WINE STABILIZATION AND FINING

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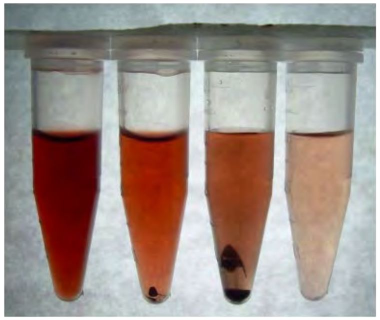
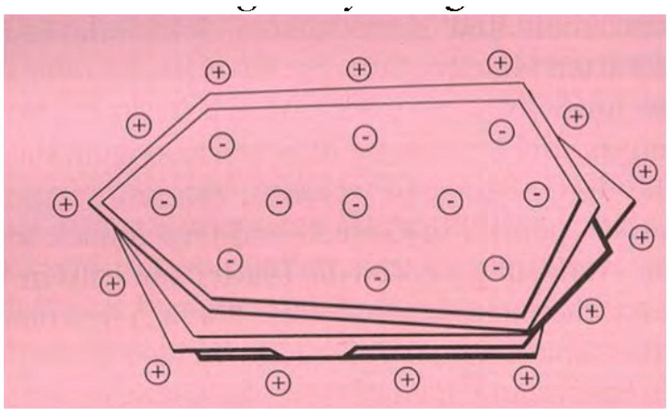
Reasons to Fine





- Adjust Flavor
  - Remove astringency
- Adjust Color
- Remove unwanted aroma
- Enhance wine Stability
  - Remove additive such as an enzyme

Classes of Fining Agents

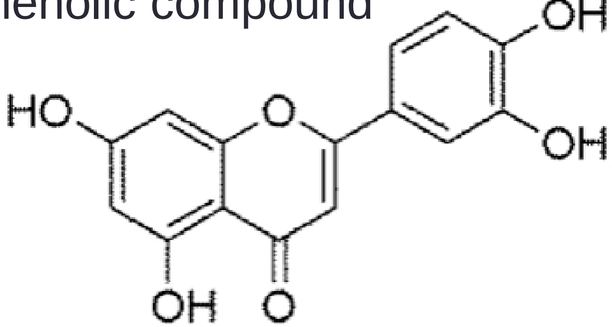
- Proteins
  - Gelatin
  - Casein
  - Egg-whites
  - Others
- Charcoal
- Copper
- Polymers
  - Polyvinyl poly pyrrolidones
- Bentonite
- Polysaccrides
- Silica Gel

How fining agents Work

Positive charge

protein

Phenolic compound



Negative charge

Haze	Property
Protein	"+"
Tartaric Acid	"-"
Copper/Iron	"+"
Phenolics	"-"
Polysaccharides	"-"

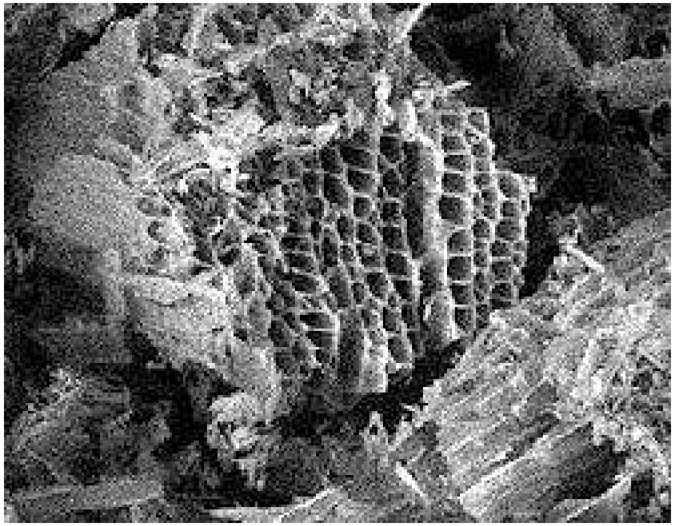
Van der Walls forces

$$\overset{\delta+}{H}—\overset{\delta-}{Cl}\text{- - - - -}\overset{\delta+}{H}—\overset{\delta-}{Cl}$$

- Weak molecular interactions not arising from ionic or covalent bonds
- Mechanism for fining
- Also a reason for instability

Brief over view of options

Activated Charcoal (Carbon)

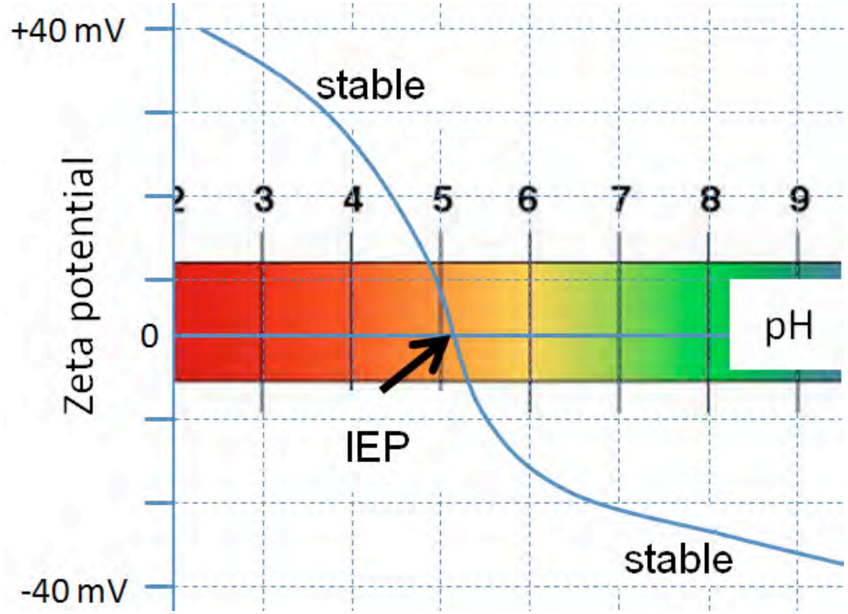


- Non selective
- Adsorption occurs due to van der Waals interactions
- Useful for making a simple “base” wine
- To remove wine faults
- Clean up bad fruit before fermentation
- Different types depending on goal

