WINE SENSORY DEFECTS

Introduction

Enartis VINQUIRY

Blending Innovative Technology with Unparalleled Service

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WINE SENSORY DEFECTS

Purpose

- There are many different types of wine defects, many of which overlap due to complex relationships…
  - Chemical
  - Microbial
  - Sulfur-related
  - Taint
- Origin and description of wine sensory defects
- What you can do to prevent defects

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- Wine defect: an attribute not wanted in the wine

- Value judgment
  - Some people may like the "defect": Acetic, 4EP/EG at low levels add complexity

  - Threshold and tolerance vary among individuals

WINE SENSORY DEFECTS

Is it a defect?

- Can you *detect* the aroma in question?
- Does the attribute alter the *balance* (and therefore your enjoyment) of the wine?
- If the answer is “yes” to both questions → you *probably* have a wine defect!

- Realities of wine defects
  - Personal preferences and styles differ
  - Detection of attributes differ
  - Interpretation of attributes differ
  - Interactive affects of attributes in the bottle and/or glass are profound

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- **Hazes, Clouds, Sediments, Dust**
  - Growth of oxidative yeast or bacteria cause sediment, gas, haze
  - Heat-unstable proteins, clouds and haze
  - Crystals (tartrates, etc.) calcium
  - Iron casse (blue haze)
  - Bottling is a harsh activity! Cork dust, pieces of cork

- **Precipitation of Tartaric Acid**
  - Potassium bitartrate instability (needs tartaric acid, ethanol, cold temp, removal of proteins)
  - Calcium tartrate instability (to a lesser extent)

Chemical Browning in White Wines

Oxidation of phenolic compounds (catechins to leucoanthocyanidins)

3 mechanisms: Carmelization, Maillard Rxn, Direct phenolic oxidation

http://www.redwinebuzz.com

Prevent oxidation by keeping wine vessels topped up and properly sulfured! Winemaking begins at crush, and with oxygen management, you can clean out any oxidizable phenolic compounds before fermentation.

- **Pinking**
  - Found primarily in Sauvignon Blanc and Pinot Grigio, but can be in any white wine
  - Seems to be linked with oxygen exposure, but direct cause unknown
  - Formed when wine stored under reductive conditions suddenly exposed to oxygen. There is a rapid conversion of flavenes to their red flavylidium salts.
    - Use PVPP to fix

- **Lacquering: color pigment instability**
  - A deposit forms in the bottle while in the cellar
  - Primarily found in young red wines (especially Syrah)
  - pH plays a role
  - Products available to prevent color instability

Oxidation (Acetaldehyde)

Smells like: Over-ripe bruised apples, Sherry, Nut-like

Comes from:

- Wine aging (chemical oxidation of ethanol)
  - Associated with:
    - Increased color depth in white wines
    - Brickish tint in red wines
- Improperly stored wines
  - Surface (flor or film) yeast growing aerobically may oxidize ethanol to acetaldehyde
  - Growth of oxidative bacteria on wine surface
  - Excessive heat during storage

Detection: Flor Sherry is 500mg/L
New wine: <75mg/L
Sensory: 100 – 125 mg/L

- **Volatile Acidity (VA)**
  - Smells like:
    - Vinegar (acetic acid)
      - Has a “rotting” odor
      - “Acetic aroma” not exclusively a result of acetic acid → complexed with ethyl acetate
    - Fingernail polish or Fingernail polish remover (ethyl acetate), contributes significantly to VA defect
      - More pungent than acetic acid
      - Lower aroma threshold

