Wine Faults

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The Types of Wine Faults

- Hazes/Cloudiness
- Sediment/Precipitates
- Off-Characters: Taints

Hazes/Cloudiness

- Protein
- Polysaccharide
- Colloidal Instability
- Microbial growth

Sediments/Precipitates

- Tartrate instability
- Oxidative polymerization
- Microbial growth

Wine Taints

- Color
- Aroma
- Taste

Sources of Taints

- Vineyard
- Unsound fruit
- Fermentation microbes
- Oxidation/reduction reactions
- Spoilage microbes

Taints

- Same off-character may come from different sources (acetaldehyde)
- Some off-characters arise only in specific chemical/microbial environments
- Compound(s) responsible for some taints unknown

Wine Taint Definition

Something that is:

- generally recognized as negative
- native to the cultivar but undesired
- undesired for a specific style
- an odd wine character

Generally Recognized as Negative

- Sulfur volatiles: rotten egg, canned vegetables, onion, garlic, clam, fishy, swampy, natural gas, etc.
- Malolactic off-characters: mousy, fur, rancid, vomit, poo
- *Brettanomyces* characters: medicinal, Band-Aid, artificial smoke, rancid, putrid/decay, perfume

Native to Cultivar but Undesired

- Pyrazines/vegetal character
- Unripe apple
- Passion fruit/sweaty/cat urine
- Smoke + tobacco = ashy
- Single trait dominating wine aroma profile

Undesired for a Specific Style

- Too much forward fruit
- Too little forward fruit
- Too much jam/cooked fruit
- Not enough jam/cooked fruit

Odd Wine Characters

- Atypical aging character
- Plastic/solvent/paint taints
- Rose taint
- Metallic taints
- Material other than grape (MOG) taints
  - Insect taints
  - Contaminant plant taints

Timing of Taint Formation

- Upon Crushing/Processing of Fruit
- During Fermentation
- During Aging

Taints Arising Upon Crushing/Processing of Fruit

- Originating in Vineyard
  - MOG-associated
- Arising early in processing
  - Cluster rot-associated
  - Aerobic fermentation during delivery of fruit

Taints Arising During Fermentation

- From wild microbiota
- From *Saccharomyces*

Wild Microbiota Taints

- Lactic acid bacteria
  - Butter
  - Fatty acid/oxidized character
  - Acetic acid
- Non-*Saccharomyces* yeast
  - Acetic acid
  - Ethyl acetate

Classes of *Saccharomyces* Taints

- Fusel compounds
- Esters
- Sulfur volatiles

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

Ester Family

- Also arise from yeast nitrogen metabolism
- Low concentrations: fruity and floral
- High concentrations: perfume/extracts/solvent
- Can dominate wine aroma profile
- Are lost over time
- Production varies by strain and juice conditions

Positive Wine Characters Associated with Esters

- Fruit
  - Apple
  - Apricot
  - Fig
  - Melon
  - Peach
  - Pear
  - Prune
  - Raspberry
  - Strawberry
- Honey
- Tropical fruit
  - Banana
  - Coconut
  - Mango
  - Pineapple
- Floral
  - Rose
- Butter
- Spice
  - vanilla
- Yeast (bread)

Negative Wine Characteristics Associated with Esters

- Foxy
- Nail polish
- Bubble gum/cotton candy
- Soapy
- Candle wax
- Perfume
- Intense fruit
- Intense floral

In General . . .

- The higher the concentration of the ester the more negative the impression is of the character
- Longer chain esters fall into soapy, perfume range
- Combinations of esters can confer a stronger aroma than the sum of the individual compounds

Sulfur Volatiles Family

Come from:

- S-containing amino acid metabolism
- Vitamin degradation
- S-compounds used in vineyard
- Degradation of cell materials during adaptation

Why Are Sulfur Compounds a Problem?

- Low thresholds of detection
- Negatively-associated aromas
- Chemical reactivity
- Difficulty in removal
- Difficulty in masking

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

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

Sources of Sulfur Compounds

- Non-biological
  - Elemental sulfur
  - S-containing pesticides
- Biological
  - Sulfate/Sulfite reduction and reduced sulfide reactions
  - S-containing amino acid metabolism
  - S-containing vitamins and cofactors degradation
  - Glutathione metabolism and degradation
  - S-containing pesticides degradation
  - Elemental sulfur

Factors Impacting H_2S Formation

- Level of total nitrogen
- Level of methionine relative to total nitrogen
- Fermentation rate
- Use of SO_2
- Vitamin deficiency
- Presence of metal ions
- Inorganic sulfur in vineyard
- Use of pesticides/fungicides
- Strain genetic background

Timing of Sulfur Fault Formation

- Primary Fermentation Early: Hydrogen Sulfide
- Primary Fermentation Late: Hydrogen Sulfide
- Post Fermentation: Hydrogen Sulfide or Sur Lie Faults
- Bottling: S-fault development

Higher Sulfides

- Emerge late in fermentation and during sur lie aging
- Release of compounds during entry into stationary phase by metabolically active yeast
- Come from degradation of sulfur containing amino acids
  - Biological
  - Chemical
    - From reaction of reduced sulfur intermediates with other cellular metabolites?
    - Formed chemically due to reduced conditions?
- Degradation of cellular components: autolysis

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 Higher Sulfides

- S-Containing Amino Acids
- S-Containing Vitamins and Co-factors
- Glutathione (Cysteine-containing tripeptide involved in redox buffering)

Taints Arising During Aging

- Microbial Spoilage
  - *Brettanomyces*
  - Acetic Acid Bacteria
  - Lactic Acid Bacteria
- Oxidative Taints
  - Sherry-like characters
  - Solvent/chemical taints

Brettanomyces Aromas in Wine

- Horse sweat
- Leather
- Earthy
- Medicinal
- Band Aid
- Smoky
- Tobacco
- Barnyard
- Putrid
- Lilac

Brettanomyces Impacts on Wine

- Loss of ‘fruit’, ‘floral’ & ‘honey’ aromas
- Loss of negative aromas
- Increase in overall complexity
- Acetic acid, vinegar aroma
- Spice and smoke aroma
- Chemical, Plastic, Band Aid aroma
- Metallic, bitter taste
- Mousiness

Compounds Produced by Brett in Wine

- Signature spoilage compounds - ethyl phenols, vinyl phenols
- Other spoilage compounds – acetic acid, ethyl acetate, fatty acid, carboxylic acid
- Compounds that are positive – Esters, higher alcohols, terpenes

Oxidative Taints

- Off-colors:
  - pink
  - brown
- Off-flavors:
  - Aldehyde (nutty)
  - Rancid (oxidized fatty acid)
  - Hamster fur/stale tortilla chips
  - Chemical notes

Oxidative Taints

- Function of oxygen exposure and wine's ability to consume oxygen
- Related to phenolic content
- Impacted by other factors such as pH
- Some oxidation reactions are desired; not all lead to defects = a delicate balance!

Taint Mitigation

- Best not to get it in the first place
- Need to accurately define taint and source
- Need to conduct well-designed trials to test efficacy of removal