ACID MANAGEMENT AND ADJUSTMENT

TERMS AND DEFINITIONS

- pH vs. TA (titratable acidity)
  - TA is approximately amount of acid in wine (slightly less than total acidity).
    - Measured as percent or grams/L.
  - pH is a measure of dissociated protons: strength or effectiveness of acid.
    - Measured as the negative log of the moles of hydrogen ions (H^+)/L.
    - $1/10^3 = 10^{-3}$ = pH 3. The lower the pH, the stronger the acid.
- Strong Acid vs. Weak Acid
  - Strong acid—complete dissociation of protons (H^+).
  - Weak acid (all organic acids)—partial dissociation of protons.
    - Acid group $COOH \rightarrow COO^- + H^+$
- Buffer Capacity (see illustration)
  - Definition: amount of OH^- or H^+ to obtain change of one pH unit.
  - Ability of solution to keep constant pH.
  - Testing for buffer capacity.

PH AND ACID IN WINE

- All acids in wine are weak: tartaric, malic, citric, lactic, acetic, succinic.
  - Tartaric and malic most common.
  - Malic may be higher in short season and/or cool climate.
- Wine pH range generally 3.0-4.0.
  - Low pH generally associated with high acid, cool climate.
  - High pH generally associated with low acid, warm climate.
  - Nightmare situation: high acid and high pH, exacerbated by high potassium.
- Very low pH and high acid corrected by deacidification (carbonate or Acidex).
- High pH and low acid corrected by acidification.

EFFECTS OF PH

- Low pH.
  - Anti-microbial protection.
  - Makes SO_2 more effective as anti-microbial agent (see SO_2/pH chart).
  - Moves color toward red.
  - Very low pH (<pH 3.1) may inhibit fermentation and MLF.
  - <3.65, pH remains stable or lowers with potassium bitartrate precipitation.
- High pH
  - More susceptible to microbial infection.
  - SO_2 less effective as anti-microbial agent.
  - Moves color toward blue.
  - >3.5, lactic acid bacteria more apt to produce VA.
  - >3.65, pH moves up with potassium bitartrate precipitation.

ACIDIFICATION OF HIGH PH WINES

- Used to lower pH, brighten flavors, help structure.
- Tartaric acid used at juice stage.
  - Tartaric is strongest of grape acids with greatest impact lowering pH.
  - [Strength of grape acids: 1) Tartaric, 2) Malic, 3) Citric].
  - [Perception of sour: 2) Malic, 2) Tartaric, 3) Citric].
- If high addition is needed, some prefer tartaric/malic combination.
- Inexact rule: one gram/L tartaric acid addition results in 0.1 pH drop.
  - Depends on pH buffer.
- Post-fermentation addition:
  - Tartaric acid—most effective lowering pH, but increases potential tartrate instability.
  - Citric acid—will not form insoluble crystals, but may add citrus character and be substrate for bacteria.
  - Malic acid—higher acid perception; will not form insoluble crystals at wine pH; needs sterile filtration because it is substrate for bacteria.

DEACIDIFICATION IN HIGH ACID WINES

- Carbonates (removal of tartaric acid)
  - Potassium bicarbonate (removal of H^+ and KHT).
    - Used for low pH, high acid wine/juice.
    - Neutralizes H^+; potassium creates insoluble potassium bitartrate.
    - Reduction of 1.0 g/L TA requires 0.9 g/L potassium bicarbonate.
  - Calcium carbonate (removal of H^+ and CaT).
    - Used for high pH, high acid wine/juice (Zoecklein et al, <u>Wine Analysis</u>..).
    - May create calcium tartrate crystals, which are hard to control.
    - Reduction of 1.0 g/L TA requires 0.62 g/L calcium tartrate.
- Double Salt Deacidification (removal of tartaric and malic acids)
  - Calcium carbonate mixed with calcium tartrate and calcium malate.
  - Carbonate raises pH above 4.5, followed by calcium malate and tartrate precipitation.
  - Theoretically, maintains original tartrate/malate ratio.
- Malolactic Fermentation
  - Bacterial conversion of malic to lactic acid, lowering TA and raising pH.
- Malic-consuming Saccharomyces
  - Certain Sacch. species convert malate to ethanol (e.g., 71B, Enoferm C, Exotics).
- Schizosaccharomyces pombe
  - Converts malic acid to ethanol (used in combination with Saccharomyces).
- Cold stabilization
  - Drops out potassium bitartrate crystals (potassium$^+$ + bitartrate anion$^-$).
    - Lowers TA.
    - At pH <3.65, may lower pH to follow equilibrium curve.
    - At pH >3.65, may raise pH to follow equilibrium curve.
- Other: ion exchange, electro-dialysis.