Remediating Wine Defects

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What Could be a Defect?

- Primarily, anything that negatively affects color, appearance aroma, mouthfeel/balance, stability:
  - Color: browning/pinking
  - Appearance: Hazes, Turbidity, precipitate
  - Aroma: Sulfur Compounds, 4EP/4EG, “cork” taint, VA, Acetaldehyde
  - Mouthfeel/balance: low/high acidity, mousy taint, bitterness/astringency, ETOH
  - Stability: high pH, inadequate SO2, oxidation, contamination, effervescence
  - Other: legal limits, label issues, compliance

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First Step in Fixing a Defect

- Identify the problem!
  - Ask other winemakers for help
  - Consult with suppliers
  - Send Samples to a Lab
  - Run and track analysis over time
    - Ex: reoccurring depletion of SO2 over time is an indicator of Oxidation and/or unwanted microbial growth
- Once identified, a remediation plan can be developed

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What tools do we have in our Toolbox?

- Fining agents
- Enzymes
- Filtration/Clarification
- Tannins
- Blending
- Stability Agents
- Temperature Control
- Specific Inactivated Yeast
- Inert Gases
- pH Manipulation
- Ion Exchange
- Crystal inhibitors
- others

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Fining Agents

- Settling Agents:
  - Help to settle particulate and microbial populations, in prep for racking
- Reactive Fining Agents:
  - Bind with certain compounds for removal
    - Electrical (charge) interaction
      - Particles are induced to coalesce with the agent, forming larger particles.
      - Due to greater density, the complex eventually settles out of solution.
    - bond formation
    - absorption
    - Adsorption
- Sometimes, a combination of agents will be necessary

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What impacts efficacy?

- Proper lab trials
- Quality of material
- Method of preparation
- Method of addition
- Concentration
- pH
- Metal Content
- Temperature
- Age
- Previous treatments

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Comparison of Fining Aids

color reduction	tannin reduction	volume of lees formed	clarity and stability	potential for overfining	quality impairment
carbon	gelatin	bentonite	bentonite	gelatin	carbon
gelatin	albumen	gelatin	carbon	albumen	bentonite
casein	casein	casein	isinglass	isinglass	casein
albumen	bentonite	albumen	casein	casein	albumen
isinglass	carbon	isinglass	gelatin		isinglass
bentonite		carbon	albumen		
*comparison of fining agents with respect to desired effects and potential					
problems in decreasing order of activity or effectiveness					
Source: Berg 1981					

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Enzymes

- Today, there are a host of enzymes commercially available to help winemakers solve (and prevent) problems
  - Pectinases
  - Glucanases
  - Beta-glucanases
  - Lysozyme
  - Blends
- These can improve settling time, enhance filterability, control microbial populations, change the “matrix”

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Bench Trials!

- Items needed:
  - Mixing plate and bars
  - Assortment of pipets including micropipette
  - Appropriate sample containers and closures
  - g/mg scale
  - Nephilometer (bento)
  - Spectrophotometer (enzymes/clarity)

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Bench Trials, cont

- Select appropriate dose range
  - g/hL, ppm, #/gal, etc
- Prepare stock solution (ie 10%)
- Dose sample wine, hold
- observe

Bench Trial Recommendation (per 375ml bottle)

Target Addition	lbs/1000gal	mls of 10% Lab Dilution	microlitres of 10% Lab Dilution
15 g/hL	1.3	0.56	560
20 g/hL	1.7	0.75	750
30 g/hL	2.5	1.13	1130
40 g/hL	3.3	1.5	1500
50 g/hL	4.2	1.87	1870
60 g/hL	5	2.25	2250
70 g/hL	5.8	2.62	2620

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Bench Trials, cont

- Some bench trials may take a few days – few weeks
- Try to emulate cellar conditions
  - Temperature and container dimensions (ie 1:1)
- Use fresh fining aid (note expiration)
- Some fining aids require specific preparation
  - Follow mfgs recommendation
- Sometimes, bench trials can be done again to dial in dose
- Tannin trials can expand to use combinations

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Volatile Sulfur Compounds

- **H2S – rotten egg**
- **Ethyl mercaptan – onion, rubber**
- **Methyl mercaptan – rotten egg, cabbage**
- **Dimethyl disulfide – onion, cabbage**
- **Diethyl disulfide - burnt rubber, garlic**

Sulfur compound detection trial

Glass	Compound added to wine
1	Nothing, keep as control for smell comparison
2	3-5 drops .05% cadmium sulfate
3	3-5 drops .05% copper sulfate
4	10 drops 1% ascorbic acid, wait 15 minutes, then 3-5 drops copper sulfate

Note – this trial is for smell only, never taste samples after adding copper or cadmium.

