Malolactic Fermentation - The Mysteries of MLF

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Prepare to enter the mysterious world of malolactic fermentation. This article discusses the why and how of performing MLF on your wine including MLF strain selection, best practices for success, encouraging or discouraging buttery diacetyl production, and the greatest mystery of them all---determining whether the MLF fermentation has completed.

PREPARATION OF THE UNINITIATED

Malolactic fermentation is the process in winemaking where tart-tasting malic acid, naturally present in grapes, is converted to softer-tasting lactic acid. Malic acid tastes mostly like green apples. By contrast, lactic acid is less tart. MLF enhances the body and flavor in wine, producing wines of greater palate softness and roundness.

Most malolactic fermentations are done on red wine varietals and barrel fermented Chardonnays. In some red wines, the choice is optional, such as Zinfandel or Pinot Noir. White wine varietals like Sauvignon Blanc, Viognier, and

Riesling, for example, often do not undergo any malolactic fermentation. These wines are recognized for their high acid levels and crisp finish. That is not to say that you can't experiment. In 2009 instead of inoculating her Syrah, Robyn accidentally inoculated her Sauvignon Blanc. (She says, "Don't judge me, it was dark.") The wine ended up being quite delicious so she called it Fumé Blanc and entered it in the Harvest Fair, where she received a silver medal! On the contrary, the first year that she made Zinfandel she chose not to inoculate with malolactic bacteria (otherwise known as Oenococcus oeni). We all really like fruit forward jammy Zinfandel so she made the choice to pass on MLF. That wine also received a silver medal at the Harvest Fair. The point is that the winemaker gets to decide whether or not to undergo MLF. Equip yourself with the following information on the ins and outs of MLF, so you can decide what to do on your next wine.

THE CRYSTAL BALL

or What will the wine be like after MLF?

There are three primary reasons to put your wine through MLF: stability, acid reduction and flavor. The stability of wine is improved by taking the wine through a complete MLF, ending with 30 ppm of malic acid or less. Residual malic acid above this level still has the potential for unintended fermentation, just as residual sugar in a wine could possibly cause a fermentation to restart in the bottle. Both situations may produce cloudy, effervescent wine in the bottle.

The fermentation of malic acid results in the production of lactic acid. As each molecule of malic acid is converted to lactic acid, the contribution to titrable acidity (TA) drops by half. In a wine that starts with 0.2% TA from the malic acid (with the remainder of the TA made up of stable tartaric acid), MLF will drop the 0.2% malic portion to just a 0.1% lactic portion. That represents a 0.1% drop in the overall TA. That is a significant change in acidity---the flavor profile of the wine will be much different post-MLF. The combined effect of acidity reduction and change in acid type can turn a bright and sharp wine into a softer, more approachable wine.

The decision of whether to put your wine through a malolactic fermentation is often a process of weighing the pros and cons. The pros listed in the above paragraphs should be considered against potential cons. The biggest potential con is that a MLF fermentation may reduce the acidity of your wine to a level where it tastes flabby and is susceptible to accelerated oxidation. Remember that MLF fermentation is a deacidification technique. If you have a low acid wine, you should be working to increase the acidity, not to decrease it further with MLF. Another potential con may be the impact of MLF on flavor. While MLF will soften the acidity and mouthfeel, it generally also reduces fruitiness.

THE RITUALS

or Fermentation Best Practices, Selecting a MLF Bacteria, and The Diacetyl Factor

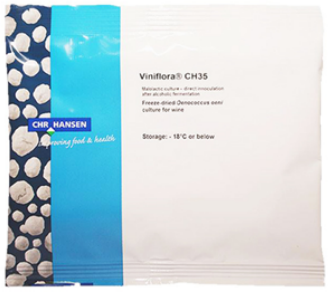
MLF Fermentation Best Practices - Our favorite time to perform MLF is at the end of primary fermentation. Most commonly we add the culture when 0 brix is reached. In reds, this means adding it just after pressing. If the culture is added early while sugar is present, there is a risk of producing volatile acidity. The malolactic bacteria can ferment sugar into VA, so it is best not to give them the chance. If the pH level of the wine is above 3.5 pH (most reds and many whites) then the bacteria will likely convert the sugar to VA, below that level they will preferentially consume malic acid rather than sugar. As long as you choose a strain that can handle high alcohol which is produced for direct addition, add it at the end of primary.

