MLF choices in Sparkling wine production

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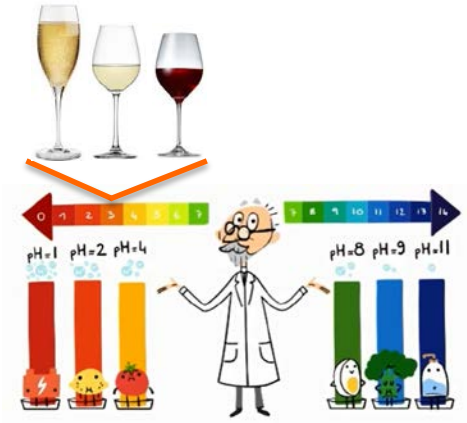
MLF in sparkling wine

- Style desired
  - Reduce acidity of the base wine
  - Provide microbial stability to the base wine
    - Don’t want MLF during 2° fermentation

- Challenges
  - Base wine has high acidity
  - SO2 is more effective at low pH



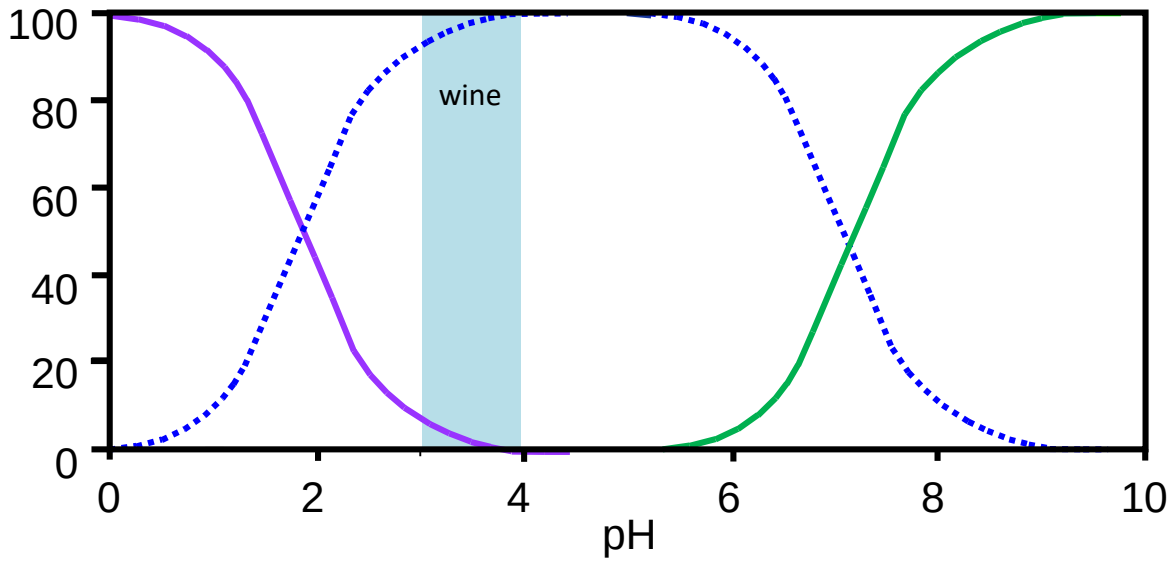
Sulphur dioxide

In solution SO_2 exists in 3 main forms in equilibrium

$SO_2 + H_20 \rightleftharpoons HSO_3^- + H^+ \rightleftharpoons SO_3^{2-} + 2H^+$

Molecular — Bisulfite — Sulfite

92~99%



A molecular SO_2 level of 0.4 ppm (equivalent to a free SO2 level of 20 ppm at 3.50 pH) will kill wild yeast without adversely affecting *Saccharomyces*.

