Wine Faults

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When Good Wines Go Bad!

- Classification of Wine Faults:
  - Chemical
  - Physiochemical
  - Microbial
  - Environmental/Contact

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Chemical Wine Faults

- Oxidation/reduction
  - Browning
  - Pinking
  - Post Bottling formation of Volatile Sulfur Compounds
  - Aceteldehyde
  - “Source Code”
- Legal Limits
- Ethyl Carbamate

Oxidation/Reduction

- Browning
  - Common problem in bottled wines
    - Usually, this is developed in the cellar, and exacerbated as container size decreases
- Pinking
  - In white wines, when handled reductively, can “pink” when exposed to air (bottling)
  - Brown Juice vs Green Juice

Post Bottling VSC Formation

- Depending on how the wine was processed (DO content), these VSC can express themselves post bottling
  - They can also show up in the cellar post fermentation
  - "reductive" conditions promote the development
  - Splash racking temporarily masks VSC, but causes more problems
- Judicious Dissolved Oxygen management can help prevent this
- Usage of appropriate closure for wine type and aging potential

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Oxygen "Source Code"

- Dissolved Oxygen
  - Levels and exposure can vary wildly
    - Handling and processing techniques
    - Temperature

Operation: Wine Transfer	Temperature (°F)	Average mg/L O2 pickup
Bottom Tank Pumping	70	0.5
Bottom Tank Pumping	50	1.3
Splash Racking	n/a	7

Action in cellar	Dissolved O_2 (mg/L)
Topping	1
Pumping	1 - 2
Filtration	0.5 - 2.5
Racking	2 - 5
Racking with O_2	4 - 8
Centrifugation	1.5 - 2.5
Cold stabilization	3.5 - 6
Bottling	0 - 4
Transport (full tank)	0 - 6

Oxygen “Source Code”

- Oxygen exposure decreases Free SO2 content
  - This, in turn, reduces it’s anti-microbial function
  - High pH levels exacerbate this phenomena
- Oxygen is necessary for certain spoilage microorganisms
  - Non-*Saccharomyces* require more O2 that *Saccharomyces*
  - *Acetobacter and Gluconobacter*
  - *Brettanomyces* (produces sig higher levels of VA in presence of O2)
  - “Flor/Sherry” yeasts require High DO levels to grow

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Legal Limits

- To be considered a “fault,” a compound must exceed the legal limit, and therefore be unsaleable
- US limits can be different than other countries
  - Important for export
- In the case of SO2, Free SO2 levels >60ppm can be detected sensorally
  - Can be unpleasant, or cause a reaction (sneezing?)
- For metals, can accelerate oxidative reactions and potentially cause hazes

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Ethyl Carbamate

- Formed slowly after fermentation through a chemical reaction from nitrogenous (mainly urea) precursors and ethanol
- Greatly influenced by storage temperature
  - For each 1ppm of urea present:
    - 0.15 µg/L @ 13.3°C
    - 0.60 µg/L @ 18.6°C
    - 2.2 µg/L @ 23.9°C
- Suspected to be a carcinogen
  - Voluntary target of 15ppb……

Physiochemical Stability

- Colloidial stability: refers to the wines ability to maintain solubility of various compounds
  - Unstable wines can drop sediment in the bottle
    - Typically all wines are unstable at some age
- Pinking – reductive handling as juice
- Browning- caused by improper SO2 and DO management
  - Also linked with acetaldehyde production
  - Can be associated with VA production

Physiochemical Stability

- Tartrate formation
  - Calcium vs Potassium Tartrate
    - Crystal formation
    - Impacted by soil chemistry
    - Ca instability exacerbated by higher pH levels
  - Traditional chilling techniques can be effective
    - Can greatly increase oxygen solubility
  - Tartrate crystal inhibitors
    - Claristar-can be used on reds, roses, whites
    - CMC- only used on white wines that are very heat stable, can cause filtration problems, difficult to handle
    - Bench trials are important for both, neither are effective on calcium tartrate

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Physiochemical Stability

- Haze formation
  - Different than microbial cloudiness
  - Pectin haze (particularly Concord)
  - Metal haze (use of non stainless metallic cellar tools, CuSO4, bentonite)
  - Protein haze (heat stability)

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Physiochemical Wine Faults

- Effervescence
  - Can be pleasant in some wines
  - Can be derived from microbial activity or addition of CO_2/dry ice
  - ~700ppm = tactically perceivable
  - ~1000ppm = bubble formation
  - Inversely soluble with temperature
    - (pushing corks)
  - Sparging with high purity Nitrogen can eliminate it

Microbial Wine Faults

- 4EP/4EG
- Mousiness
- Ropiness
- Biogenic Amines
- Ethyl Acetate
- Volatile Acidity
- Volatile Sulfur Compounds
- Acrolein
- Mannitol
- Geraniol (Geranium Taint)
- Diacetyl
- Effervescence
- Haze