Protein fining agents

- Rationale: softening red wines
  - Removal of polyphenols and tannins
- Used to remove color compounds that might lead to instabilities (white wines)
- *Positive* charge in wine
  - Protein/tannin interaction = hydrogen bonding
- Residue concerns
  - 20% of casein may remain

Iso-electric Point



- Depending on pH a protein can change charge
- Wine
- Impacts effectiveness and solubility
- At wine pH most proteins are net positive

Protein - Egg albumin (whites)

- Composed mostly of ovalbumin
  - Isoelectric point – 4.6
  - Other proteins in albumin range from 4.1-14.3
- 3.6% proline by mol
- Used to decrease astringency in red wines
  - Less efficacious than gelatin (see %proline)
- Less “fruit” character lost

- Primarily using casein as fining agent
- However special because micelle has been stabilized on introduction
- Fat may also play role (potential off aromas)
- Used To remove phenolic compounds or excessive oak

Casein

- Milk protein (3% as Ca caseinate)
  - Isoelectric point – 4.6
  - 8% proline by mol
- Used in white wines to remove:
  - Color, browning compounds
- Recommended for press wines
- Can reduce Cu and Fe (oxidation implications?)

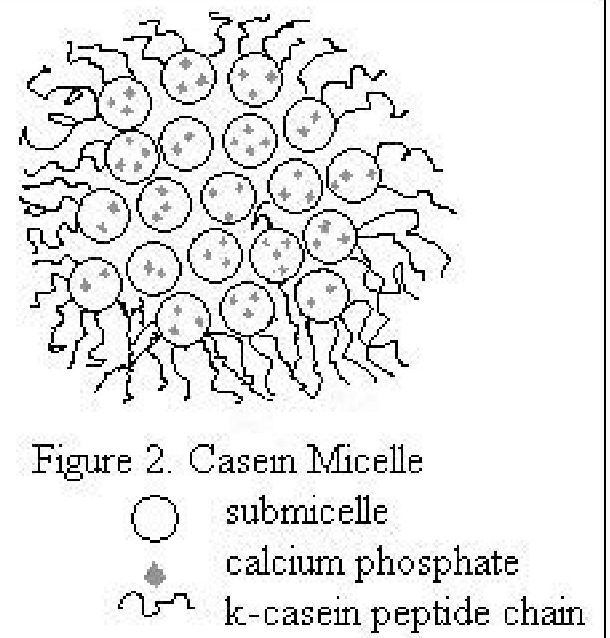
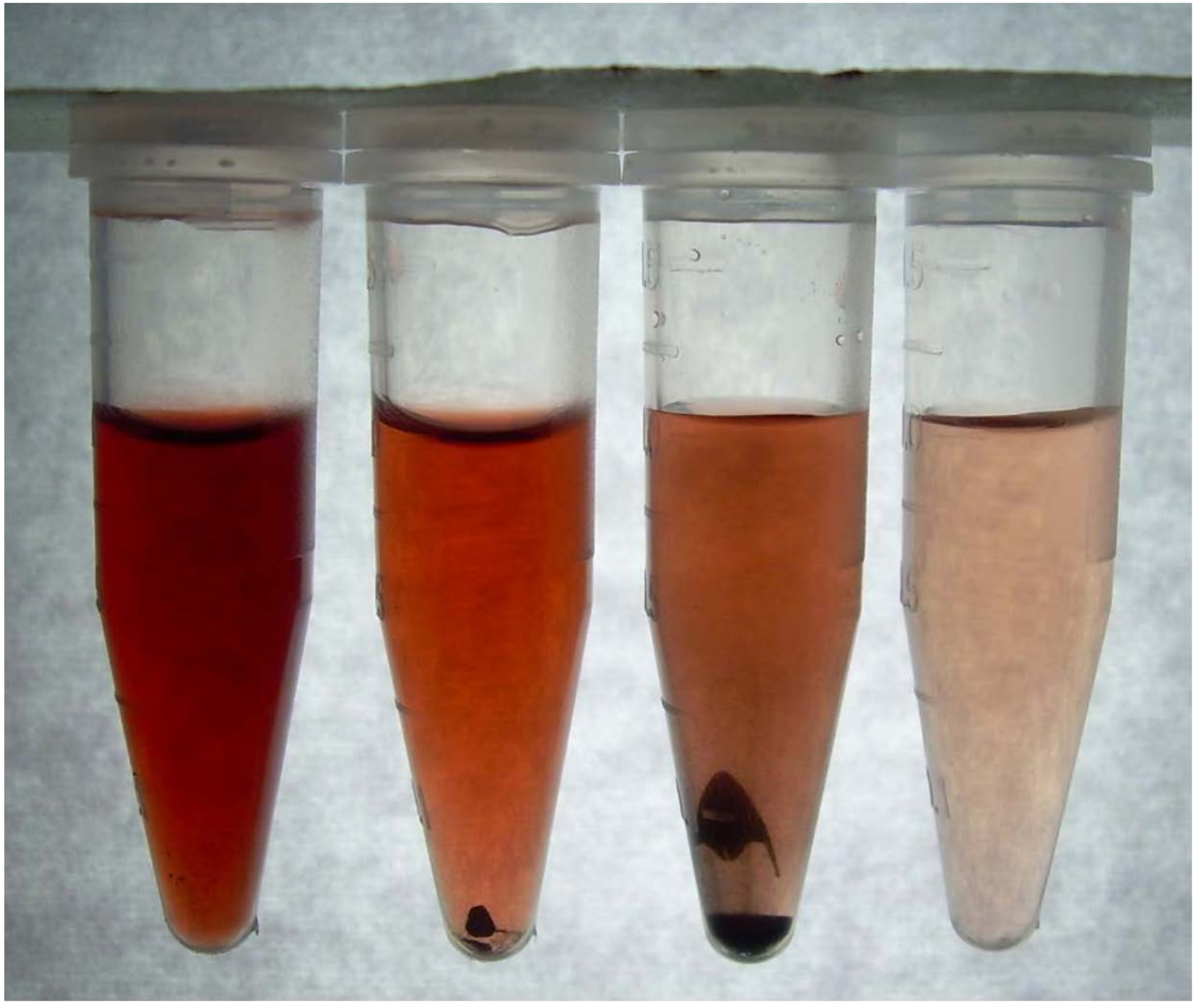