Oenococcus oeni are not the only strain of bacteria that will ferment malic acid. There are wild strains of lactobacillus that sometimes infect our beverages. In brewing, it is a very common spoilage organism and can result in a complete sour-ing of the beer. In wine, it is also best to avoid them. They do not ferment as cleanly as oenococcus oeni and may contribute off-flavors that cannot be removed. A “spontaneous” MLF will likely result in these undesirables. Using a laboratory produced package of malolactic bacteria is the most predictable option. You don’t want to risk ending up with a funky and stuck MLF---it’s a headache! To avoid trouble, please consider the following MLF fermentation best-practices.

Checklist of MLF Best Practices

- Keep the total of all pre-ML sulfite additions below 50 ppm. These mysterious creatures are easily hurt by sulfite.
- Add a lab produced culture after pressing and/or when the brix have dropped to around 0. Cell counts can be important as these bacteria will not begin to ferment unless they are at or above a population of 1 million cells/ml. So, don't cut corners on cell counts!
- Ensure your ML bacteria have enough nutrition by rehydrating them with a nutrient such as Acti-ML.
- Maintain temperatures that are warm but not hot. These bacteria ferment best above 70 degrees F, but can be killed above 80.
- If you want a buttery character, keep the wine in a barrel or other vessel which allows micro-oxygenation during fermentation. Do not stir during fermentation. If you want to avoid a buttery character, keep the wine in a stainless, glass or PET plastic vessel and stir the lees on a regular basis during fermentation.
- Ideally, fermentation should be complete in about 3 weeks. Test for completition with a Chromatography Kit, or submit a sample for lab testing. If your malic levels are below 30 ppm, you are done. Sulfite as soon as possible!

Selecting a MLF Bacteria - Selection of a MLF bacteria for your fermentation is generally based on batch size, alcohol tolerance, SO2 tolerance, pH tolerance, and to a lesser extent, flavor profile. We have pure strains available. The following presents our MLF strain options based on these parameters.



We stock 5 cultures from 3 labs: Wyeast, Enoferm by Lallemand, and Viniflora by Christian Hansen.

Batch size:

- Small batches (5 - 15 gallons)
  - Wyeast's 4007 MLF Liquid Blend
- Large batches (15 gallons and above)
  - Christian Hansen's Viniflora Oenos 2.0
  - Christian Hansen's Viniflora CH16
  - Christian Hansen's Viniflora CH35
  - Enoferm's Alpha
  - Enoferm's Beta

Alcohol Tolerance:

- up to 14% ABV
  - Christian Hansen's Viniflora Oenos 2.0
  - Christian Hansen's Viniflora CH35
- up to 14.5% ABV
  - Enoferm's Beta
- up to 15.5% ABV
  - Wyeast's 4007 MLF Liquid Blend
  - Enoferm's Alpha
- up to 16% ABV
  - Christian Hansen's Viniflora CH16

SO2 Tolerance:

- up to 40 ppm Total SO2 Additions
  - Christian Hansen's Viniflora Oenos 2.0
  - Wyeast's 4007 MLF Liquid Blend
- up to 45 ppm Total SO2 Additions
  - Christian Hansen's Viniflora CH35
- up to 50 ppm Total SO2 Additions
  - Christian Hansen's Viniflora CH16
  - Enoferm's Alpha
  - Enoferm's Beta

pH Tolerance:

- down to 3.4 pH
  - Christian Hansen's Viniflora CH16
- down to 3.2 pH
  - Christian Hansen's Viniflora Oenos 2.0
  - Enoferm's Alpha
  - Enoferm's Beta
- down to 3.0 pH
  - Christian Hansen's Viniflora CH35
- down to 2.9 pH

- Wyeast's 4007 MLF Liquid Blend

In summary, for a carboy you can use the 125 mL package of Wyeast's 4007 MLF Liquid Blend. For larger batches and barrels, our most popular choices are Viniflora CH16 and Enoferm Alpha due to the high alcohol tolerance (16% and 15.5%, respectively) and general dependability. Viniflora Oenos 2.0 is a lower cost strain that has less resilience to alcohol but is appropriate for low alcohol wines. Viniflora CH35 is a good choice for white wines due to the low pH tolerance. Enoferm's Beta is specifically stocked and used in Pinot Noir due to its production of floral aromas.

The Diacetyl Factor - MLF bacteria can, and usually do, produce diacetyl as a byproduct of fermentation. Diacetyl is a chemical that is also produced in dairy fermentations and gives the distinct flavor and aroma of butter. In some wines, such as Chardonnay, the presence of buttery diacetyl is considered desirable. In others, such as any red wine, it is considered to be a flaw. Therefore, you will sometimes want to encourage diacetyl production, and other times you will want to discourage it. The following list presents the main factors that contribute to diacetyl production during MLF fermentation.