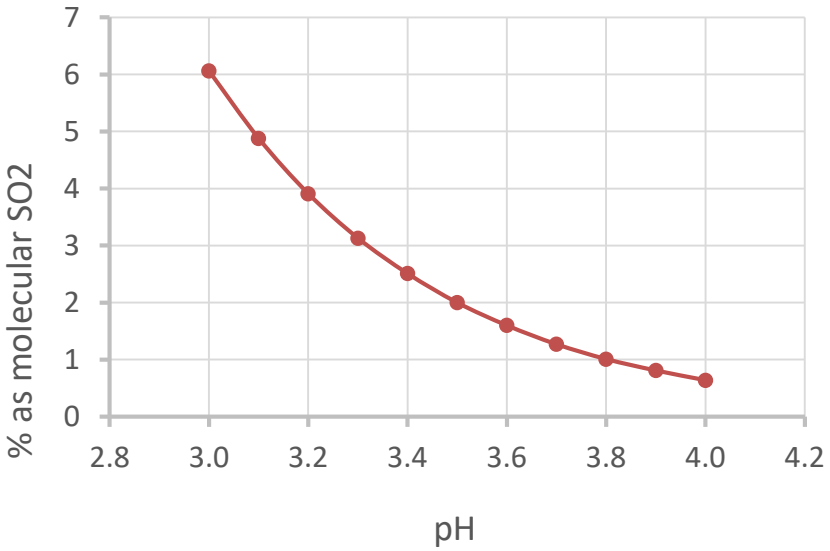
Sulphur dioxide

- Antimicrobial & antioxidant
- Binds to carbonyls (particularly acetaldehyde), sugars, colour & phenolics
- In wine we talk about
  - Molecular, Free, Bound & Total SO2

SO2 form	Definition	
Molecular SO_2	SO_2	Antimicrobial
Free SO_2	Mol SO_2 + bisulfite HSO_3^-	Antioxidant
Bound SO_2	Includes both strongly & weakly bound forms	Contributes to total SO_2
Total SO_2	Free + Bound SO_2	

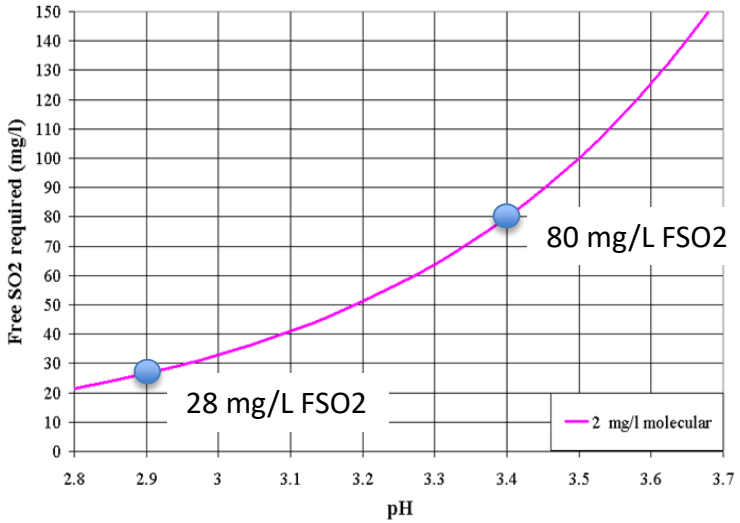
Interplay of Free SO2, Molecular SO2 and different pH levels in wine

Percent of the Free SO2 that is present as molecular SO2 at different pH levels in wine.



- More mol SO2 at lower pH

Concentration of Free SO2 required for 2 mg/L mol SO2 at different wine pH.



- Less FSO2 is required for equivalent of 2 mg/L mol SO2 at pH 2.9 than at pH 3.4

➢ *Lower pH = higher mol SO2 = free SO2 is more effective at lower pH*

Challenges for MLF in Sparkling wine

- Base wine has high acidity
- SO2 is more effective at low pH

- Alcohol is not usually a problem

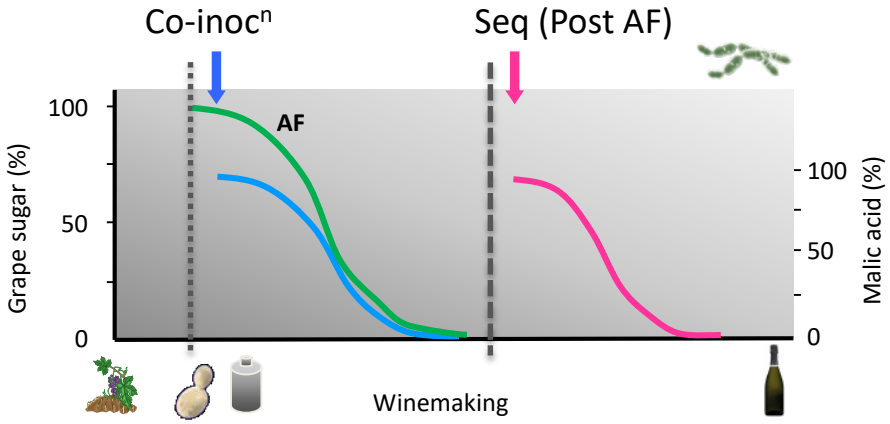
- Malic acid – high
  - Lactic acid can be inhibitory to bacteria