Figure 2. Casein Micelle

PVPP Trial



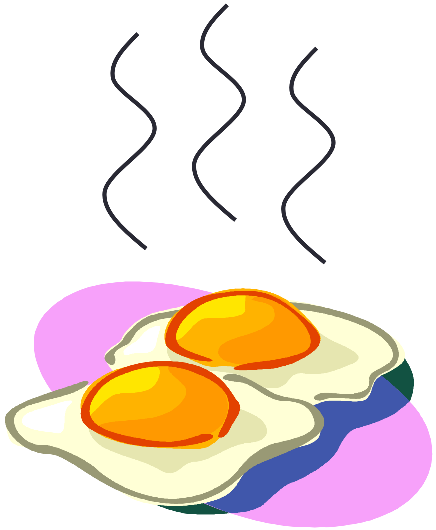
Thiol Removal through copper fining

$Cu^{2+} + H_2S \rightarrow 2H^+$ CuS (insoluble)

$CuSO_4$ About 25% copper by weight

Fate of H_2S in wine

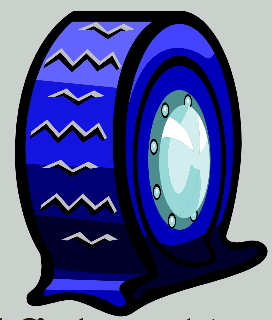
Vinification



Hydrogen Sulfide

(1-10 µg/L)

Mercaptans (0.3- 1 µg/L)



Disulfides (1-5µg/L)

<u> Not removable with copper</u>*

- Early intervention key
- Must know H_2S concentration otherwise may exceed legal limits for copper
- Addition limit 6.0ppm but Residual limit 0.5ppm

So you have made it to the end!

- Fermentation is finished
- ML completed
- Acid Adjustments have been made
- Blending Finished
- Additions
  - Sugar
  - Tannins
  - SO_2
  - Pixie Dust, Love and Snake Oil

- The wine is just how you like it (or close), but what can you do to keep the consumer form ruining it

Removing Proteins

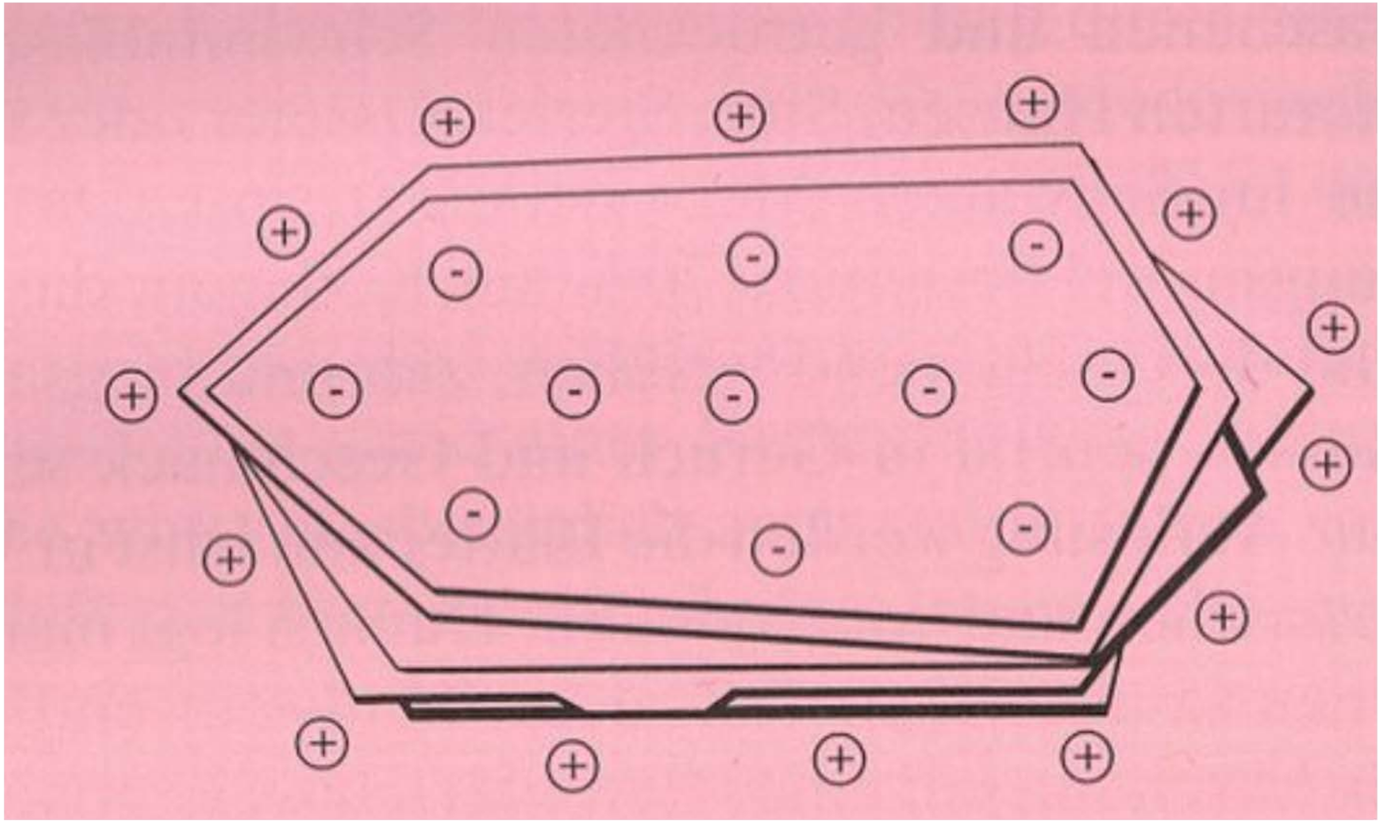
- Over time proteins can denature causing a haze
- More likely when a wine is heated (think of cooking an egg