Factors That Increase or Decrease Diacetyl

- Micro-Oxidation - MLF bacteria only produce the precursors to diacetyl, not actual diacetyl. The production of diacetyl requires an oxidation reaction. Micro-oxidation during MLF fermentation can have an exponential impact on the the production of diacetyl. This is a very important factor. Wine barrels and porous plactic fementers allow micro-oxidation, whereas sealed stainless fermenters, PET plastic and glass vessels restrict it.
- Citric acid - MLF bacteria ferment citric acid into diacetyl precursors. It is not recommended, however, to add citric acid to your wine because it is also fermented into volatile acidity which is very undesireable!
- Contact time with yeast lees - Live yeast will metabolize and reduce diacetyl. If you wish to reduce the presence of diacetyl, you may choose to keep the yeast in contact with wine until MLF has completed.
- Stirring - Stirring, especially with live yeast present, will help stimulate them and encourage the yeast to metabolize diacetyl and reduce it.
- Sulfite (SO2) - Free SO2 will bind oxygen, thereby reducing the chances that diacetyl precursors will oxidize into diacetyl. SO2 will also bind diacetyl and reduce its flavor presence for a period of time. This reaction with diacetyl, however, is reversible and the diacetyl may come back in time.

THE DIVINATION

or Has MLF Fermentation Completed?

Assuming that your numbers look good and you can keep the wine temperature warm enough for active fermentation, you should be able to complete MLF in 3 to 6 weeks. For reference, it is useful to know that MLF bacteria will double their cell count every 3.6 days, and they will not ferment malic acid until they reach the "magic number" of 1 million active cells per ml. This behavior is called quorum sensing. It is worth considering if you might have pitched a lower than needed cell count, in which case you will need to wait longer for your MLF to complete.

How do you know when it is done? Ask your winemaker friends, but you may want to sit down to really enjoy the answers you get. Everyone has a trick. None of them work very well. Most are either guesswork or something like divination. Here's a few popular answers. 1: You can see little CO2 bubbles in the wine when it is active. 2: You can hear it crackling by putting your ear to the barrel. 3: It smells like tennis shoes while fermenting. These all contain bits of truth, but also contain some winemaking myths. There is no way to know whether the CO2 production is from sugar fermentation or MLF and none of these techniques gives you a way to decipher between a complete and stuck MLF. Of course, there is this next reply. 4: Oh well, a stuck MLF will finish in the spring when it warms up again. While it is possible and sometimes this strategy works, it requires you to forego your normal SO2 additions that keep your wine protected through the fall, winter, and spring months.

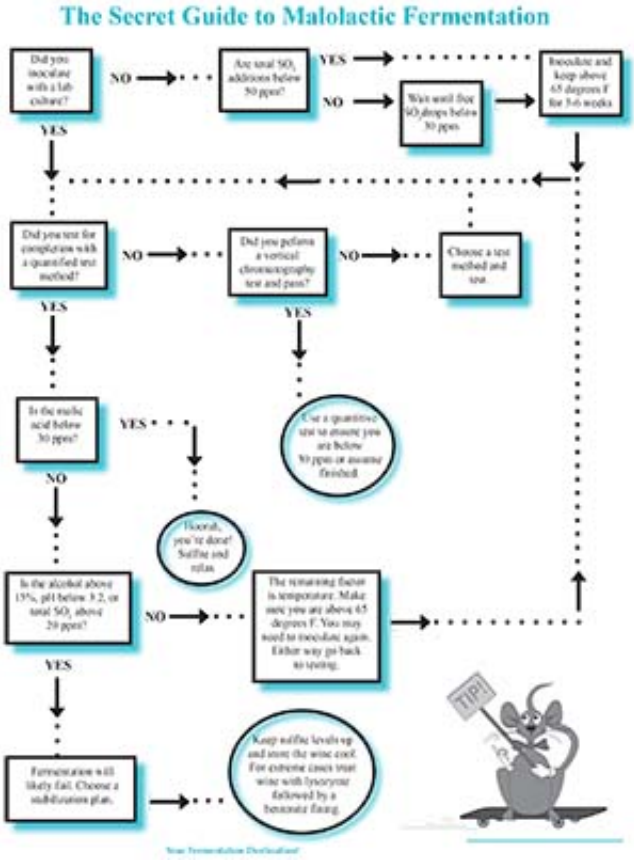
THE DISCOVERY

Once you believe it is done, test it to confirm completion. The only reliable method is to perform a test or have a sample tested at a lab. For home use we have a Vertical Chromatography test kit. It is a fun test to perform giving you a colorful chart showing the presence or absence of malic, lactic, and tartaric acid in your wine. Unfortunately it does not give you quantified results. For a quantified test result, you will need to deliver a sample of your wine to wine lab.

