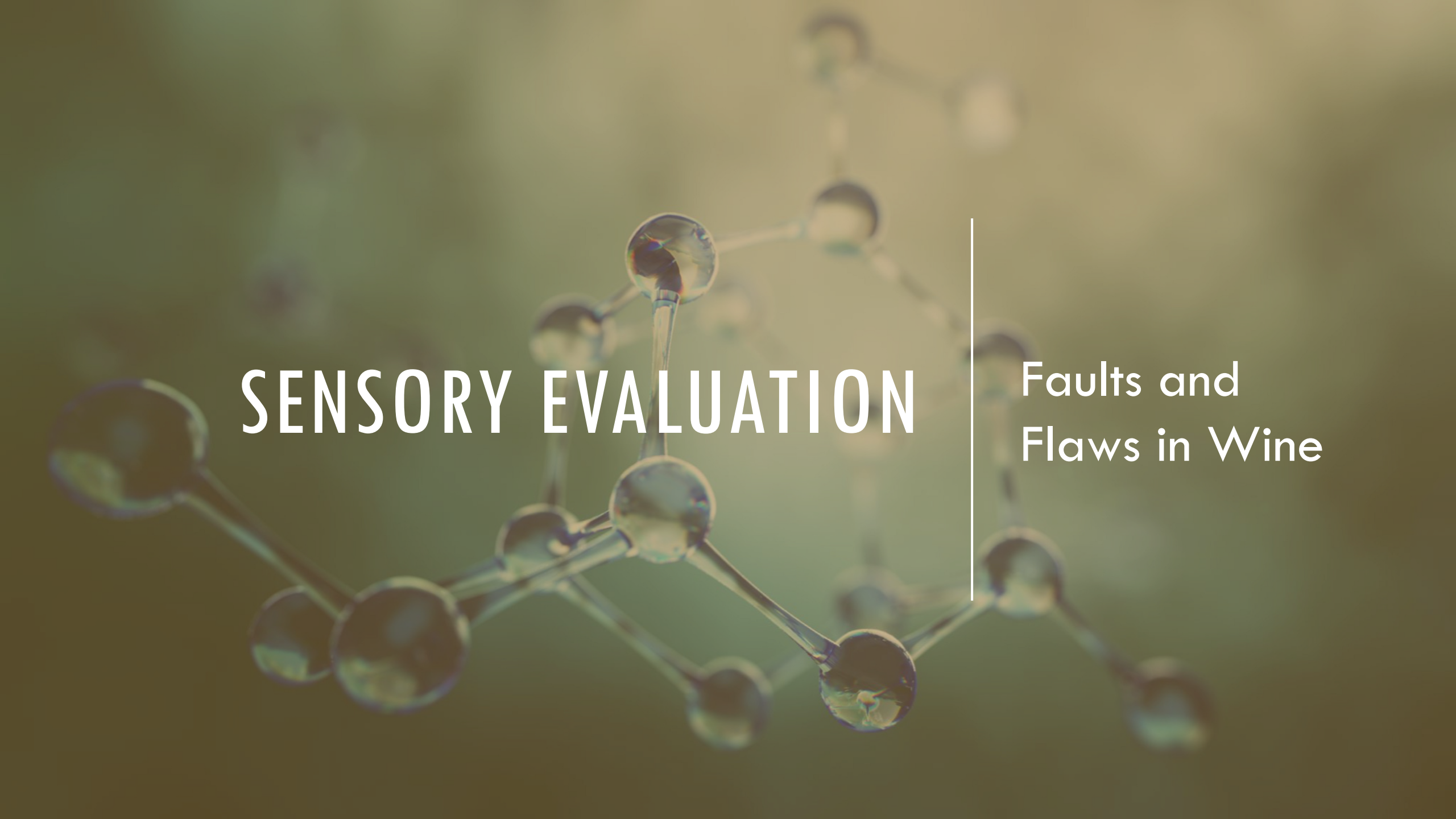


SENSORY EVALUATION

Faults and Flaws in Wine

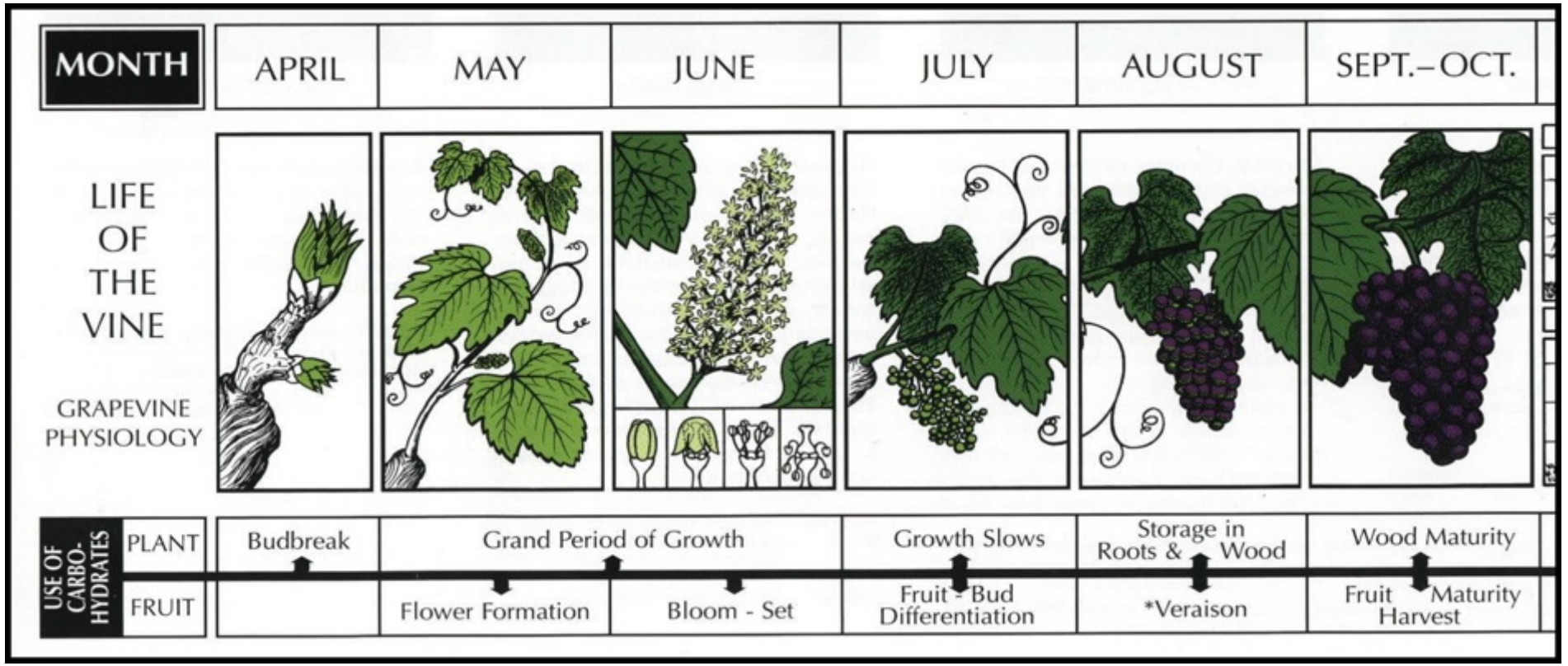
What is the vine doing now?

Flowers appear in June approximately 100-120 days later the fruit is ripe (vintages vary due to weather)

Fruit set follows in July as heat increases so do sugars in the fruit as berries swell.

Acidity starts a steep decline as sugars start a sharp increase in August (during verasion)

