



# Wine Flaw

# Sensory Evaluation

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# Wine Flaw Sensory Evaluation

- Chemistry
- Sensory
- Causes
- Prevention-Management-Removal



# Wine Flaw Sensory Evaluation

- Reduction
- Oxidation
- Volatile Acidity
- Nailpolish
- Brettanomyces
- Buttery
- Sorbate
- Geranium
- Lady Bug
- Cork Taint



# Wine Flaw Sensory Evaluation

## CHARACTER

- Reduction
- Oxidation
- Volatile Acidity
- Nailpolish
- Brettanomyces
- Buttery
- Sorbate
- Geranium
- Lady Bug
- Cork Taint

## IMPACT CHEMICAL

- Hydrogen Sulfide et al.*
- Acetaldehyde*
- Acetic Acid*
- Ethyl Acetate*
- 4-Ethyl-Phenol et al.*
- Diacetyl*
- Sorbic acid*
- 2-Ethoxyhexa-3,5-Diene*
- Isopropyl-Methoxypyrazine*
- 2,4,6-Trichloroanisole*



# Sulfur in Wine

*Reduced* ←————→ *Oxidized*  
electron-rich                      neutral                      electron-poor

$H_2S$   
hydrogen sulfide

$S^{2-}$   
sulfides

$S$   
elemental sulfur

$SO_2$   
sulfur dioxide

$SO_4^{2-}$   
sulfate

$HSO_3^-$   
bisulfite



# Reduction

## *3x Sulfides*

- Hydrogen Sulfide  $\text{H}_2\text{S}$
- Mercaptans
- Disulfides



# Reduction

## *Sulfides*

**Sulfide**

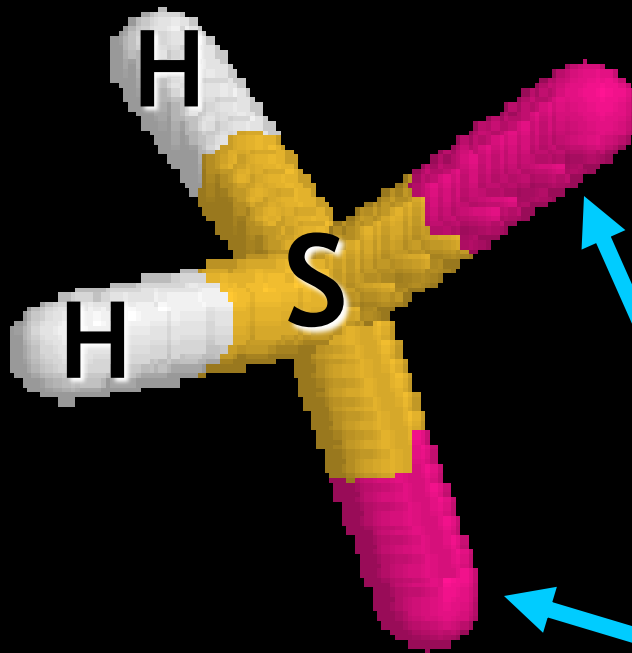
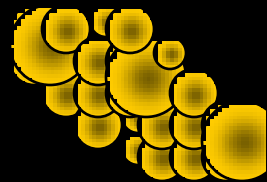
**Odor Descriptors**

**In Wine  
µg/L**

hydrogen sulfide	$\text{H}_2\text{S}$	rotten egg, sewage-like	0.9-1.5
ethyl mercaptan	$\text{CH}_3\text{CH}_2\text{SH}$	burnt match, sulfidy, earthy	1.1-1.8
methyl mercaptan	$\text{CH}_3\text{SH}$	rotten cabbage, burnt rubber	1.5
diethyl sulfide	$\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_3$	rubbery	0.9-1.3
dimethyl sulfide	$\text{CH}_3\text{SCH}_3$	canned corn, cooked cabbage, asparagus	17-25
diethyl disulfide	$\text{CH}_3\text{CH}_2\text{SSCH}_2\text{CH}_3$	garlic, burnt rubber	3.6-4.3
dimethyl disulfide	$\text{CH}_3\text{SSCH}_3$	vegetal, cabbage, onion-like at high levels	9.8-10.2
carbon disulfide	$\text{CS}_2$	sweet, ethereal, slightly green, sulfidy	5

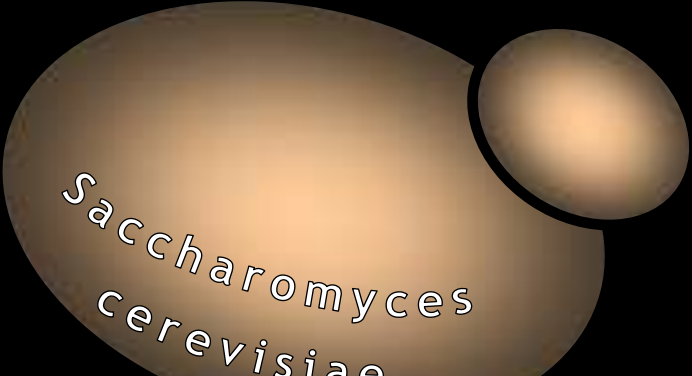
# Reduction

## Hydrogen Sulfide



Copper fining possible!