Bentonite

- Non-pure silicone volcanic clays
  - Montmorillonite
- High swelling & ion exchange capacity
- • Two common forms: Na^+ & Ca^{++}
  - Na^+ - USA (not legal in EU) – too much Na^+ to wine
  - Ca^{++} - EU (less swellable)
- • *Negative* charge (some *positive* too)

Bentonite sub-structure

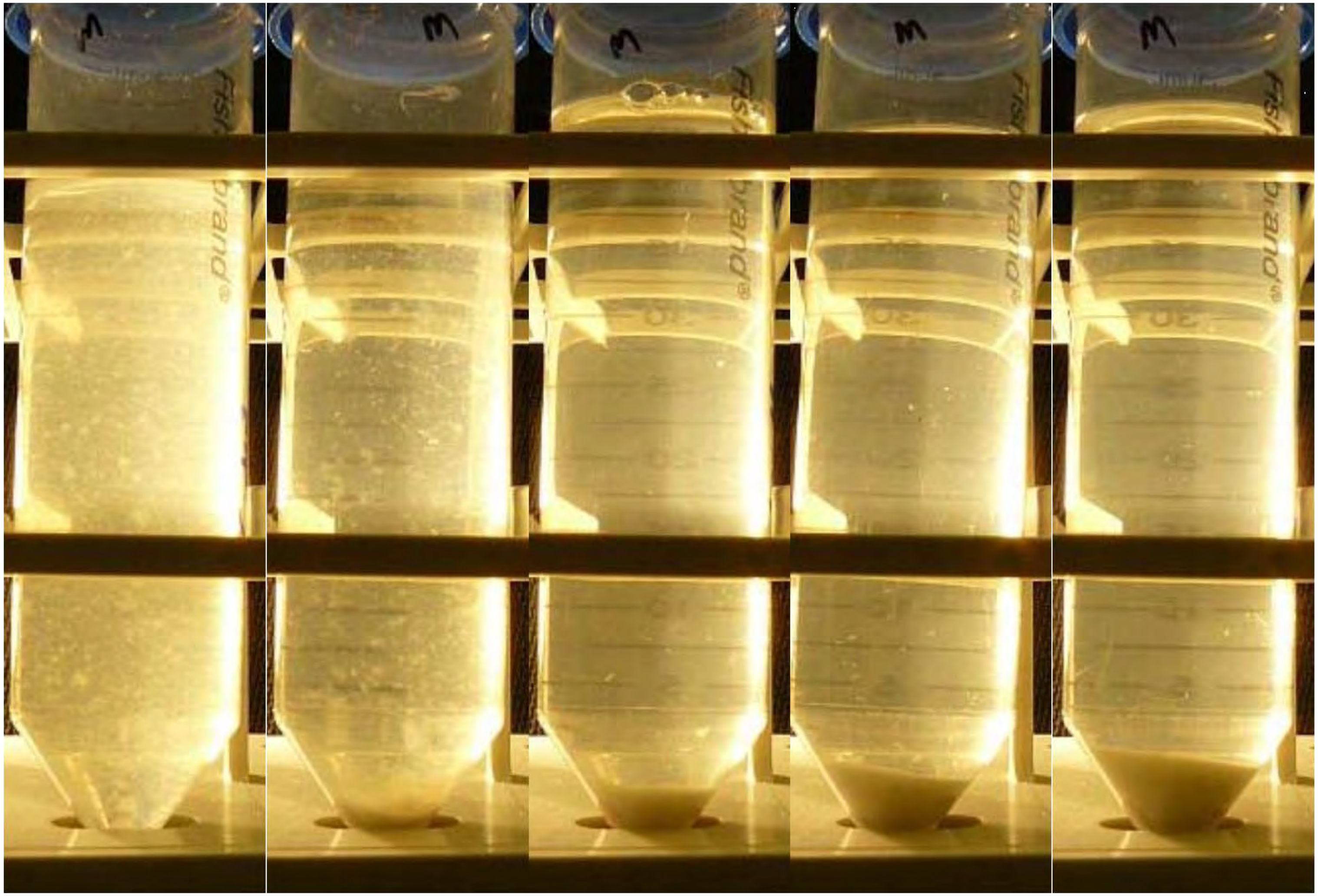
- *Positive* edges, *negative* interior
- Overall more *negatively* charged