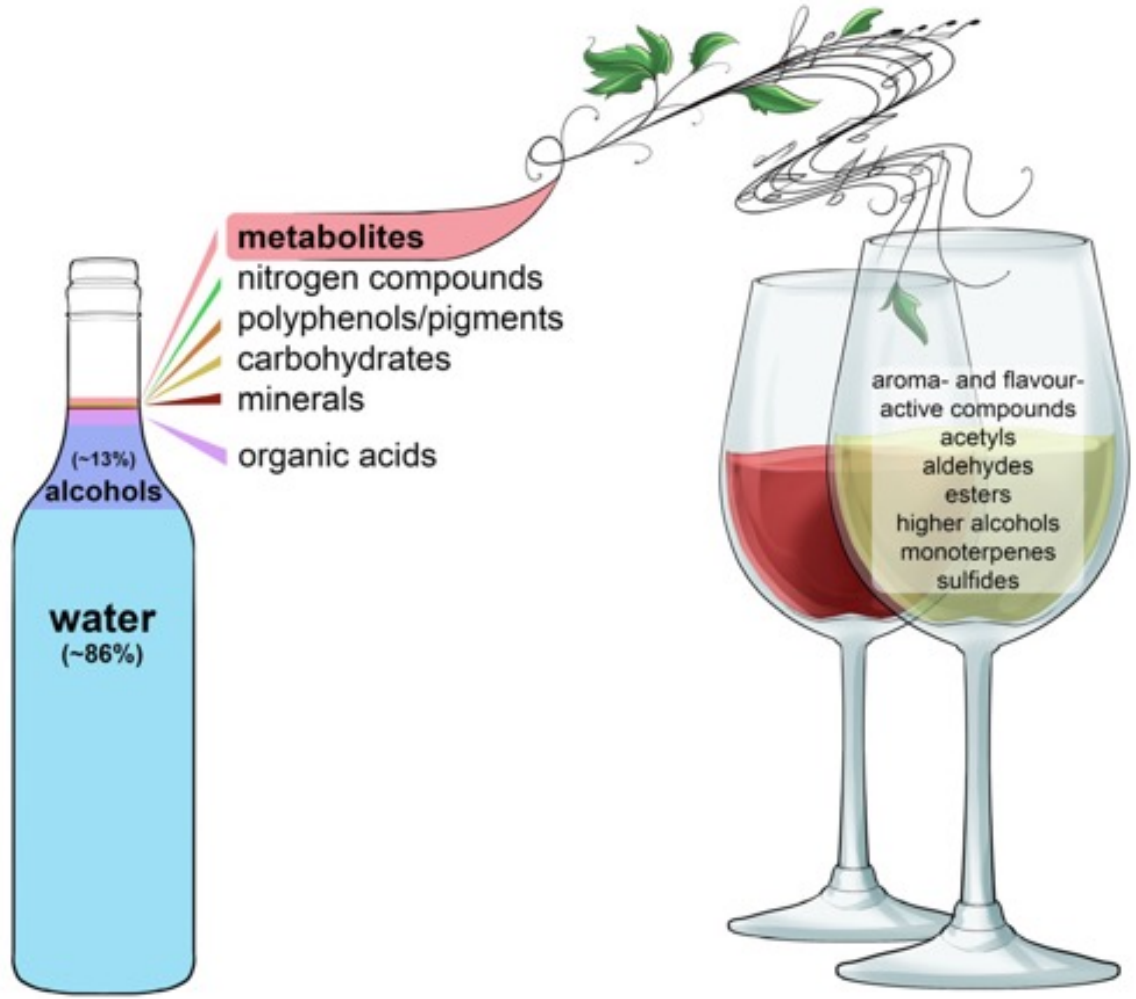
Weather is extremely impactful to balance, flavors and good conditions for ripe and healthy fruit.



AROMA COMPOUNDS

Volatile odorous compounds are produced in wine and derived from these sources:

1. **Grapes** (flavors)
    1. compounds are found just under the skin
2. **Fermentation**
    1. **Temperature is crucial**
    2. **Controlled oxidation/air**
3. **Aging/Maturation**
    1. **Continued care during barrel aging**
4. **Cellar conditions**
    1. How and where you store and cellar



Odorous compounds in the grape are mostly present in the skin and the layers of cells immediately beneath it.

Flavor concentration (flavor compounds) generally increases during ripening.

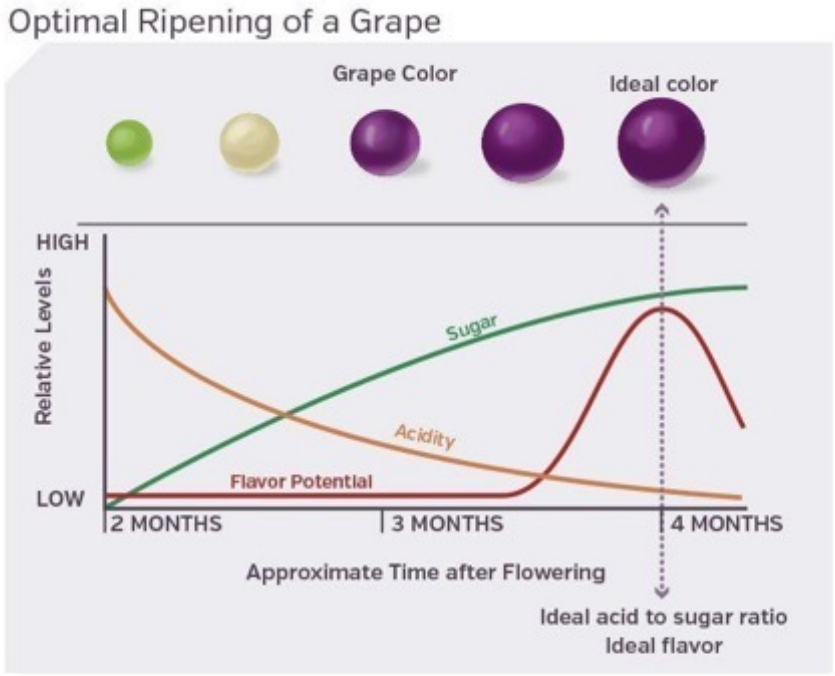
Most grapes are harvested when the flavor is at its peak allowing pronounced aromas.