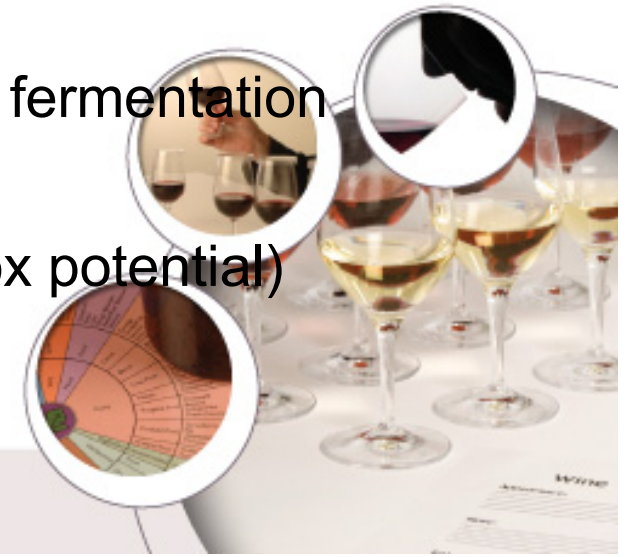
- **Volatile Acidity (VA) sources:**
  - Yeast
    - Many non-*Saccharomyces* strains able to produce relatively large amounts of acetic acid and esters
    - Cold soak is a common source associated with VA, wild yeast
  - Bacteria
    - Lactic Acid Bacteria during primary and secondary fermentations. VA is harder to detect because it is acetic acid without ethyl acetate esters
      - Immediately treat with lysozyme to inhibit formation of VA
      - Stabilize with SO2 soon after MLF
    - Acetic Acid Bacteria, produces ethyl acetate so easier to detect, can be controlled with sulfur and oxygen management.

- **Sulfur**
  - From a *sensory* standpoint, volatile sulfur compounds typically have intense, disagreeable odors (rubbery, skunk, onion…)
  - Sulfur can be sensed in a variety of forms:
    - Sulfate (SO_4^{2-})
    - Sulfite (SO_3^{2-})
    - Amino Acids (methionine, cysteine)
    - Mercaptans

- **Sulfur**
  - Concentration of sulfur in grape juice (ranges from 100 – 700mg/L) at harvest, depends on:
    - Grape variety, Soil, Nutrient content, Vintage
  - Can somewhat control sulfur product with YAN levels
  - Yeast need sulfur for protein synthesis, vitamins and to support cell growth, but must reduce it to be useful (5mg/L)
  - During fermentation, the reduction of sulfates can form H_2S (yeast, temp)

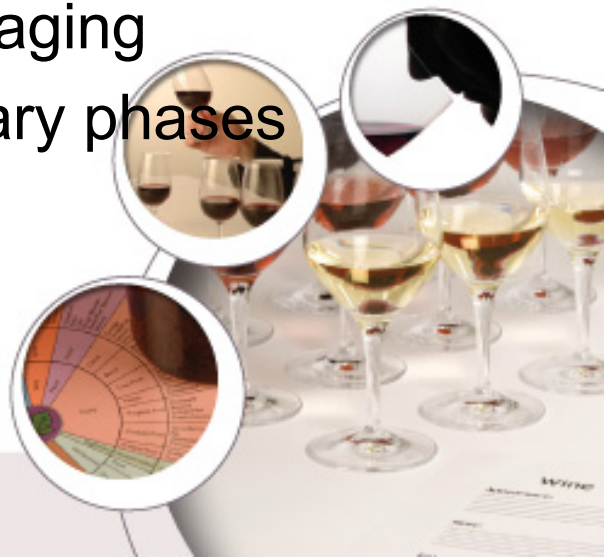
- **Sulfur**
  - Volatile sulfur compounds that elicit a sensory response:
    - Sulfur dioxide (Burnt Match), added during winemaking and synthesized by yeast during ALF
    - Hydrogen sulfide (Rotten Eggs), comes from elemental sulfur, yeast, and yeast strain during fermentation (low vs. high H2S producers)
    - Sulfides and Thiols/Mercaptans
      - Methyl Mercaptan
      - Ethyl Mercaptan
      - DMS
      - DMDS
      - Diethyl Disulfide

- **Hydrogen Sulfide**
  - Concentration depends on:
    - Type and amount of elemental sulfur used on grapes, and timing of applications
    - Yeast strain genetics (low vs. high H_2S producers; rate of fermentation) *Wild yeast, rapid fermenters (Montrachet, UCD 522).*
    - Juice chemistry (pH, YAN, Ethanol concentration, levels of sulfite and sulfate, metal ions, vitamin concentrations, Nitrogen concentrations, methionine concentrations)
    - Physical parameters (suspended solids, fermentation temperature) less H_2S at lower temps
    - Environmental factors (tank height, redox potential)