MLF options

- Timing of inoculation
- Bacteria culture preparation

Timing of inoculation

- **Co-inoculation**
  - Adaptation to juice/wine
  - Completed sooner



- **Sequential inoculation**
  - Managing only MLF (bacteria)

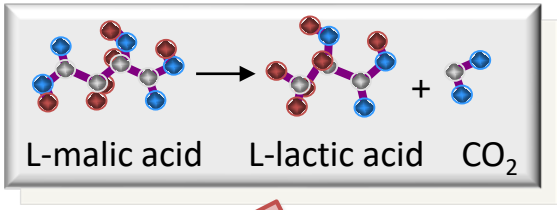
❖ High malic acid content
  - As MLF progresses, lactic acid produced
    - ➢ *Lactic acid can be inhibitory to bacteria*

Malic acid tolerance / Lactic acid sensitivity

Factors that impact MLF	Easy	Moderate	Difficult	Extreme
Initial level of malic acid (g/L)	2 - 4	4 - 5 or 1 - 2	5 - 7 or 0.5 - 1	>7 or <0.5

2-4 g/L malic acid ideal for MLF efficiency

>4 (5+) g/L malic acid an be difficult to get to completion



Inhibition of the bacteria by increasing concen^{n} of L-lactic acid derived from the MLF itself

<1 g/L malic acid not as inductive to MLF

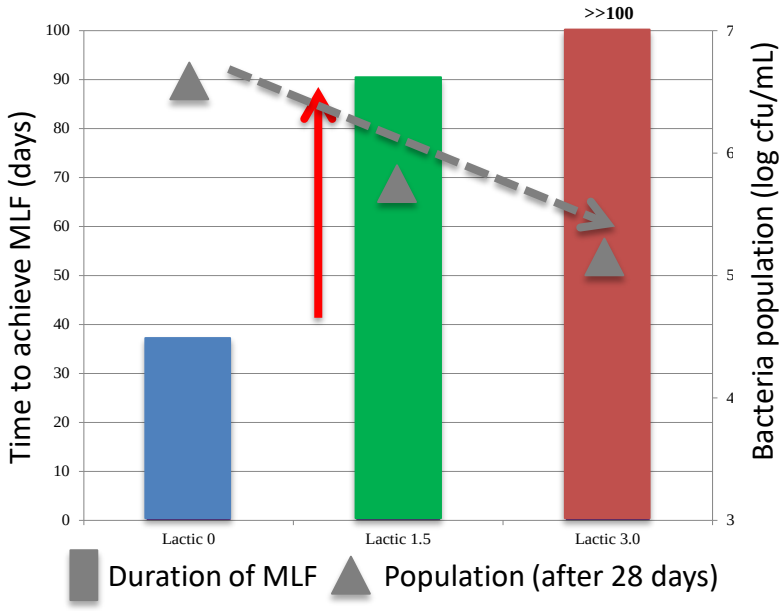
<0.8 g/L malic acid can be difficult to restart MLF

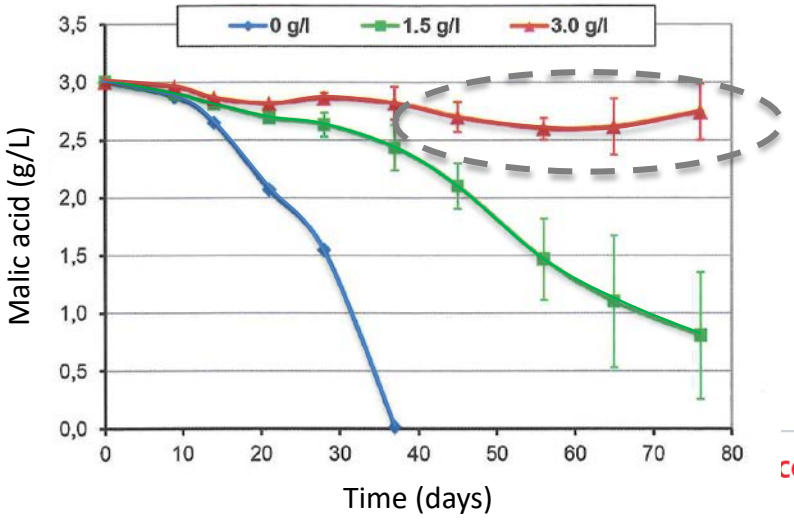
~ 3 g/L lactic acid can be inhibitory to LAB