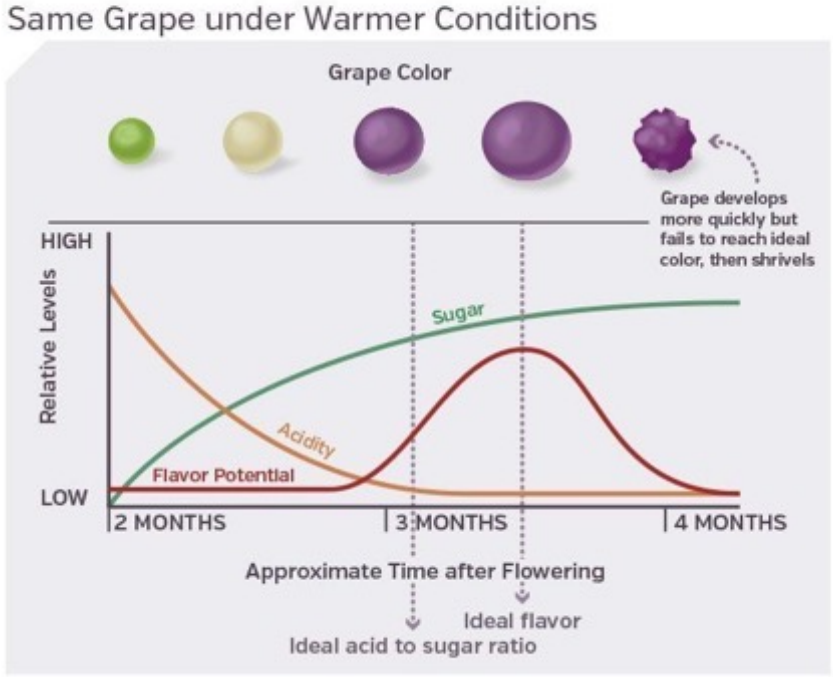
- Aromas mature and develop after sugar accumulation starts to plateau.

Balanced acid/tannin/sugar ratios are impactful in establishing *natural* anti-microbial stability.

Organic acids in grapes and wine include tartaric, malic, acetic, succinic and lactic acids.

- Maintaining balanced acid in grapes and wine will aid in anti-microbial stability





Rots, mildews, molds, bacteria, and immature grapes will all contribute to off-flavors in the wine.

