HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP)

Section 2.

Step 3. Establishing Limits for Each CCP that May Impact SLO Formation

An important step in a HACCP plan is to establish, when possible, acceptable ranges or limits for each CCP. There is a positive (although not always strong) correlation between YAN and SLO.

Generally, the minimum concentration of YAN required is approximately 140 mg/L for a 21°Brix juice, and 250 mg/L or more for a 23°Brix juice. However, it should be noted that these are broad-based generalizations and can vary for several reasons:

- Nitrogen requirements are highly yeast-strain specific, governed largely by genetics and environment.
- The qualitative nature of YAN, including the makeup of FAN amino acids (not simply the total N), is the most important factor. The significance of this qualitative nature may help to explain so-called “reductive” grapes, varieties that have a greater tendency to produce sulfur-like off odors. It also may help explain seasonal and block differences in SLO production.
- A low concentration of YAN is often coupled with deficiencies in important micronutrients required for optimum yeast performance.

Step 4. Developing a Monitoring Procedure for Each CCP

CCP monitoring involves chemical, physical, microbiological, and/or sensory analyses. Two common procedures for measurement of fermentable N are the Formol titration and NOPA. As with all analyses, an understanding of precision and accuracy is essential.

Sensory Monitoring. From testing grapes for assessment of maturity and quality in the vineyard, to evaluations of wines post-bottling, decisions based on sensory evaluation are made throughout the winemaking process. These decisions are often made by an individual, based on personal sensory experiences and impressions.

Sensory evaluation can be an important component of a viable HACCP plan, as long as the limitations are understood and procedures are standardized. Several problems in relying on a single evaluator include the following:

- variation among individuals performing the evaluation on different occasions
- assessments based upon personal standards and personal experiences
- possible bias due to preconceptions about the product or treatment

An additional common difficulty is that such evaluations may be carried out under less-than-optimal conditions, which may impact objectivity. The following is a summary of issues of importance in a standardized and controlled environment for successful sensory evaluation:

- use of representative sample(s)
- sample temperature

- glass type, shape, and fill volume
- elimination of bias
- importance of sample contrasts
- evaluator skill levels
- number of evaluators required to gain a true picture
- minimize presentation effects (adaptation)
- minimize physiological effects (time of day, not tasting for a period after eating or drinking)
- number of evaluations to gain a true picture
- use of the proper testing method, such as triangle difference tests, duo-trio, paired comparison, sample difference tests, and paired preference testing
- establish if a difference exists before deciding on preferences testing

Step 5. Establish a Plan for Corrective Action for SLO Management

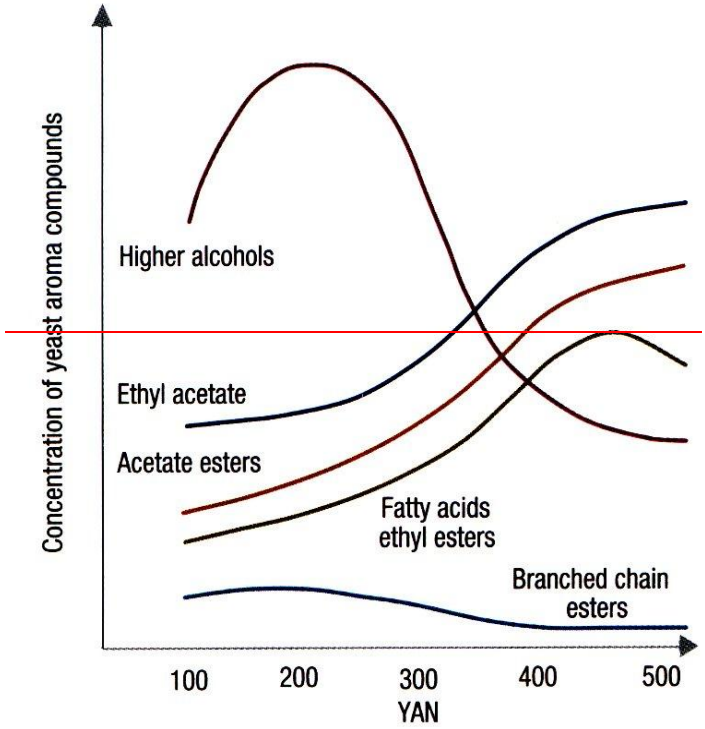
If a CCP is outside acceptable limits, HACCP plans call for corrective action. In the SLO example, if low YAN is measured, timing and concentration of nitrogen supplementation may be crucial to preventing or minimizing the impact of the problem. Failure to act, or ineffective addition levels and/or timing of the addition, can result in increased production of SLO, increased unwanted flora (if added too early or too late), rapid fermentation, loss of volatiles (particularly if the source is DAP), or diminished complexity.

Amino acids are an important source of yeast-derived esters, which can add to complexity and wine quality. Thus, the supply of nitrogen must be available at the early stage of fermentation to allow a continuous re-synthesis of proteins. If that does not occur, yeast lose the ability to conduct the fermentation. The various volatile groups found in wine and impacted by YAN are shown in Figure 4. While

the figure shows the trends observed, it should be noted that it does not represent the quantitative relationships among the different chemical classes.

Nitrogen additions may be effective in optimizing yeast performance during the first two-thirds of fermentation. During the last phase, yeast are generally unresponsive to added nutrient supplementation and, thus, addition has little or no positive impact.