Bentonite

- Used for absorptions & adsorptions
- Removes protein non-specifically
  - Haze and foam active proteins
  - Implications for beer and sparkling wine???
- Bench trials conducted for dosing rate – Heating wine after fining
- Potential loss of metals into wine

Bentonite Trials

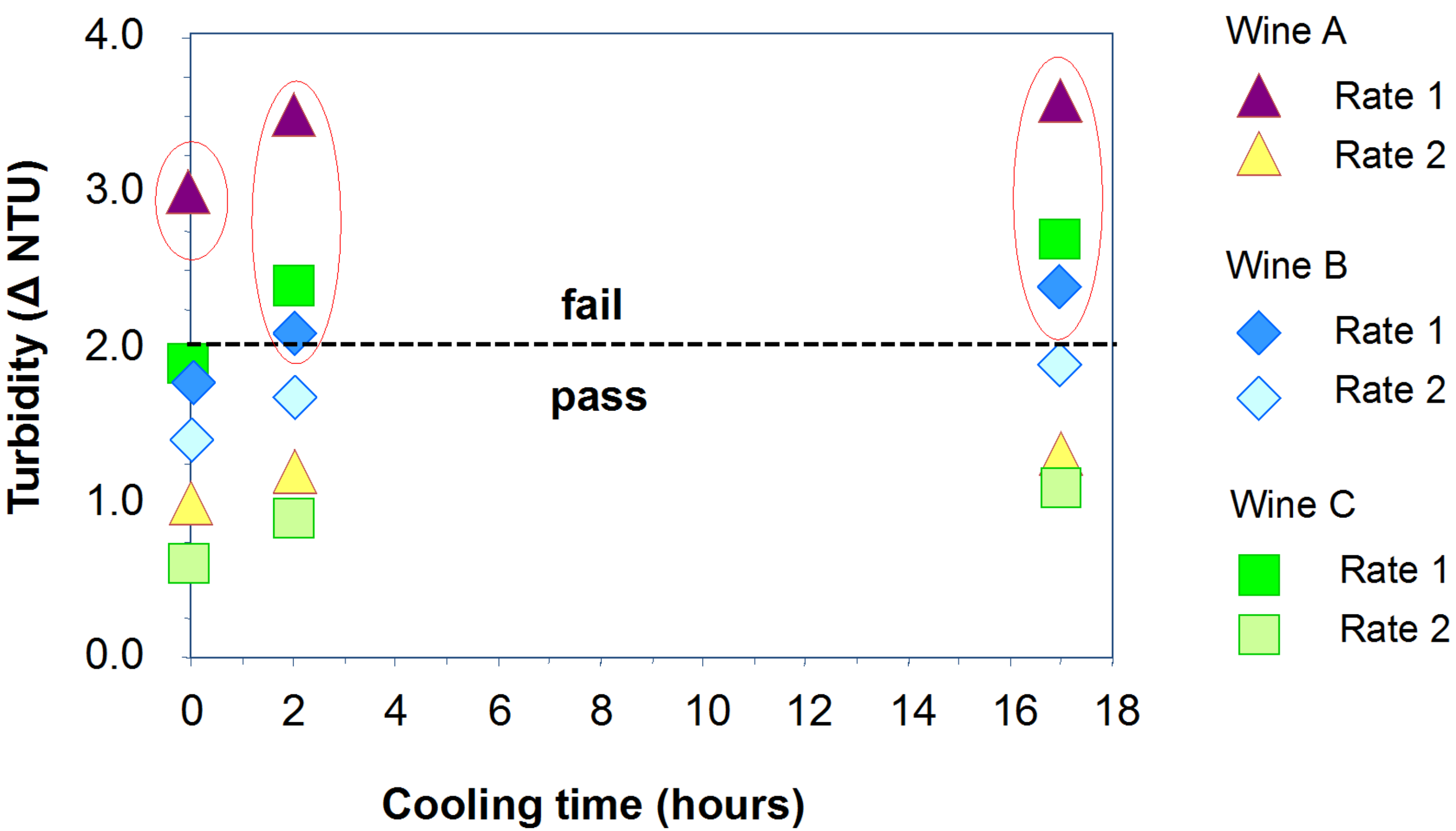


Control 0.5 g/L 1.0 g/L 1.5 g/L 2.0 g/L

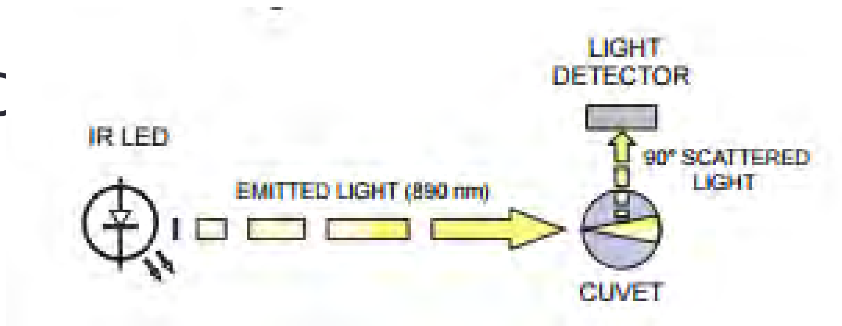
Heat Stability testing

- Primarily testing for protein instability
- Many variants
  - simple method you heat wines at 80 C for 6 hours
- Some methods also use reagents to simulate storage
- Ultimate goal to predict what gets to the consumer