- **Hydrogen Sulfide**
  - Formation of H_2S:
    - **Quick Fermentation** (2-4 days): due to Nitrogen imbalance
    - **Late/End Fermentation**: due to degradation of S-containing compounds or Ethanol tolerance
    - **Sur lie aging**: due to yeast autolysis, fatty acids can be extremely odorous
    - If not managed properly, can turn to Mercaptans…

- **Mercaptans**
- Smells like: Cabbage, Rubbery, Struck Flint or Burnt Rubber
  - Dangers of:
    - Hydrogen Sulfide can react with other wine components to form Mercaptans
    - Difficult to remove from wine, copper won't help
    - Have a more rotten aroma than H_2S, very odorous
  - Formation:
    - Emerge later in fermentation and sur lie aging
    - These are released during yeast stationary phases
    - S-containing amino acid degradation



WINE SENSORY DEFECTS

Aroma Defects

- **Methanethiol (Methyl Mercaptan)** *"lightstruck"*
  - Smells like: Cooked cabbage, Onion, Putrefaction, Rubber
- **Ethanethiol (Ethyl Mercaptan)** *1.1ppb*
  - Smells like: Onion, Rubber,Natural Gas
- **Dimethyl Sulfide (DMS)** *25ppb*
  - Smells like: Asparagus, Canned Corn, Molasses
    - Not related to H2S production
- **Diethyl Sulfide** *0.92ppb*
  - Smells like: Cooked Vegetables, Onion,Garlic
    - Not related to H_2S production
- **Dimethyl Disulfide (DMDS)** *29ppb*
  - Smells like: Onion, Cooked Cabbage
- **Diethyl Disulfide** *4.3 ppb*
  - Smells like: Burnt Rubber, Garlic

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- **Sulfur Compounds**

  A Lesson Learned:

  – Sulfur compounds have a lot of commonalities, but you have to determine whether you can treat them or not

  – Treat sulfides and mercaptans with copper. Dimethyl Sulfide, Diethyl Sulfide, DMDS and DEDS do not react with copper. Products like Tanenol Max Nature (an oak-derived tannin) work well in conjunction with copper to remove off-aromas. Remember! Some thiol compounds, at lower concentrations, contribute to pleasant, fruity aromas

- **Cork Taint (Corked)**
  - Smells like:
    - Musty
    - Swampy
    - Moldy
    - Dank Cellar
    - Wet Newspaper

- **Cork Taint or "Corked":** Primarily recognized as TCA (2,4,6-Trichloroanisole)
  - Comes from:
    - Mold on the cork wood
    - Chlorine washing
    - Cellar contamination
  - Chloroanisoles are not naturally occurring in wine
  - Wine contamination requires contact with contaminated material (wood pallets!)
    - Contact of wood with chlorine
    - Mold activity
    - Bentonite susceptible to TCA contamination

- **Cork Taint (Corked)**
  - TCA – compound mostly associated with cork taint
  - Other compounds:
    - Geosmin (earthy, muddy, cooked beets)
    - 2-Methylisoborneol (2-MIB) (moldy, dirt)
    - 2-Methoxy-3,5-dimethylpyrazine (MDMP)
    - Tribromoanisole (stronger than TCA)

- **Brettanomyces Dekkera (Brett.)**
  - Smells like:
    - Barnyard
    - Pharmaceutical (medicine chest, Band-Aid)
    - Horse (blanket, sweat, saddle)
    - Wet Dog
    - Tar
    - Leather
    - Tobacco
    - Plastic
    - Creosote

- **Brettanomyces Dekkera (Brett.)**
  - Impact Compounds Associated with Brett.
    - 4-ethylphenol (medicinal, Band-Aid) *500ppb*
    - 4-ethylguaiacol (smoky, bacon) *50 – 100ppb*
    - Isovaleric Acid (vomit, sour, cheesey)

- **Brettanomyces Dekkera (Brett.)**
  - Many compounding problems with Brett
    - Spoilage yeast sources
      - Air?
      - Grapes?
      - Cellar (surfaces, equipment)
      - Cooperage
    - Bacteria – *Pediococcus* – can produce small amounts of 4EP/4EG, but not really a factor.