Microbial Wine Faults

- 4EP/4EG/4EC
  - 4-ethylphenol: “medicinal” “band-aid”
  - 4-ethylguaiacol: “spicy” “smoky”
  - 4-ethylcatechol: ”savoury” “sweaty/cheesy” “barnyard/animal”
  - produced in differing quantities by strains of *Brettanomyces*
    - Affected by strain of *Brett*, substrates, growth factors, etc
  - Some LAB can conduct an intermediary metabolic function in the production of these compounds (ie *brett* and bacteria symbiosis)

Microbial Wine Faults

- Mousiness
  - Not “odor-active”
  - Not perceptible at wine pH’s
  - Described as “mouse urine” “candy corn” “popcorn”
  - Usually produced by LAB, but also Brett
  - Depends on a persons sensitivity
  - Expresses itself after the wine has been swallowed and the saliva in the mouth dilutes the wine acids and raises pH

Microbial Wine Faults

- Ropiness
  - Typically produced by Periococcus and/or Leuconostoc
  - Polysaccharide formation
    - “oily’’ character

Microbial Wine Faults

- Biogenic Amines
  - Histamine, Tyramine, Putrescine, Cadaverine
  - Produced mainly by LAB
  - Can cause anaphylactic responses
    - Headache, facial flushing, nausea, respiratory distress
  - Can be smelled as “putrid” “meaty” “cadaver”
  - Indication of poor winemaking practices, native MLF
  - Using a commercial strain can eliminate production

Microbial Wine Faults

- Ethyl Acetate "nail polish remover"
  - Mainly produced by yeasts (native fermentations)
  - Low levels can contribute to complexity
- Volatile Acidity
  - Can be produced by AAB, LAB, and some yeasts
  - AAB: in the presence of high levels of DO
  - LAB: metabolism of sugar
  - Yeasts: native and stuck fermentations

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Microbial Wine Faults

- Volatile Sulfur compounds
  - H2S typically produced by yeasts, especially in stressed environments or unhealthy populations
  - Mercaptans: reactions develop from H2S and ethanol/methanol
    - Reacts with Copper Sulfate
  - Disulfides: oxidation of mercaptans (splash racking)
    - Persistant
    - Does not react with Copper Sulfate
    - Can be reduced back to mercaptans using ascorbic acid

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Microbial Wine Faults

- Acrolein
  - Produced by LAB
  - Can contribute to extreme bitterness in wines
- Mannitol
  - In high pH, sweet wines, some LAB can produce from fructose
  - "Viscous" and can cause an irritating finish
  - I perceive it as a corrosive finish, bitter, caustic, aggressive

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Microbial Wine Faults

- Geraniol (geranium taint)
  - The usage of sorbic acid (sorbate) in the presence of active LAB populations can lead to geraniol production
  - LAB utilize the sorbate as a carbon source
- Diacetyl
  - Inoculation of MLB after first racking can lead to higher leves
  - *Pediococcus* & *Lactobacillus* can produce elevated levels
  - "Butter"
  - Can be a stylistic tool, but can be objectionable in some wines

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Microbial Wine Faults

- Effervescence (CO2)
  - While desired in some wines, can be an indicator of spoilage
  - In most wine styles, it is objectionable
- Microbial haze
  - Reliable indicator of microbial bloom

Environmental/Contact Wine Faults

- Halogenated Anisoles
  - 2,4-dichloroanisole(DCA)
  - 2,4,6-trichloroanisole (TCA)
  - 2,3,4,6-tetrachloroanisole (TeCA)
  - pentachloroanisole (PCA)
  - 2,4,6-trichlorophenol (TCP)
  - 2,3,4,6-tetrachlorophenol (TeCP)
  - penthaclorophenol (PCP)
  - 2,4,6-Tribromoanisole (TBA)
- Cork derived compounds
  - Guaiacol
  - Geosmin
  - 2-methylisoborneol
- Plastic-like taints

Halogenated Anisoles and Cork Derived Compounds

- Most commonly found in corks, can also be found in barrels and other "wood" sources
- Can be environmental in the cellar
  - Bentonite and other materials can be a "sink"
- Cork Derived Compounds
  - There are a number of sensorally active compounds that can be imparted to the wine from contact with cork

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Plastic-like taints

- Sources:
  - Bag in the box
  - Plastic Cellar vessels
  - Can liner interactions
  - Alcohol is a solvent, combined with high acidity (low pHs)

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Ok, so what now?

- Control microbial populations
  - Fining, settling, filtration
  - Microbial control agents
    - Chitosan, chitin/glucan, velcorin, etc
- Proper SO2 and DO management
- pH control
- Cadence of processing (primary implantation, MLF, etc)
- Remediation
  - Fining agents, tannins, blending

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