1 g malic acid → *in practice* = 0.5-0.55 g lactic acid
(in theory = 0.67 g lactic acid)

Impact of addition of L-lactic acid before MLF

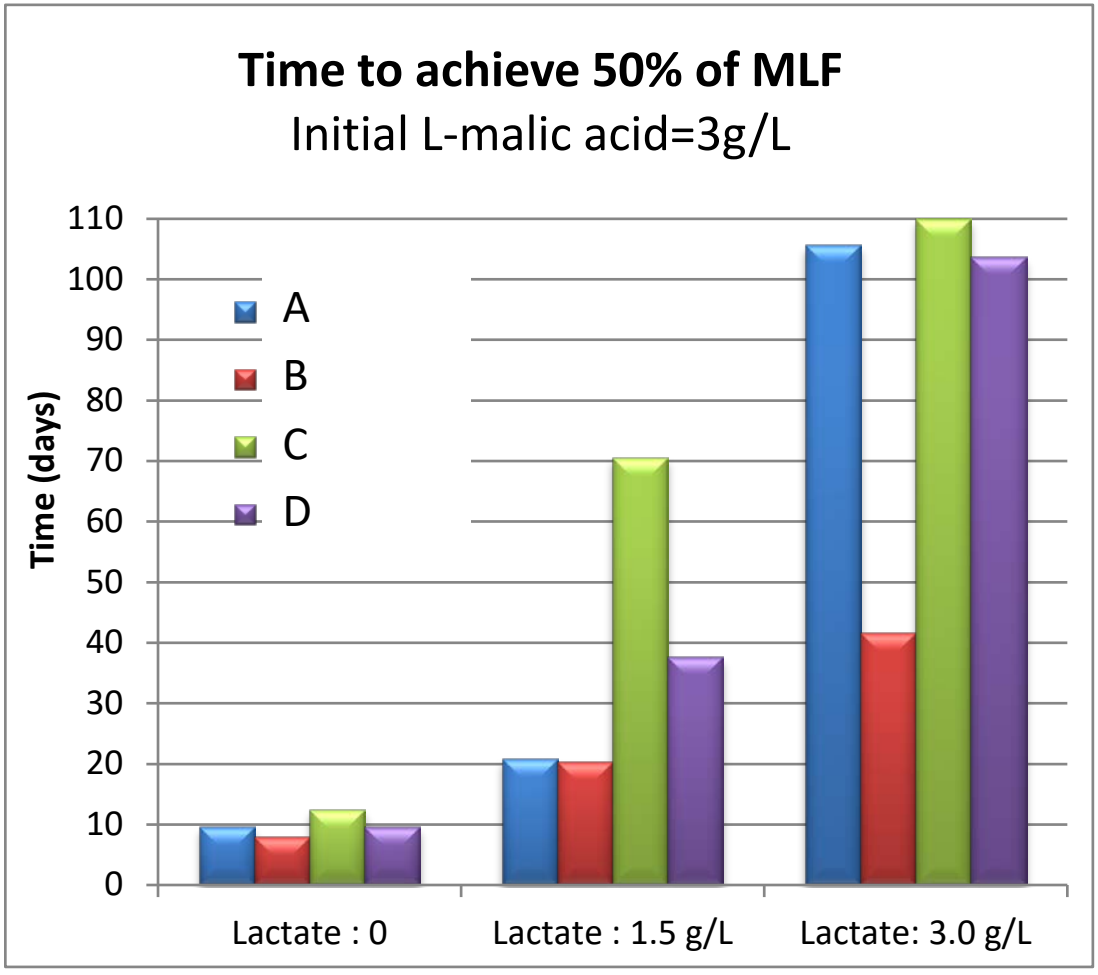
Pinot noir	
Alcohol	12.3%
pH	3.25
Malic acid	3 g/L
Temp	16 °C





- Addition of 1.5g/L greatly increases the time to achieve MLF.
- Bacteria viability decreases with higher lactic acid concentrations
- Addition of 3g/L induces a high loss of viability which leads to stuck MLF.

