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Acid Reduction Techniques in Must and Wine

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Since each harvest year is different, the winemaker must be able to adapt his vinification practices in achieving a well balanced wine. Excess acidity at harvest may occur in cool climate viticultural areas such as it does in the Northeastern United States and Canada.

Wine acidity is responsible for freshness, tartness and crisp taste. Wines of high acidity may appear to be very tart or acidic whereas wines of low acidity may appear flat or insipid. Therefore, it is vital to develop a wine that has a good balance with acid being a major factor.

The predominate acids found in must and wine are tartaric and malic acid often accounting for over 90 percent of the total acids found in grapes with citric acid considerably lower in concentration (1). Other organic acids formed mainly during fermentation at different levels would include acetic, succinic and lactic acids (2).

In determining correct acid concentrations in wine one must not make acid adjustments based on the titratable acidity and taste alone. It is vital to examine juice and wine acids and their direct effect on pH. Monitoring juice pH is important to help determine ripeness of the grape, wine color, chemical and microbial stability. The degree of dissociation of acids into H^+ ions, influence a wines pH. The free hydrogen ion (H^+) concentration measured by electrodes is then placed on a logarithmic scale. Acid levels significantly influence both juice and wine pH which usually falls between 3.0 and 3.9 on the pH scale. As grape maturity develops we have a lowering of the acidity with a corresponding increase in pH.

As mentioned earlier, grapes in cool climate growing regions often have a high acid content ranging from 5 to 10.6 g/L (3). This paper will not include the viticultural aspects leading to musts with higher acidity other than to mention practices such as over cropping, vines of high vigor and an unorganized spray program may delay maturation and cause high acidities (4). The rest of this paper will examine acid reduction techniques in must and wine.

Listed below are several methods to consider:

- Amelioration
- Blending
- Malolactic fermentation
- Sugar addition
- Chemical neutralization

According to Boulton (5), there are four scenarios of classifying acidity and pH conditions.

1) Low TA and high pH	(TA<6g/L)	(pH>3.5)
2) Moderate TA and pH	(TA 6-9g/L)	(pH 3.0-3.5)
3) High TA and low pH	(TA>9g/L)	(pH<3.0)
4) High TA and high pH	(TA>9g/L)	(pH>3.5)

The first acidity and pH condition represents a warmer climate such as California. This would require acid addition. I will focus more on the second through fourth case observations. Depending on the variety, final acidity, and residual sugar, must or wine with a moderate TA and pH can be candidates for amelioration, blending, malolactic fermentation, sugar addition or chemical neutralization. In the case of chemical neutralization, the use of potassium carbonate or potassium bicarbonate can be effective. Utilizing these compounds create less risk of calcium instability. Again, depending on variety and desired final TA, a must or wine with a high TA and low pH may benefit from amelioration, blending, malolactic fermentation or chemical neutralization. In chemical neutralization, the use of calcium carbonate for deacidification is usually preferred (1). Even though there is a risk of calcium instability, the increase in pH is less using calcium carbonate, which is beneficial in preventing chemical or microbial problems throughout vinification. It would also be advisable to make larger acid adjustments to the must rather than to the wine (6). Must or wine with a high TA and high pH are problematic. This scenario would be dealt with most satisfactory by using either calcium carbonate or better yet the “double salt method” in providing the best results. I will briefly describe each deacidification procedure below.

Amelioration

Amelioration is the blending of sugar, water and or sugar-water to the must to be fermented. According to federal regulations this may be used in reducing the acidity as long as the TA is not reduced below 0.5 percent and the volume of water or sugar water added is not greater than 35 percent of the resultant volume of the must. Although, this is an effective method in reducing acidity, it is often used for certain American or labrusca varieties due to their strong aromas and flavors. It is advisable to refer to the TTB regulations regarding amelioration when using this procedure.

Blending

Blending is an effective technique in reducing wine acidity. In addition, this technique is often used to alter other important wine constituents in improving wine quality. These include: oak and tannin management, body and mouth feel to name a few. Blending trials should always be performed in the laboratory before making the final blends in the winery. It must be understood, however, that even if all wines going into the final blend are considered to be stable, changing the wine chemistry in the final blend may produce an unstable wine in terms of microbial and tartrate stability.

Malolactic Fermentation

Acid reduction may be achieved in using certain lactic acid bacterial strains. In general, there are three types of lactic acid bacteria found in must and wine. These include Pediococcus, Lactobacillus, and Leuconostoc with the former being the most desirable. Malolactic fermentation refers to the bacterial conversion of malic acid to lactic acid and carbon dioxide. This secondary fermentation usually takes place at the very end or after primary fermentation. The benefits of malolactic fermentation show a reduction in acidity adds complexity and provides a more microbial stable wine. Some limiting factors of completing successful malolactic fermentations include low pH (2.9-3.1), high levels of $S0_{2,}$ temperatures below 65º F. and aeration (7). It is also advisable to choose a commercially recommended malolactic strain.

Sugar

One must not forget the positive attributes of a little sugar. Depending on the final target acidity, variety and style, the addition of small amounts of sugar may reduce the perception of a slight to moderate acidic wine. Even wines finished in a dry style may benefit in body and mouth feel with the addition of .25 to .45 percent without being noticed on the palate. In any case, bench trials should be performed in determining the correct amount of sugar to be added.

Potassium bicarbonate

For must and wine with slight to moderate acid reductions of 8-10g/L with a low pH around 3.0 the use of potassium bicarbonate is preferred (1). The benefit of potassium bicarbonate is that potassium is naturally occurring in wine and therefore its reaction with tartaric acid involves both neutralization of hydrogen ions and precipitation of tartrate ions as potassium bitartrate. It also has the ability of being used in combination with other acid reducing techniques such as amelioration and malolactic fermentation (8). Typically adding .9g/L will reduce the TA by 1g/L in must or wine. Potassium bicarbonate can be added to either the clarified must or filtered wine. The disadvantage of using potassium bicarbonate in high acid must and wine is not effective in reducing the acidity adequately without raising the pH excessively.

Calcium Carbonate

Harvest years providing must and wine with high acidities can be treated with calcium carbonate. Calcium carbonate is mainly recommended for large acid adjustments of 2g/L and higher (TA above 9g/L) (9). The addition of .67g/L of calcium carbonate theoretically will yield a reduction in TA of 1 g/L. This reaction will commonly produce calcium tartrate a neutral salt with precipitation occurring over time. The choice of calcium carbonate will deliver the maximum acid reduction with a minimum increase in pH. As mentioned earlier, large acid reductions are mainly done to the must where smaller reductions are made to the wine (6). Even though there is no cooling required for calcium tartrate precipitation, a disadvantage is seen with the slow precipitation rate along with no guarantee of calcium stability (2). However, wines with a higher pH will benefit greatly with the reduction in acidity using calcium carbonate with a minimal increase in pH.

Double salt method

The double salt method may be used for must or wine with a high TA and high pH. The true double salt method comes from the use of a proprietary compound called Acidex. To my knowledge, I do not believe this product is no longer available. However, according to Henick-Kling (9), similar results can be achieve with the use of calcium carbonate alone and careful monitoring of pH which is the critical part of this procedure. The critical pH must reach and be maintained at 4.5 or higher for the removal of calcium malate and calcium tartrate.

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