- Boiling Point:  $-51^{\circ}\text{F}$
- State: it's a gas!



*Saccharomyces  
cerevisiae*



# Reduction *Mercaptans*

$\text{H}_2\text{S} + \text{Alcohol} = \text{Mercaptan}$



Copper fining possible!



# Reduction *Disulfides*

Mercaptan + Mercaptan = Disulfide



Copper fining **NOT** possible!



# Reduction *Sulfides*



## Sensory Threshold

- $H_2S$  1  $\mu g/L$
- Mercaptans 1  $\mu g/L$
- Disulfides 30  $\mu g/L$



# Reduction *Sulfides*

## Causes

- Juice nitrogen imbalances
- Fungicide (sulfur) residues
- Excess sulfate

## Remedies

- Prevention!
- ~~Aeration~~
- Copper Sulfate



# Aeration/Splashing

- $\text{H}_2\text{S}$  + Air 
- Mercaptans + Air = Disulfides = bad idea!

## Why?

### In Barrel:

- Disulfides

Sensory Threshold

30  $\mu\text{g}/\text{L}$

### In Bottle:

- Disulfides => Mercaptans

1  $\mu\text{g}/\text{L}$



# H<sub>2</sub>S Prevention

- Assess juice nitrogen status
- Add juice nutrients selectively
- Lower elemental sulfur residues
- Reduce solids in whites
- Add SO<sub>2</sub> at crush
- Inoculate early/reduce inoculum
- Use low H<sub>2</sub>S-producing yeast strains
- Lower fermentation temperature
- Aerate fermenting must



# H<sub>2</sub>S Prevention

## After fermentation

- Rack off lees *immediately* if smelly
- Don't aerate wine with mercaptans
- Test bulk wine for disulfides

## Removal

- Add copper sulfate solution (Bench test!)



# Oxidation

## Chemistry

- Acetaldehyde

## Sensory

- *Sherry*, nutty, bruised apple
- Sensory threshold: 100 mg/L





# Oxidation Acetaldehyde

## Causes

- Yeast fermentation by-product
- Oxidation of ethanol (alcohol)  
via oxidized phenolics

## Prevention/Removal

- Proper free  $SO_2$
- Air exclusion: aging/bottling/storage

# Volatile Acidity “V.A.”

## Chemistry

- Acetic acid

## Sensory

- Vinegar odor
- Spoilage threshold: 700 mg/L
- Legal limits: **1,400/1,200** mg/L

(27 CFR Part 4 Subpart C §4.21 a iv)



# Volatile Acidity “V.A.”

## Causes

- Yeast fermentation by-product
- Lactic acid bacteria
- Acetic acid bacteria



## Prevention/Removal

- Clean fruit, SO<sub>2</sub> at crush, sanitation
- Avoid yeast stress
- Minimize fruit flies
- Reverse osmosis + ion exchange



# Nailpolish

## Chemistry

- Alcohol + V.A. = Ethyl acetate

## Sensory

- Nailpolish/remover odor
- Spoilage threshold: 150 mg/L



vs. Acetic acid: 700 mg/L

↕



# Nailpolish

## Ethyl acetate

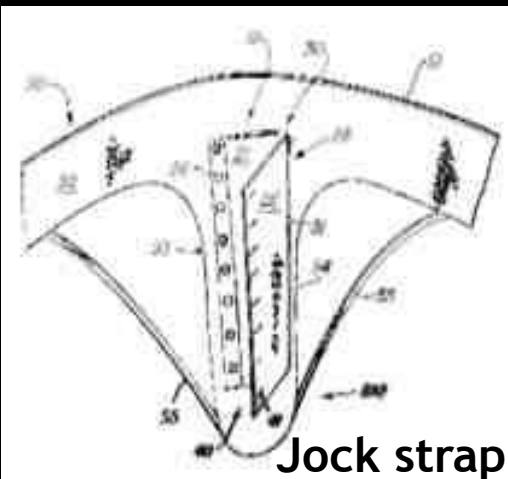
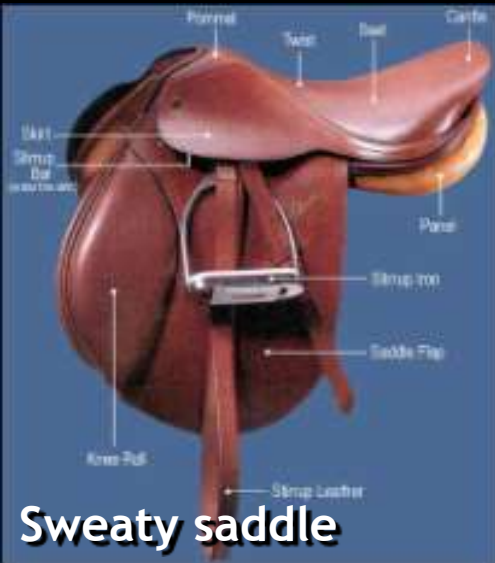
### Causes:

- Yeast fermentation by-product
- Lactic acid bacteria
- Acetic acid bacteria

### Prevention/Removal:

- Clean fruit,  $\text{SO}_2$  at crush, sanitation
- Avoid yeast stress
- **CANNOT** be fully removed

# Brettanomyces





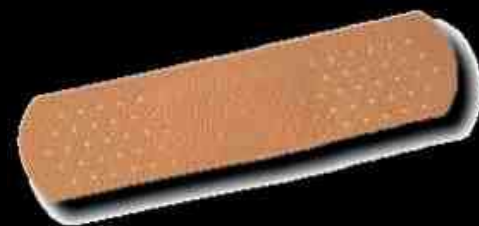
# Brettanomyces

## Chemistry:

- Impact compound: 4-Ethylphenol

## Sensory:

- Medicinal, band aid
- Threshold: 440  $\mu\text{g}/\text{L}$





# Brettanomyces Yeast

## *En-wine-ronment:*

- Residual Sugars (pentoses)
- Alcohol
- Vitamin *Thiamin* => low free  $SO_2$
- Amino acids (including proline)
- Oxygen (air)
  
- Warm temperature (>50F)
- High pH => low molecular  $SO_2$
- Low alcohol

# Brettanomyces

## 4-Ethylphenol

### Causes:

- Brettanomyces yeast
- + Grape/Oak components



### Prevention/Removal:

- Proper free  $\text{SO}_2$  based on wine pH
- Sanitation, monitoring of 4-Ethylphenol
- Barrel maintenance
- Sterile filtration
- Reverse Osmosis?



# Brettanomyces

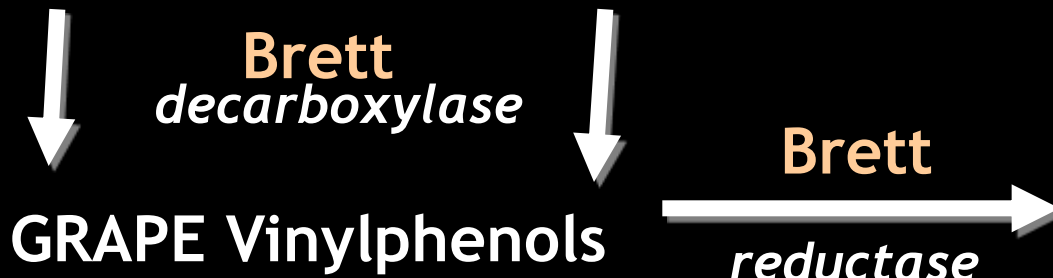
## Wet Dog Odor



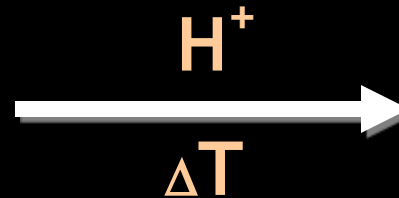
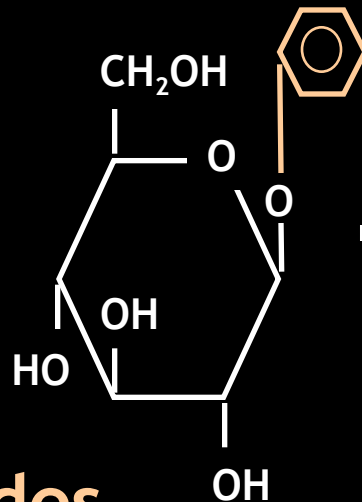
# Brettanomyces

## *Volatile Phenols*

### GRAPE Phenolic Acids



- 4-Ethylphenol
- 4-Ethylguaiacol
- 4-Vinylphenol
- 4-Vinylguaiacol
- 2-Phenylethanol



- Vanillin
- Tyrosol
- Ethylcinnamate
- Benzaldehyde

### GRAPE Glycosides

# Brettanomyces

## Barrel maintenance



# Buttery

## Chemistry

- Diacetyl



## Sensory

- Buttery, nutty, movie popcorn
- Desirable in certain wine styles
- Funk threshold: 5 mg/L