Sensitivity of bacteria strain to L-lactic acid

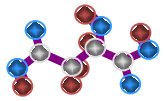


Chardonnay	
Alcohol	12.5%
pH	3.25
Malic acid	3 g/L
Temp	16 °C

- Strain variation in lactic acid sensitivity/resistance

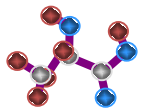
Malic acid tolerance / Lactic acid sensitivity

Malic acid



- Increasing concentration of malic acid increases the speed of malic acid degradation, but of course also increases the duration of MLF.
- Some strains more suitable than others for high malic acid content

Lactic acid

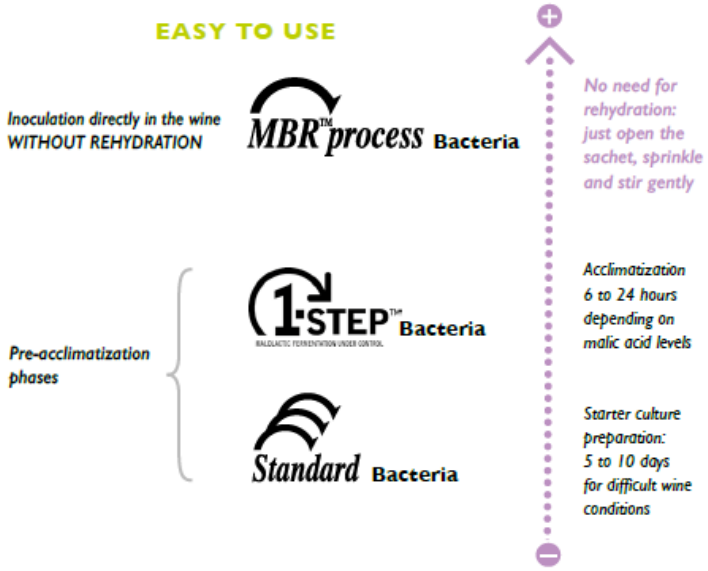


- The presence of L-lactic acid in the wine inhibits the implantation and growth of the inoculated wine LAB resulting in an inhibition of MLF.
- An initial content of L-lactic acid in the range of 1.5 g/L strongly slows MLF, but a content of 3.0 g/L fully inhibits MLF.

➢ *Problems inducing MLF by inoculation with selected wine bacteria may be encountered in wines with a partial MLF.*

Bacteria starter culture

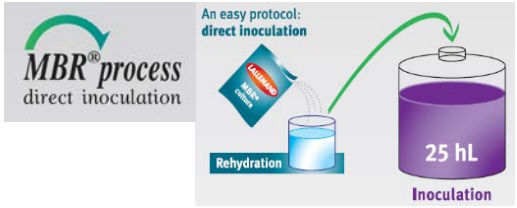
- **Ideal**
  - Direct inoculation
- **Reality**
  - Acclimatisation
- **The real world in relation to Sparkling wine!**
  - Starter culture preparation



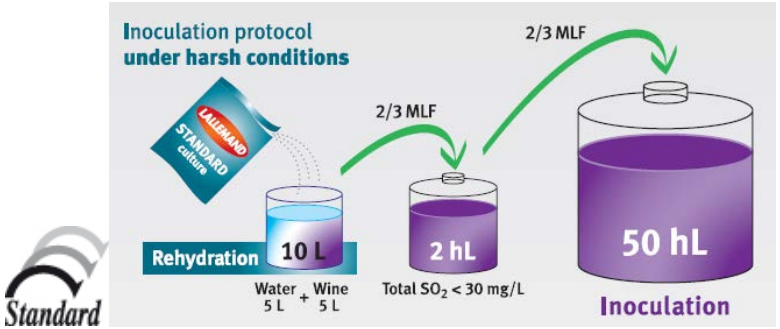
➢ *Balance between pH (& mol SO2) and starter culture readiness*