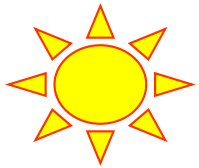
- **Brettanomyces Dekkera (Brett.)**
  - Why is Brett so difficult to prevent?
    - Most strains are resistant to acid
    - Tolerates high ethanol, and many strains use ethanol as a carbon source
    - Slow growth makes it resistant to SO_2
    - Grows on substrates *Sacchromyces* will not utilize (ethanol, amino acids, wood sugars, fructose, etc.)
    - Difficult to destroy with sanitation practices (due to biofilm formation)

- **Methoxypyrazines**
  - Smells like: Green, Grassy, Vegetative, Herbaceous, Bell Pepper (IBMP, IPMP)
  - Comes from:
    - Varietal character (Cabernet Sauvignon, Cabernet Franc, Sauvignon Blanc, Merlot, Semillion, and Carmenere)
    - Unripe fruit
    - Climate
    - Poor production practices

- **Methoxypyrazines**
  - Some of the compounds that contribute to vegetative aromas: C_{13}-norisoprenoids, C_6-compounds, and S-compounds
    - control immediately as juice with Ascorbic and Sulfur (AST)

- **“Lightstruck”**
  - Smells like: Skunk, Cheese, Plastic
  - Comes from:
    - Amino acid, methionine, rearrangement

Methionine



H2S, DMS, Methanethiol,
DMDS, Ethyl Methyl Sulfide

- **"Lightstruck"**
  - Particular problem in sparkling wines
    - Aroma perception magnified by CO_2

http://i.telegraph.co.uk/telegraph/multimedia/archive/01385/champagne_cork_1385836c.jpg

- **Mousey**
  - Smells like (and exhibits an aftertaste of): Mouse Urine, Rancid Nuts
  - Comes from:
    - *Lactobacillus,* and sometimes *Oenococcus*
    - *Brettanomyces* (rarely)
  - Main compound responsible for:
    - 2-acetyl-3,4,5,6-tetrahedropyridine
    - Produced in the presence of lysine and ethanol
  - Other Microbial Aromas: Muddy, earthy, musty, beets, turnip

- **Smoke Taint**
  - Smells like:
    - Smokey
    - Burnt Toast
    - Earthy
    - Smoked Meat
    - Burnt
    - Tobacco
    - Beet Root
    - Drying
    - Ashes
    - Cigar Box
    - Truffle
    - Charcoal
    - Ash Tray
    - Charred
    - Fungal
    - Tar
    - Bacon
    - Roast Meat
    - Leather
    - Salami
    - Coffee
    - Chocolate
    - Disinfectant

- **Smoke Taint**
  - Comes from:
    - Exposure of smoke to the grape berries
      - Dependent on timing of smoke exposure (most sensitive 7 days post veraison)
      - "Smoke Taint" aroma/flavor compounds appear to be present in grape as glycosides, suggesting berry metabolism of smoke components. Hard to test due to compounds being bonded with sugars.

Ranges: guaiacol – most 5-50 ppb (Few really high >150 ppb)
4-methylguaiacol- <5 ppb to 50-60 ppb high range
4-ethyl guaiacol and 4-ethyl phenol at low levels with 4-ethyl guaiacol conc. greater than 4-ethylphenol

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- **Over-Extraction**
  - Mouthfeel attributes:
    - Excessive Bitterness
    - Excessive Astringency
  - Comes from:
    - Extracting too much tannin during pressing
    - Excessive astringency

THE TAKE HOME MESSAGE!

Done!

- **A sensory reminder…**
  - Just because you don't smell (or taste) something "bad," it doesn't mean that the compound(s) is (are) not present in the wine…
  - The concentration of the compounds may be below *your* individual level of sensitivity

    OR
  - The compounds have not yet combined with others to form the noticeable off-aromas or off-flavors

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