Cooling matters



Heat Stability: Turbidity



- Formazine Turbidity Unit (FTU)
- Light source = High Emission Infrared LED
  - Wavelength peak at 890nm

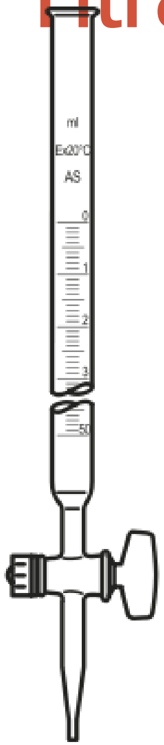
Cold Instability

- Consumers are terrified because of “broken glass” in their wine
- Caused by tartrate instability
  - Usually potassium bitartrate precipitation
  - Rarely calcium tartrate can be and issue as well

What is needed for tartrate crystal formation

- Solution needs to be saturated
  - Lower solubility at low temperatures
  - Lower solubility at high alcohol
- Cations need to be present (pottasium, to a lesser extent calcium
- Initial nucleation needs to happen
  - With out nucleation even a super saturated solution maybe ok

Titratable acidity



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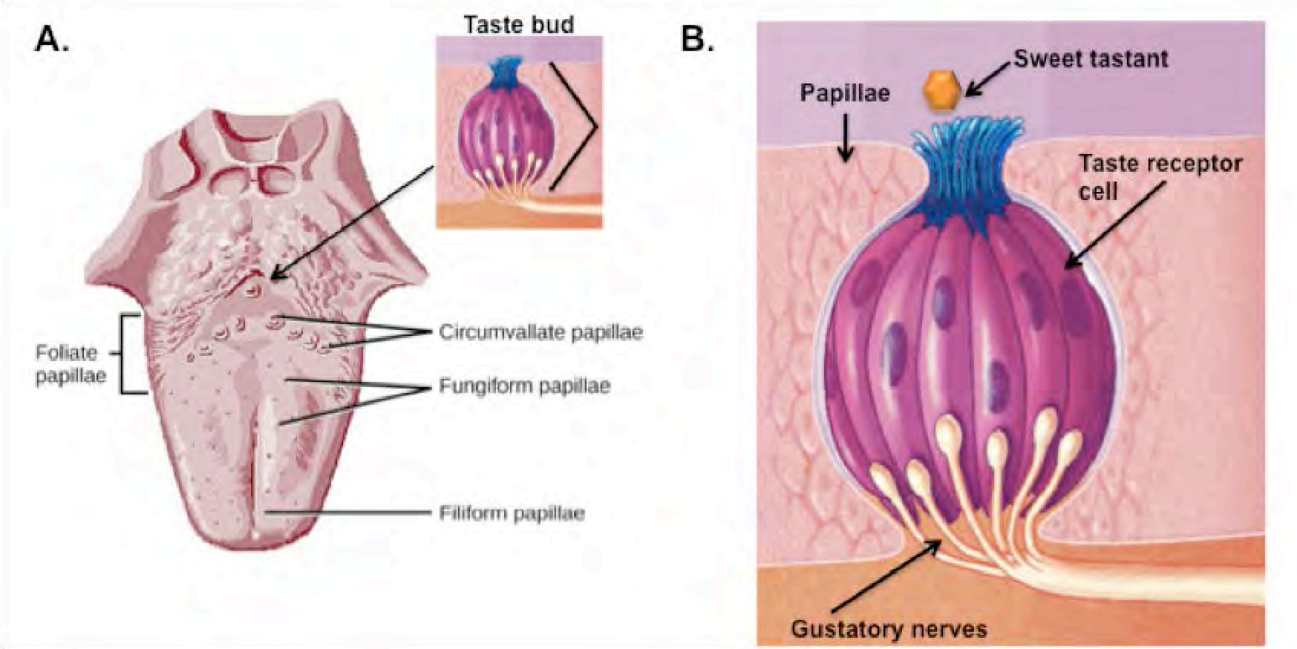
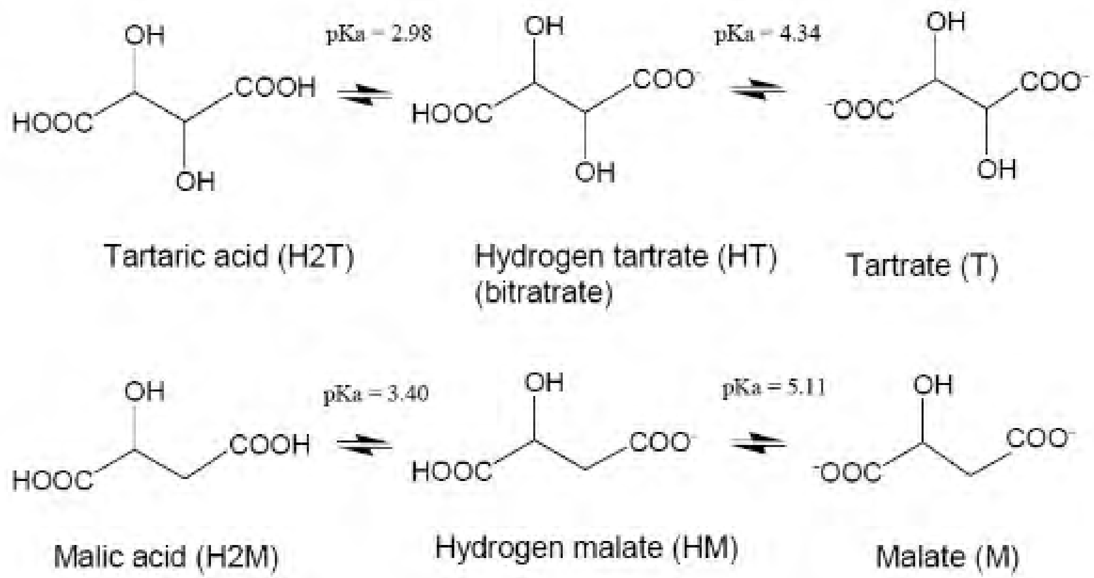