Figure 4. Volatile Wine Compounds Impacted by YAN



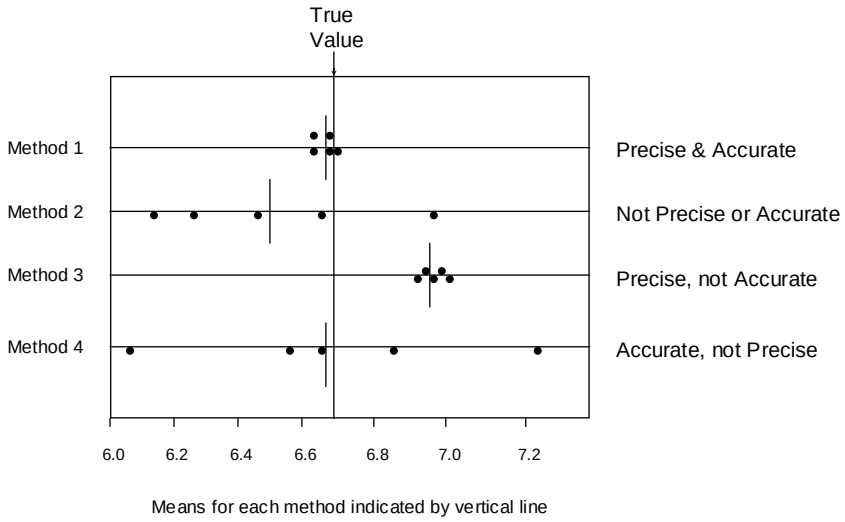
Step 6. Establishing an Adequate Record System

Adequate recordkeeping is vital to the success of any HAACP-based program. Choosing the optimum software for vineyard and winery operations requires a consideration of needs, cost of software, training required, update availability, etc.

Step 7. Developing a Verification Plan

In validating or verifying monitoring methodology, differences between precision and accuracy should be reviewed (Figure 5). In each of the four methods shown, the calculated mean of the five data points is indicated by a vertical line, and can be compared to the true value.

Figure 5. Differences Between Precision and Accuracy



Bottling HACCP-Like Plans

The following are examples of pre-bottling and bottling critical control points.

Pre-bottling Sensory Profiling

- adequate, unbiased hedonic evaluation under proper temperature conditions

- volatile sulfide screen

Wine Stability Evaluations (Chemical/Physical)

- bitartrate stability
- protein stability
- others

Wine Stability (Microbiological)

- sterile bottling, membrane pore size
- sterile pads, operational pressures
- chemicals (preservatives or sterilants)
- evaluate RS and malate levels relative to alcohol, pH, and free/total SO_2 (sulfur dioxide)

Microorganisms Review

- *Brettanomyces* spp.
- *Zygosaccharomyces* spp.
- lactic acid bacteria: *Pediococcus, Lactobacillus, Oenococcus*

Carbon Dioxide Levels

- potential foaming
- monitoring bottling-tank carbon dioxide
- monitoring wine-bottle carbon dioxide

Dissolved Oxygen Levels

- calibrate dissolved-oxygen meter

Monitoring Addition Compounds

- sulfur dioxide
- ascorbic/erythorbic acid
- potassium sorbate
- DMDC (dimethyl dicarbonate)

Wine at Bottling

- wine temperature
- bottle fill levels
- wine clarity

Packaging Materials and Quality Control: Sampling Strategy

- establishing operational quality for bottles, closures, capsules, labels
- glass case dust, contaminants
- glass contact surfaces/bore dimension(s): glass internal diameter at the bottom of the cork
- compatibility with natural cork, agglomerates, and synthetic closures
- closure coatings: paraffin and silicon
- dimensional measurements

- cork moisture (5-7%)
- physical flaws (critical vs. cosmetic)

Bottling Line Setup and Sterilization

- physical sterilants
- hot water and steam
- chemical sterilants
- peroxides or “proxy” compounds
- peroxyacetic acid (PAA)
- ozonated water
- membrane bubble-point test
- membrane storage
- back-flushing membranes

Vacuum Closure

- check vacuum pressure
- check headspace pressure using external gauges
- gauge calibration

Practical Summary of Winemaking Issues

- HACCP-like plans are used by the grape and wine industry to help integrate chemical, physical, microbiological, and sensory analyses, for quality and stylistic control.
- HACCP-like plans for the grape and wine industry involve the following:
  - Analysis of the dangers to product quality and consistency.

- Identification and control of the critical steps in the production system.
- Chemical, physical, microbiological, and/or sensory monitoring.
- Verification.

- HACCP-like plans help to answer the following:
  - Why each analysis is performed.
  - Where the analysis fits into the scheme of quality wine production.
  - When results are needed.
  - The specific range for each result.
  - Procedures for results that are not within specification.
- HACCP defines the production process, quality, and style indicators, and their recommended values. It identifies critical control points in the process using chemical, physical, microbiological, and sensory analyses. Measured values are compared with recommended values. An action plan is established to correct or modify any deficiencies, and action is taken. Results are assessed to determine if additional steps are needed.

Study Questions

1. How does the concept of HACCP differ from a “best practices” plan?

2. Pick a specific red grape variety in a specific geographic region of Virginia. Assuming the goal is to produce fruit for premium quality, develop a detailed HACCP outline. This should include all of the CCPs you believe are needed to optimize fruit quality.

3. Pick a specific white grape variety. Devise a HACCP plan for production of a premium wine from this grape, from fruit in the door at the winery, to the

glass. List all the CCPs you believe are important to attain your stylistic and quality goals.

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