

## The Strategic Control of Diacetyl Expression:

One of the biggest stylistic arguments in modern winemaking is the emphasis (or deemphasis) of compounds released during malolactic fermentation that give the wine a buttery, creamy persona. The primary compound responsible for this flavor profile is diacetyl.

Diacetyl production by malolactic bacteria and its expression in wine can be controlled through careful management of the malolactic fermentation and subsequent handling of the wine. Diacetyl is an intermediary product of bacterial metabolism that is eventually reduced to less aromatic compounds like acetoin and 2,3-butanediol. The level of diacetyl (and buttery characteristics) in wine during malolactic fermentation can be increased by maximizing its production from citric acid metabolism and minimizing its subsequent reduction. In short, to get a buttery wine, the goal is to produce a lot of diacetyl and stop the MLF shortly after diacetyl levels peak.

## Key Practices to Maximize Diacetyl Production During MLF:

- Inoculate the wine with ML bacteria sequentially, after alcoholic fermentation is complete or nearly so.
  - Actively fermenting yeast and bacteria reduce diacetyl to non-aromatic compounds. Waiting until the yeast population is dead or dormant allows diacetyl to accumulate.
  - Conversely, adding the bacteria at the start of alcoholic fermentation (co-inoculation) is the best way to minimize diacetyl.
- Inoculate the wine with a commercial *Oenococcus oeni* strain known for its high potential to produce diacetyl, such as **Malo-D** from ATPGroup.
- A slow malolactic fermentation favors the accumulation of diacetyl.
- Conduct the MLF at the lower end of the bacteria's optimal temperature range (17–18°C or 63–65°F) or pH range (e.g., 3.2–3.4) to increase the potential for diacetyl production.
- Slight stirring or a small dose of oxygen during MLF can favor the chemical conversion of the diacetyl precursor ( $\alpha$ -acetolactate) into diacetyl, rather than its enzymatic conversion to acetoin. This maintains a higher redox potential in the wine.
- Timing the SO<sub>2</sub> addition to stop MLF is the most critical step to retain the buttery character.
  - Regularly analyze the wine for diacetyl (or sensory-test the wine) as malic acid levels approach zero. The diacetyl level is typically highest right after the malic acid is depleted and before the bacteria begin to fully consume the citric acid. Once the desired buttery aroma is achieved, immediately add a sufficient dose of sulfur dioxide (SO<sub>2</sub>) to kill the remaining bacteria and halt any degradation of diacetyl.
  - Note that sulfur dioxide can bind with diacetyl, lowering its expression. Luckily, this is a reversible reaction, and diacetyl will slowly unbind back into solution.
- Once fermentation has concluded, rack or filter the wine off any residual yeast or bacteria lees promptly. Aging the wine on lees will continue to reduce diacetyl levels.
- The addition of oak, particularly toasts that enhance sweet and buttery aromas, will enhance the creamy perception of the wine, even at lower diacetyl levels.

In conclusion, whether to embrace or eschew the buttery notes in wine is a deliberate choice for the winemaker, guided by a deep understanding of malolactic fermentation. By meticulously managing bacterial inoculation timing, selecting specific *Oenococcus oeni* strains, controlling fermentation conditions, and precisely timing SO<sub>2</sub> additions, winemakers can artfully sculpt the diacetyl profile of their wines. This precise control allows them to craft expressions ranging from rich, creamy, and buttery to crisp and fruit-forward, ultimately offering consumers a diverse and thoughtfully produced array of styles to savor. Reach out to your local ATPGroup representative today to discuss MLF options that fit your wine style.