Locally in Sonoma County, ETS Labs in Healdsburg can complete the test for you. Remember, you want it to be below 30 ppm for assurance of stability. It's a happy time for winemakers when the MLF is done and they can "put their wines to bed" for the winter.

THE TRUTH REVEALED

At The Beverage People, we have hundreds of conversations each year about these fermentations. We have heard all the problems and helped people complete MLF successfully year after year. We have seen winemakers struggle at it, especially when they get stuck. Our conversations with winemakers always follow a definite decision making course. So we decided to lay it out for your use---we created a MLF flow chart! Our first recommendation is to inoculate as discussed above, keep the temperature up and finish successfully in 3-6 weeks. If things should go awry with your MLF, take a tour of the flowchart. It will help guide you to a successful finish.



Open this pdf to work through our Secret Guide to Malolactic Flow Chart and find your way to a complete fermentation...or at least a stable wine.

ITEMS FROM THESE INSTRUCTIONS MAY BE FOUND BELOW OR IN THE SHOPPING AREA OF OUR WEBSITE.

Vertical MaloLactic Chromatography Kit with 6 sheets.

$87.98

Qty: 1

ADD TO CART

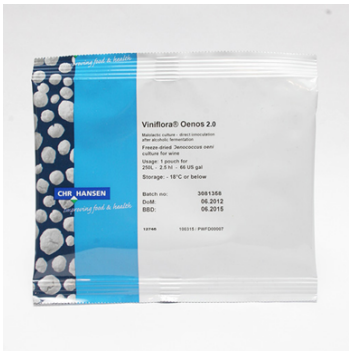
Malolactic Bacteria Culture - Wyeast 4007 - Liquid - Treats up to 6 Gals

$9.90

- Treats up to 6 gallons.
- Alcohol Tolerance: 15.5% ABV
- SO2 Tolerance: 15 ppm Free SO2
- pH Tolerance: Down to pH 2.9

Qty: 1

ADD TO CART



Malolactic Bacteria Culture - Viniflora Oenos 2.0 - Freeze Dried - Treats up to 66 Gals

$22.06

- Treats up to 66 gallons.
- Alcohol Tolerance: 14% ABV
- SO2 Tolerance: 40 ppm Total
- pH Tolerance: Down to pH 3.2

Qty: 1

ADD TO CART

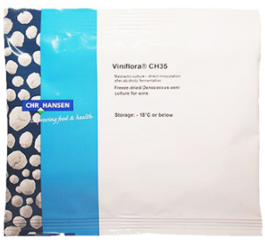
Malolactic Bacteria Culture - Viniflora CH16 - Freeze Dried - Treats up to 66 Gals

$26.33

- Treats up to 66 gallons.
- Alcohol Tolerance: 16% ABV
- SO2 Tolerance: 50 ppm Total
- pH Tolerance: Down to pH 3.4

Qty: 1

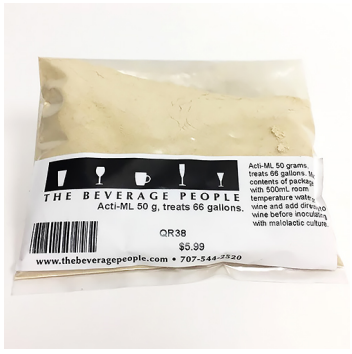
ADD TO CART



Malolactic Bacteria Culture - Viniflora CH35 - Freeze Dried - Treats up

Malolactic Bacteria Culture - Enoferm Alpha - 2.5 g Freeze Dried - Treats

Malolactic Bacteria Culture - Enoferm Beta - 2.5 g Freeze Dried - Treats



Acti-ML Bacteria Nutrient - 50 g - treats 66 gallons.

to 66 Gals

$25.43

- Treats up to 66 gallons.
- Alcohol Tolerance: 14% ABV
- SO2 Tolerance: 45 ppm Total
- pH Tolerance: Down to pH 3.0

Qty: 1

ADD TO CART

up to 66 Gals

$47.26

- Treats up to 66 gallons.
- Alcohol Tolerance: 15.5% ABV
- SO2 Tolerance: 50 ppm Total
- pH Tolerance: Down to pH 3.2

Qty: 1

ADD TO CART

up to 66 Gals

$47.26

- Treats up to 66 gallons.
- Alcohol Tolerance: 14.5% ABV
- SO2 Tolerance: 50 ppm Total
- pH Tolerance: Down to pH 3.2

Qty: 1

ADD TO CART

$8.78

Qty: 1

ADD TO CART