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Wine Taints Arising During Fermentation

The following is a recap of the talk given by Linda Bisson, Wine Flavor 101 Course Director and Professor, U.C. Davis January 15, 2015

Classes of Fermentation Taints

- Arising from wild microbiota
- Arising from *Saccharomyces*

WILD MICROBIOTA TAINTS

LACTIC ACID BACTERIA

- **"Buttery" / "Cheesy" Off-Flavors/Aromas**
- **"Oxidized" Character from Fatty Acids**
- **"Vinegar" Character from Acetic Acid Production**

NON-*SACCHAROMYCES* YEAST

- **"Vinegar" Character from Acetic Acid Production**
- ***Saccharomyces* Yeast Inhibition by Acetic Acid, Stuck Ferments**
- **Ethyl Acetate Production, "Glue"/"Nail Polish" Off-Odors/Flavors**

SACCHAROMYCES TAINTS

SULFUR VOLATILES

- **Why Are Sulfur Compounds a Problem?**
  - ✓ Extremely Low Thresholds of Detection.
  - ✓ Negatively Associated Aromas/Flavors.
  - ✓ Chemically Reactive, thus Difficulty in Removal, Masking.

Different Forms are in an ever-changing equilibrium.

H_2S ⇌ Mercaptans/Thiols ⇌ Higher Sulfides

- ✓ **Treat to Remove *All* Forms, or they *will* Reform.**
- ✓ Formation can happen from Primary Fermentation to Development in the Bottle.

The Sulfur Taints

- Hydrogen sulfide
- Higher sulfides
  - Dimethyl (Diethyl) sulfide
  - Dimethyl disulfide
- Mercaptans
  - Methyl (Ethyl) mercaptan
- Thioesters
  - Methyl (ethyl) thioacetate
- Other S-amino acid metabolites
  - Thioethers
  - Cyclic and heterocyclic compounds

The Classic Sulfur Fault Descriptors

- Rotten egg
- Fecal
- Rubber/Plastic tubing
- Burnt match
- Burnt molasses
- Burnt rubber
- Rotten vegetable: cauliflower, cabbage, potato, asparagus, corn
- Onion/Garlic
- Clam/Tide pool
- Butane/Fuel/Chemical

Volatile Sulfur Compounds

- Methanethiol: CH_3-SH
- Ethanethiol: C_2H_5-SH
- Dimethyl sulfide: CH_3-S-CH_3
- Dimethyl disulfide: CH_3-S-S-CH_3
- Dimethyl trisulfide: CH_3-S-S-S-CH_3
- Diethyl sulfide: C_2H_5-S-C_2H_5
- Diethyl disulfide: C_2H_5-S-S-C_2H_5

SOURCES OF SULFUR COMPOUNDS

- **Non-Biological**
  - ✓ Elemental Sulfur Residue on Grapes from Vineyards Sprays.
  - ✓ S-containing Pesticides.
- **Biological**
  - ✓ Sulfate/Sulfite Reduction and Reduced Sulfide Reactions.
  - ✓ S-containing Amino Acid Metabolism.
  - ✓ S-containing Vitamin and CoFactor Degradation.
  - ✓ Glutathione Metabolism and Degradation.
  - ✓ S-containing Pesticide Degradation.
  - ✓ Elemental Sulfur.

FACTORS IMPACTING H_2S FORMATION

- **Low Levels of Nitrogen**
  - ✓ Know Your **YAN** (Yeast Assimilable Nitrogen) **Levels** at Crush.
    - ***Link to*** ***HARVEST NUTRIENT ADDITIONS.docx***
  - ✓ Add the **Proper Complex Wine Nutrient** at the **Right Time**.
    - ***Link to*** **BISSION NUTRIENTS 5-18-14.docx**
- **Level of Methionine, Relative to the Total Nitrogen**

- **Fermentation Rate**
  - ✓ Too Fast = Too Hot = Increase of Sulfur Volatiles.
- **Miscellaneous Factors**
  - ✓ Vitamin Deficiency / Presence of Metal Ions / Inorganic Vineyard Sulfur S-containing Pesticide Degradation / Genetics of Yeast Strain.

HIGHER SULFIDE FORMATION (Dimethyl/Diethyl Sulfide, Dimethyl Disuldide)

- **Sources of Higher Sulfides**
  - ✓ S-containing Amino Acids.
  - ✓ S-containing Vitamins and Co-factors.
  - ✓ Glutathione (Cysteine-containing tripeptide involved in redox buffering).
- **Know Your Nutrient Composition**
  - ✓ Use a ***Complex Nutrient*** made specifically for Winemaking.
  - ✓ Never just add home vitamins, etc..
  - ✓ ***Not All Wine Nutrients Are Equal***: link to **http://www.bsgwine.com/PDF/2014BSGTECH-NUTRIENTS.pdf**

- **Higher Sulfides**
  - ✓ Emerge Late in Fermentation and During Sur-Lie Aging (autolysis).
  - ✓ Can be Released by Metabolically Active Yeast as they enter the Stationary Phase (start of alcohol ferment).
  - ✓ **Come from the Degradation of Sulfur Containing Amino Acids.**
    - Biologically
    - Chemically
      - From reaction of Reduced Sulfur Intermediates with other cellar metabolites (?).
      - Formed Chemically due to the general reduced conditions (?).
    - Degradation of cellular components = AUTOLYSIS.

THE FUSEL FAMILY

Fusel Family

- Alcohols, acids and aldehydes derived from amino acids
- Alcohols are generally the products of yeast metabolism
- Fusel acids and aldehydes more toxic than alcohols
- Redox conditions during aging or bottling can convert fusel compounds into different forms
- Microbial activity (Acetic Acid Bacteria or *Brettanomyces*) can convert fusel compounds to different forms

Fusel Alcohols and Derivatives

- Below 300 mg/L = fruity and pleasant: peach, apricot
- Above 400 mg/L = pungent, chemical taste and aroma described as oil, oil refinery, plastic manufacturing
- Total produced: varies from less than 100 to greater than 500 mg/L
- Very strain dependent
- Individual compounds typically vary from 10-140 mg/L

Fusel Alcohol Formation Influenced by:

- Yeast strain
- Availability of amino acid precursors
- Presence of non-*Saccharomyces* yeasts
- Increased DAP with low nitrogen juice
- Increased juice solids