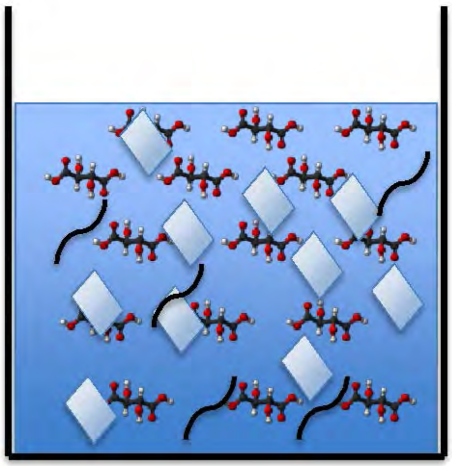
- Great metric for how we perceive wine but not much else
- Diverges greatly from total acidity due to grap cation uptake

Total Acidity



- Useful for understanding the chemistry of a wine, but hard to measure in a winery
- The amount of protons that the organic acids would contain if they where all disassociated
- Total acidity = [H+] titratable + [K+] + [Na+] (Boulton 1980)

Cold stabilization



- Basic idea is to mimic worst case scenario during transport and storage.
- Without nucleation precipitation will not occor
  - Pre-seed with potassium bitartrate

Importance of pH

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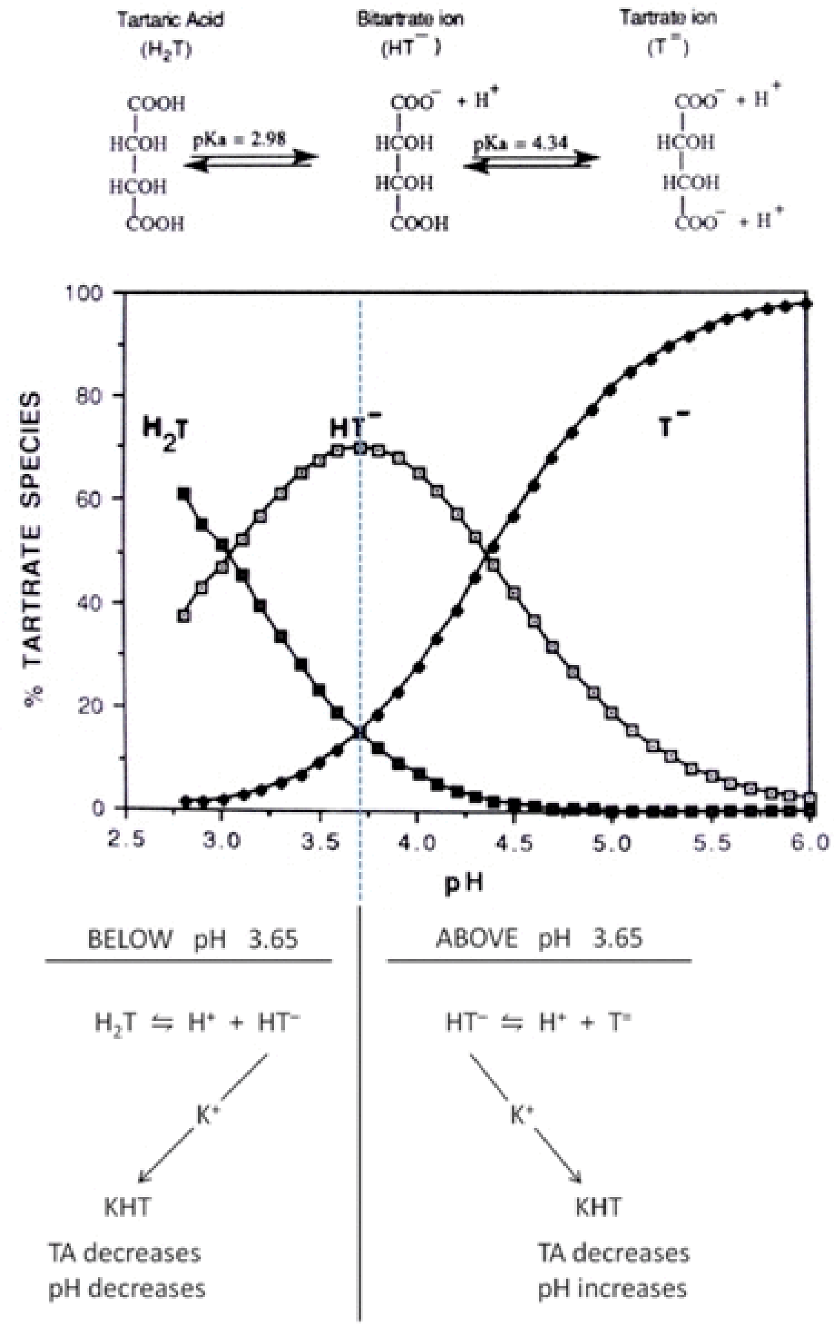
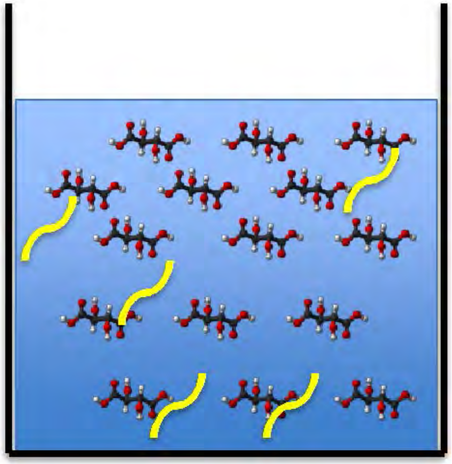


