydrate a maximum of 15 minutes before inoculation.

MLF Scorecard

To take some of the guesswork out of winemaking, Lallemand has developed this scoring system to assess the malolactic fermentation potential of a wine. Each relevant condition is assigned a score, and the total score indicates whether MLF is likely to be easy or difficult.

Scorecard for determining the ease of malolactic fermentation

CONDITION	1 point each	2 points each	8 points each	10 points each		Score
Alcohol (% vol)	<13	13 - 15	15 - 17	>17		
pH	>3.4	3.1 - 3.4	2.9 - 3.1	<2.9		
Free SO_2 (mg/L)	<8	8 - 12	12 - 15	>15		
Total SO_2 (mg/L)	<30	30 - 40	40 - 60	>60		
Temperature (°C)	18 - 22	14 - 18 or 18 - 24	10 - 14 or 24 - 29	<10 or >29		
Yeast's nutritional needs	Low	Medium	High	Very high		
Ease of alcoholic fermentation	No problems	Transient yeast stress	Sluggish / stuck AF	Prolonged yeast contact		
Initial level of malic acid (g/L)	2 - 4	4 - 5 or 1 - 2	5 - 7 or 0.5 - 1	>7 or <0.5		
Maximum AF rate (maximum loss of brix/day)	<2	2 - 4	4 - 6	>6		

Note: Other, currently less well-known factors that are not considered in this scorecard may include the level of dissolved oxygen, polyphenolic content, lees compacting, pesticide residues, etc.

Total score for the ease of malolactic fermentation:

Results

Favorable: < 13 points • Not so favorable: 13-22 points • Difficult: 23-40 points • Extreme: >40 points

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DIACETYL--FACTORS AFFECTING CONTENT IN WINE

from Bartowsky and Henschke, adapted from Martineau

Winemaking factors	**Effect on diacetyl concentration and/or sensory perception**
Malolactic bacterial strain	*O. oeni* strains vary in production of diacetyl.
Wine Type	Red wine versus white wine favors diacetyl.
Inoculation rate of malolactic bacteria	Lower inoculation rate (10^4 vs. 10^6 cfu/mL) favors diacetyl production.
Contact with active yeast culture (lees)	Yeast contact reduces diacetyl content of wine.
Contact of wine with air during MLF	Oxygen favors oxidation of a-acetolactate to diacetyl.
Sulphur dioxide content	•SO_2 binds diacetyl, which renders it sensorily inactive. •SO_2 addition inhibits yeast/bacteria activity and stabilizes diacetyl content at time of addition.
Citric acid concentration	Favors diacetyl production. However, acetic acid is also produced.
Temperature at which MLF is conducted	18°C vs. 25°C may favor diacetyl production.
pH of wine at which MLF is conducted	Conflicting information; residual sugar may reduce diacetyl production.