After 10 minutes or so, compare the smell of glasses 2 and 3 to glass 1. If #2 cleared up the odor, hydrogen sulfide is the sole offender. If #2 did not clear up the odor, but #3 did, you have mercaptan. If neither cleared up the odor, proceed to #4. Ascorbic acid is added to oxidize disulfides back to mercaptans, which are then removed by copper sulfate. If #4 removes the odor, but 2 and 3 did not, disulfides are present. If none of these work completely, and you're convinced it is a sulfur fault, redo the trial with larger additions.

Source: Bradley Beam, 2017

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Volatile Sulfur Compounds

- A lighter approach:
  - SIY products such as Reduless or Noblesse
  - Finishing Tannins
- Splash Racking?
  - Generally*:

$H_2S \xrightarrow{+O_2}$ mercaptans and thiols $\xrightarrow{+O_2}$ Disulphides

lower sensory perception threshold -> higher sensory perception threshold

Conversely

Disulphides $\xrightarrow{-O_2}$ mercaptans and thiols $\xrightarrow{-O_2}$ H_2S

This is what is commonly referred to as “reduction”

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Mousy Taint

- Common in high pH wines with improper SO2 usage, excess oxidation, and growth of LAB and/or Brett
- Not perceptible by smell, and only perceived once the wine leaves the palatte. The saliva in your mouth raises the pH and then the mousiness becomes perceptible
- Remediation
  - High addition of SO2, seal tank to change redox state
  - Gum Arabic/mannoprotein and/or casein

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Brettanomyces

- 4EP/4EG
  - Ultrafiltration aka R.O.
  - Tannins such as Royal
  - Blending
  - No Brett Inside or filtration to remove populations
  - SO2 v pH

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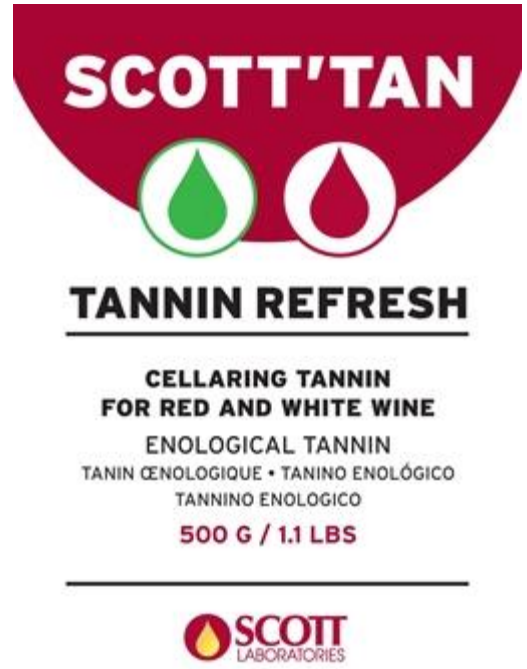
Oxidative Defects

- Browning:
  - PVPP formulations
  - Casein Formulations
- Flavor and aroma defects:
  - Tannins
  - Blending
  - Oak aging



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Filtration/Clarification

- Primarily, to reduce microbial populations and increase clarity
  - Examples:
    - Depth filtration (plate and frame, pressure leaf, lenticular)
    - Surface filtration: PES absolute membrane, Crossflow
    - Centrifuge
    - Cold Settling
    - Micro/ultra filtration
    - Spinning cone
    - Reverse Osmosis (VA removal, alcohol adj, taint removal)
  - These are some of the primary tools we have to control spoilage populations

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Tannins

- Can be used a variety of ways:
  - Change the “perceptibility” of an off flavor
  - Protect against oxidation
  - Manipulate mouthfeel to improve balance
  - Bind with proteins