Bacteria starter culture

- Direct inoculation
  - Not always able to have the ‘magic bullet’ answer



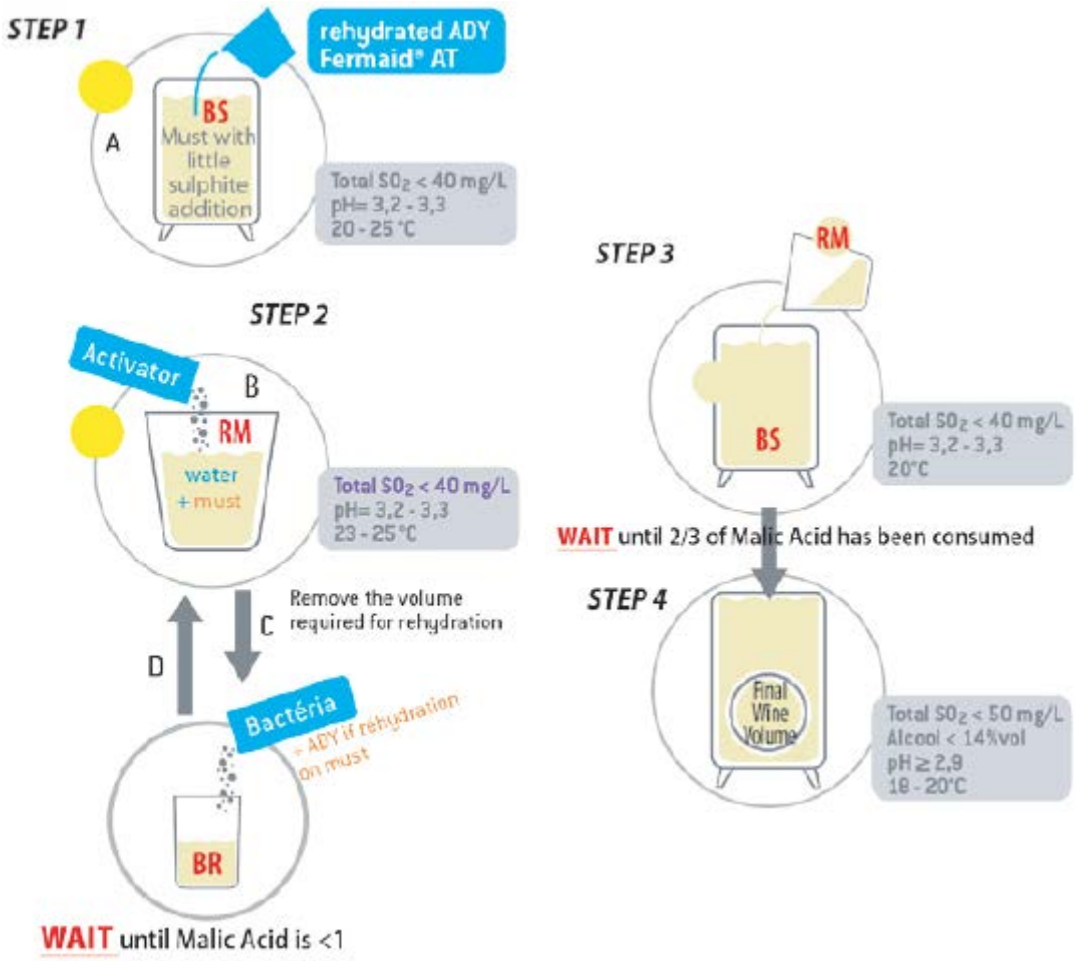
- Preparation of starter (Standard)
  - Ready bacteria for the juice/wine



IOC Inobacter

- This *Oenococcus oeni* strain has been selected from Champagne by CIVC (International Champagne Committee)
  - Each batch is rigorously controlled by the CIVC
- IOC Inobacter is specific for sparkling wine production
  - pH tolerance >2.9
  - Alcohol tolerance up to 14% v/v
  - SO2 tolerance up to 50 mg/L Total SO2
  - Low production of volatile acidity
  - No production of biogenic amines
  - ➢ ***Excellent tolerance of this strain to extreme wine conditions enables an effective malic acid metabolism***
  - Can be used as Co-inoculation with yeast or inoculated after AF as Sequential

IOC Inobacter



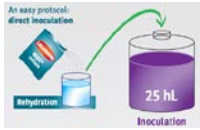
- Step-wise build up of the bacterial culture
- Acclimatisation to the wine conditions
- Actively metabolising malic acid

➢ *Bacteria are prepared for the juice /wine*

In summary ….

- Consider SO2 usage with MLF need

- Ideally, direct inoculation



  - Not always possible to have a direct inoculation because of specific challenges with sparkling base wine
  - Low pH & SO2 translate to higher mol SO2

- Select the best bacterial strain for your wine
  - pH tolerance
- High bacteria cell numbers are crucial for implantation & MLF efficiency (>10^6 cells/mL)

➢ *Even though perhaps not the most desired option, patience with building up the culture is the best way to ensure that the bacteria are ready for your sparkling base wine*