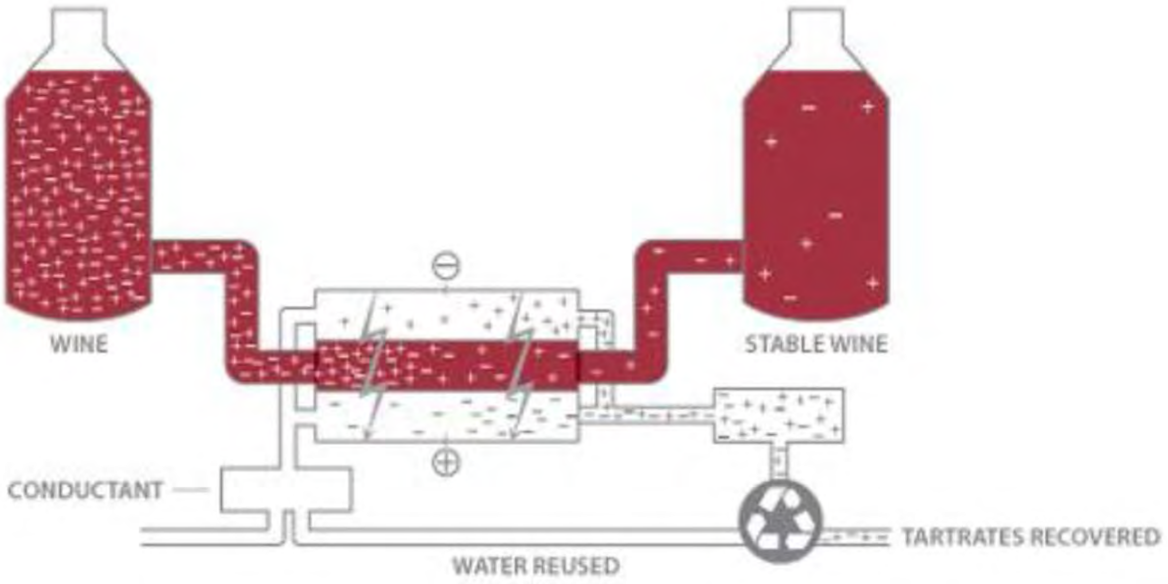
Other remedies



- Stop nucleation
  - Cellulose
  - Mannoproteins

- Potential concerns with heat stability
- Longevity?

Other Methods



- Remove Substrate for crystal formation
  - Electrodialysis
  - Cation Exchange
    - Rather then removing tartrate, removes Cations

Assessing Cold Stability

Cold Stability

Freeze/Thaw test

- Centrifuge – removes pre-existing insoluble materials
- Freeze (-20°C)
- Thaw
- Compare change in pH before and after (tartrate loss)
  - pka

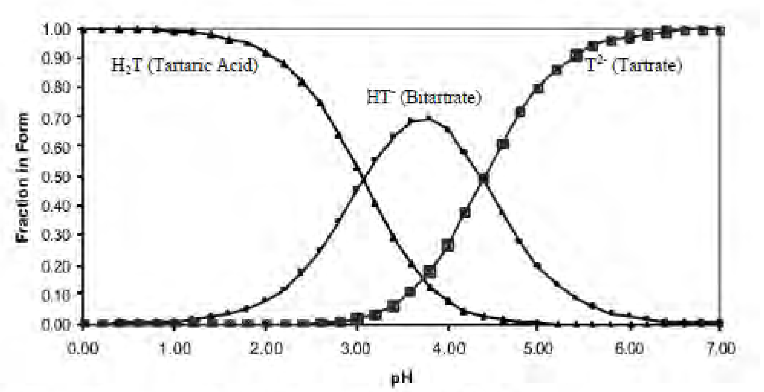


Figure 1. Tartrate Solubility Curve. *Courtesy of Dr. Roger Boulton.*

Other Methods

- Conductivity
  - Measure conductivity saturate at temp, measuure again
- CP Test- Need ethanol, potassium and tartrate calculations

Prevention

- Cation additions add up
  - Calcium carbonate, potassium mettabisulfite

Order of Finishing a wine

1. Complete fermentation
2. Additive additions
3. Heat stabilization
4. Cold Stabilization*
5. Filtration
6. Bottling