Blending

- To change again, the “perceptibility’’ of a defect, or to reduce concentration
  - Example:
    - Blend to reduce/raise pH
    - Blend in an aromatic white wine to reduce perception of undesirable
    - Blend to reduce concentration
      - “The solution to pollution is dilution”
    - Blend to modify color

Stability Agents

- SO2: KMBS, effervescent SO2, Campden tablets, liquid SO2
  - Microbial ***INHIBITOR***
    - SO2, depending on pH, intial population, and DO, temperature, ETOH can be effective inhibitors of microbes
    - IT DOES NOT KILL
    - **SO2 DOES NOT KILL YEAST, BACTERIA, ETC**

	0.8ppm molecular SO_2	0.5ppm molecular SO_2
pH	**Free SO_2 (ppm)**	**Free SO_2 (ppm)**
2.9	10	6
3.0	13	7
3.1	16	10
3.2	21	12
3.3	26	14
3.4	32	17
3.5	40	23
3.6	50	30
3.7	60	37
3.8	77	47
3.9	97	62
4.0	>120	83

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Stability Agents

- Chitin-glucan and chitosan products
  - Derived from Aspergillus, non allergenic
  - Chitosan effective against Brett
  - Chitin-glucan effective on gram + and – bacteria to include *acetobacter*
- Sorbate
  - When in combination with SO2, it can be effective at preventing refermentation by Saccharomyces (does not kill). IT IS NOT EFFECTIVE ON BACTERIA
    - If you have high populations of bacteria, they can consume the sorbate and produce geranium taint
  - Eventually breaks down to ethyl sorbate, which can add notes of pineapple or celery
- Velcorin
  - Very effective against yeasts, moderately effective on bacteria
  - Requires special dosing equipment and special handling protocols

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Temperature Control

- Chilling:
  - Can be useful to limit the growth of microbes
  - Encourage the formation of tartrates
  - Slow reaction speeds
  - *** greatly increases gas solubility
- Heating:
  - Pasteurization
  - Thermovinification
  - Flash detante
  - Increase microbial growth and reaction speeds

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Specific Inactivated Yeasts

- Powerful tool with numerous benefits
  - Mouthfeel improvements
  - Reduce perceptibility of undesirables
  - Lower metal content
  - Remove inhibitory toxins
  - etc

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Inert Gases

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Inert Gases (an Overview)

- Generally, solubility increases with lower temps
- Argon: great for inerting headspaces, low solubility, heavier than air (protective layer), Expensive
- Carbon Dioxide: inerting headspaces, high solubility, heavier than air, inexpensive, available as a gas, liquid, and a solid
- Nitrogen: removing other dissolved gases, low solubility, lighter than air, inexpensive, available as gas or liquid

pH Manipulation

- Acidulation:
  - Reducing pH by addition of Tartaric, Malic, and/or Citric Acid
  - Have different “strengths” and sensorial properties
  - Can shock microbial populations
  - Increase effectiveness of SO2 and other stability agents
- De-acidification
  - In cold regions, to raise low pHs
  - Decrease the perceptibility of bitterness/astringency

Ion Exchange

- By passing the wine through both cation (H+ form) and anion (OH- form) exchange resin, one exchanges H+ and OH- ions for potassium and tartrate ions. Thus the net result is the exchange of bitartrate for water.
- expensive

Wine	Stabilizing method	Tartaric Acid g/L	K+ mg/L
A	untreated	2.50	720
	contact	1.95	656
	chilling	2.50	715
	ion exchange	2.40	360
B	untreated	2.35	735
	contact	1.75	575
	chilling	2.00	655
	ion exchange	2.25	340

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Crystal Inhibitors

- CMC
  - Only to be used in white wines
  - Can exacerbate protein instabilities
  - Difficult to add
  - Can negatively affect filterability
  - Cannot be used in wines that have been treated with Lysozyme
- Claristar
  - Used in reds, rose's, whites
  - Reduced protein instability, but still a possibility
  - Must be in final blend state
- Neither are effective against Calcium Bitartrate
- Potassium Polyaspartate (KPA)

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Others?

- H2O2
  - Reduction of SO2
  - Check legality
- Curative fermentation?
- New Products in the Future

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THANK YOU!!!!!

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