# Buttery *Diacetyl*

## Causes:

- Malolactic bacteria (mainly)



## Prevention/Removal:

- Suppress malolactic fermentation w/ $\text{SO}_2$
- Use different malolactic strain
- Wait after ML has “finished” before  $\text{SO}_2$

# Geranium

## Chemistry:

- 2-Ethoxy-hexa-3,5-diene

## Sensory:

- Geranium leaves
- Threshold: 100 ng/L





# Sorbate/Sorbic Acid

- *Yeast* growth inhibitor: **200** mg/L
- Legal limit: **300** mg/L
- Sensory threshold: **135** mg/L
- Some yeasts are resistant
- **NO** effect against *bacteria*
- Added as *potassium* salt (sorbate)  
(=> watch cold stability)



# Geranium

## Cause

- Sorbic acid + Malolactic bacteria

## Prevention

- Avoid sorbate as preservative
- Use sorbate only with proper  $SO_2$
- Add no earlier than day before bottling
- Always bubble test/sterile filter
- **NO** removal option from wine

# Lady Bug



# Multicolored Asian Lady Beetle



## 'Ladybug taint' a new wine off-flavour

G. J. Pickering <sup>1,2,\*</sup>, J.Y. Lin <sup>2</sup>, G. Soleas <sup>5</sup>, A.  
Reynolds <sup>1,2,3</sup>, R. Riesen <sup>4</sup>, I. Brindle <sup>3</sup>

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Biological Sciences, <sup>3</sup> Department of Chemistry, Brock University,  
<sup>4</sup> Lake Erie Ecology Research Center, Youngstown State  
University, Ohio, USA; <sup>5</sup> Quality Control Division, Liquor Control  
Board of Ontario, Ontario.



How to distinguish MALB (*Harmonia axyridis*)  
(Photos courtesy of Ker and Brewster, 2003)

# Lady Bug

## Chemistry:

- (Isopropyl)-Methoxypyrazine

## Sensory:

- Asparagus, bell pepper, earthy, herbaceous, peanut
- Threshold: 10-15 ng/L



# Lady Bug *Methoxyprazine*

## Cause:

- MALB haemolymph

## Prevention/Removal:

- Remove beetles before crushing, pressing, fermenting
- **NO** removal option from wine



# Cork Taint

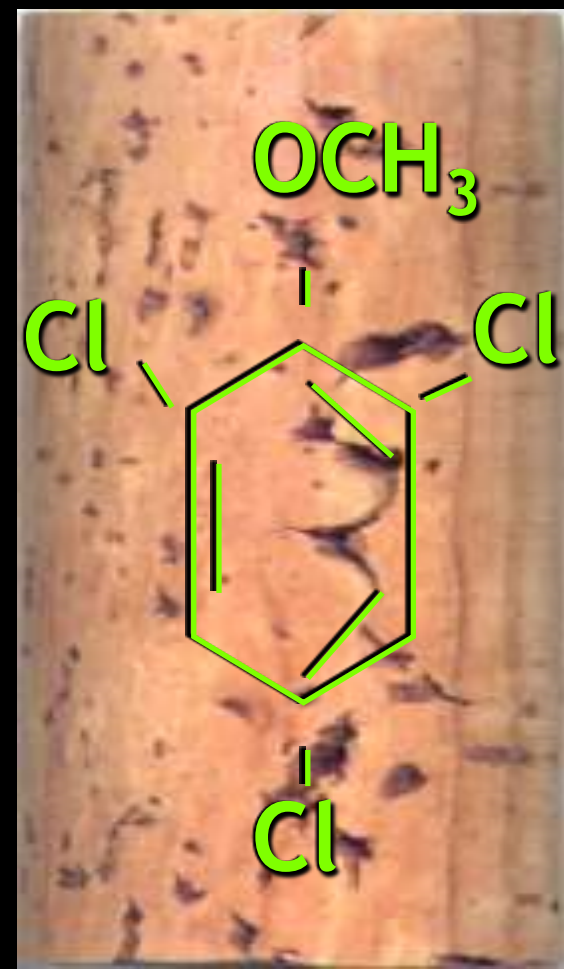
## Chemistry:

 2,4,6-TriChloroAnisole

## Sensory:

 Musty, moldy, earthy

 Threshold: < 5 ng/L



# Cork Taint

## TCA



# Cork Taint

## TCA



Chlorination

Methylation



Methylation

Chlorination



Methylation



TCA

**KEEP OUT!**

-  Winery
-  Barrel room
-  Warehouse
-  Tasting room
-  Restrooms
-  Everywhere else



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Samples in the Back!

