Overview: Grape Processing Decisions: Effect of Whole Clusters

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Outline of Presentation

- Introduction to Berry Integrity Management
- Types of Intact Berry Fermentations
- Influence of Berry Integrity on Wine Composition

INTRODUCTION TO BERRY INTEGRITY MANAGEMENT

Berry Integrity Management: The Trade-Offs

- Extraction versus Retention
- Traditional versus Modified Varietal Character
- Yield versus Complexity

Extraction Versus Retention

- Extraction depends upon exposure of berry skins and seeds to heat and ethanol during fermentation
- Retention depends upon maintaining a reservoir of varietal volatiles
- Extraction leads to loss of varietally-determined volatiles
- Factors promoting retention have the potential to diminish extraction

Traditional Versus Modified Varietal Character

- Many aromatic components are present in the form of precursors
- Many enzymatic reactions continue post-harvest, some of which lead to:
  - Release of bound aromatic compounds
  - Generation of novel aromatic characters
  - Loss of some varietal characters
- Markers of berry deterioration or enhanced complexity?

Yield Versus Complexity

- Presence of intact berries until ethanol has accumulated can lead to loss of wine volume yield
  - Reduction in shear forces
  - Deterioration of cell surfaces
- Wine needs to be protected against loss of varietal volatile compounds and therefore of complexity

TYPES OF INTACT BERRY FERMENTATIONS

Types of Intact Berry Fermentations

- Whole Berry Fermentations
- Whole Cluster Fermentations
- Carbonic Maceration

Whole Berry Fermentations

- Destemming occurs
- Destemming leads to varying levels of berry damage
- No or partial crushing of fruit

Whole Berry Fermentation: Variables

- Percentage of intact berries
- Percentage of juice/must
- Temperature of fermentation
- Time (ethanol level) at which pressing occurs
- Type of mixing
  - Pump-over
  - Submersion
  - Irrigation

Whole Cluster Fermentations

- No destemming occurs
- No crushing of the fruit occurs except that due to gravity and weight in the tank
- In whole berry, removal from rachis leads to berry damage, therefore berries are not truly intact
- Berries are intact in whole cluster fermentations
- Berry enzymatic activity persists longer in whole clusters

Whole Cluster Fermentation: The Variables

- Percentage of must
  - Submerged
  - Modified atmosphere
- Temperature
- Mixing
- Time(Ethanol Level) at time of crushing and pressing
- Rachis serves as pressing aid
- Rachis may also contribute characters

Carbonic Maceration

- Intact clusters in a closed system
- Anaerobic conditions established by continued berry and microbial metabolism
- Berry asphyxiates but metabolism continues
- Berry fermentation produces up to 2.5% w/v ethanol after which metabolism collapses
- Characteristic flavors are formed that are independent of the varietal used

Carbonic Maceration

- Traditional in Beaujolais
  - Discovered in 1934 by Pr. Flanzy
  - Attempting to hold fruit for fermentation later in season
- Characterized as being low in acidity, low in tannin, light in color with a characteristic fruity flavor

Berry Metabolism during Carbonic Maceration

- Malate is catabolized to CO_2: 15 to 60% loss
- Glucose/Fructose are catabolized to ethanol and CO_2
- pH increases
- Titratable acidity decreases

Carbonic Maceration Flavors

- Increase in grape esters
  - Ethyl cinnamate: cinnamon, spicy, plum
  - Ethyl vanillate: sweet vanilla
  - Ethyl lactate: fruity
- Shikimic acid derivatives formed
  - Benzaldehdye: cherry almond
  - Vinyl benzene: sweet floral aroma
- Breakdown of hydroxycinnamic tartaric esters
  - *p*-Coumaric acid is released

Carbonic Maceration Flavors

- Vinyl phenols are formed due to *p*-coumaric acid release
  - 4-ethyl phenol: alcohol, medicinal
  - 4-ethyl guaiacol: meaty, smoky
  - 4-vinyl phenol: chemical, phenolic, medicinal with sweet musty and meaty nuances
  - 4-vinyl guaiacol: pungent clove
- Free and bound terpenes increase (whites)

Carbonic Maceration Flavors

- Role of norisoprenoids and carotenoid degradation has not been explored
- Color loss occurs
  - Anthocyanins migrate from skin to pulp during maceration and can become modified or complexed in ways that remove colored forms

Carbonic Maceration: Variables

- Temperature
- Nature and numbers of organisms present on surface
- Amount of juice and alcohol from fermentation
- Presence of any oxygen
- Higher risk of lactic spoilage

Carbonic Maceration Issues

- Even small amounts of oxygen lead to decayed fruit characters
- Integrity of berries is important as any rot will lead to spoilage
- Sensitive to pH: high pH fruit leads to decay aromas
- Wines do not age well
- Can be used for natural deacidification
- Issues are varietal-specific

Carbonic Maceration: the Nose

- Increased red fruit: cherry, strawberry, raspberry
- Increased spiciness: cinnamon, vanilla
- Increased herbaceousness: hay, silage
- Taint described as: plastic, insecticide, chemical can occur

Chemical Taint

- May arise from vinyl phenols
- May arise from carotenoid degradation
  - (*E*)-1-(2,3,6-trimethylphenyl)buta-1,3-diene (TPB) is described as insecticide and plastic

INFLUENCE OF BERRY INTEGRITY ON WINE COMPOSITION

Influence of Intact Berries on Wine Composition

- If berry metabolism is maintained, the classic carbonic characters can be found in whole berry and whole cluster fermentation
- Whole cluster and whole berry, due to the ethanol present, maintain color and has been shown to lead to enhanced color in some cases
- Seed extraction depends upon ethanol exposure and temperature

Influence of Intact Berries on Wine Composition

- The presence of oxygen impacts berry metabolism, favoring respiration and maintenance of berry characteristics
- Oxygen can favor microbial growth and metabolism
- Impact of whole berries depends upon the varietal and the nature of the precursors present

Carbonic Maceration Tasting: Grenache

- Glass 1: 100% Must
- Glass 2: 100% Carbonic

Fruit held one week post-harvest in cold storage:

- Glass 3: 100% Must
- Glass 4: 100% Carbonic
- Glass 5: 50% Whole Berry