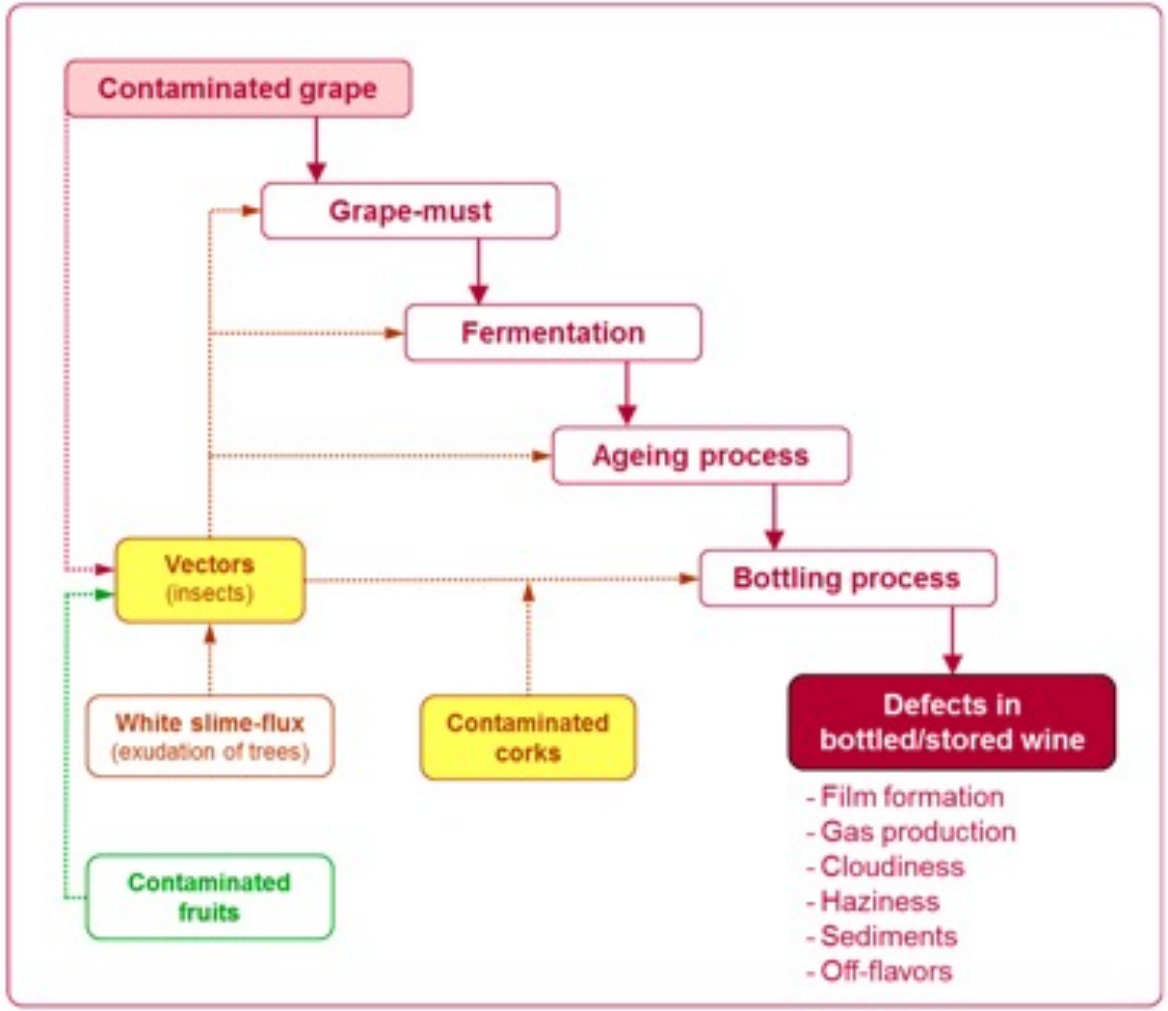
Lack of crop maintenance can produce or retain off-flavors that could potentially mask any varietal characteristics.

A lot of aroma and flavor development is determined by yeast and bacteria selection for both the primary and secondary fermentations.

Yeast and bacteria (ML) utilize some aroma-precursors during fermentation, these will contribute to the final aromas and flavors

And other secondary metabolic pathways in yeast and bacteria will produce aromas and flavors indirectly

~ Swiegers et al. 2005



WHEN IS BAD… BAD?

Many compounds that cause faults in wine are naturally present in wine but are expressed at low concentrations and don't necessarily adversely affect the wine.

Depending on perception, some concentrations may impart positive characters to the wine.

When the concentration of these compounds exceeds the sensory threshold and:

- Can completely replace pleasant aromas in the wine
- Can overwhelm the flavors and aromas in the wine
- The subjective quality of the wine is compromised
- Generally, it appears less appealing or unappealing and undrinkable. *

*NOTE : this is a very subjective assessment, as individuals vary greatly in how and what they "enjoy" and many of us will interpret and assess flavors in wine and food

THE ART OF ÉLÉVAGE

Élévage, the art of maturing wine, can be translated as educating or nursing the wine.

The French term defines that wine needs care and work to bring out its qualities before it is drinkable

Storage during aging is impactful to aromas and characteristics

- The storage vessel can affect the taste and character of the wine

Consider this with an unfamiliar wine

- The way it is aged
- The conditions of maturation
- The length of time under those conditions
- The length of time it remained in maturation

WINE FLAWS VS. FAULTS

FLAWS: minor issues that can be corrected but were not

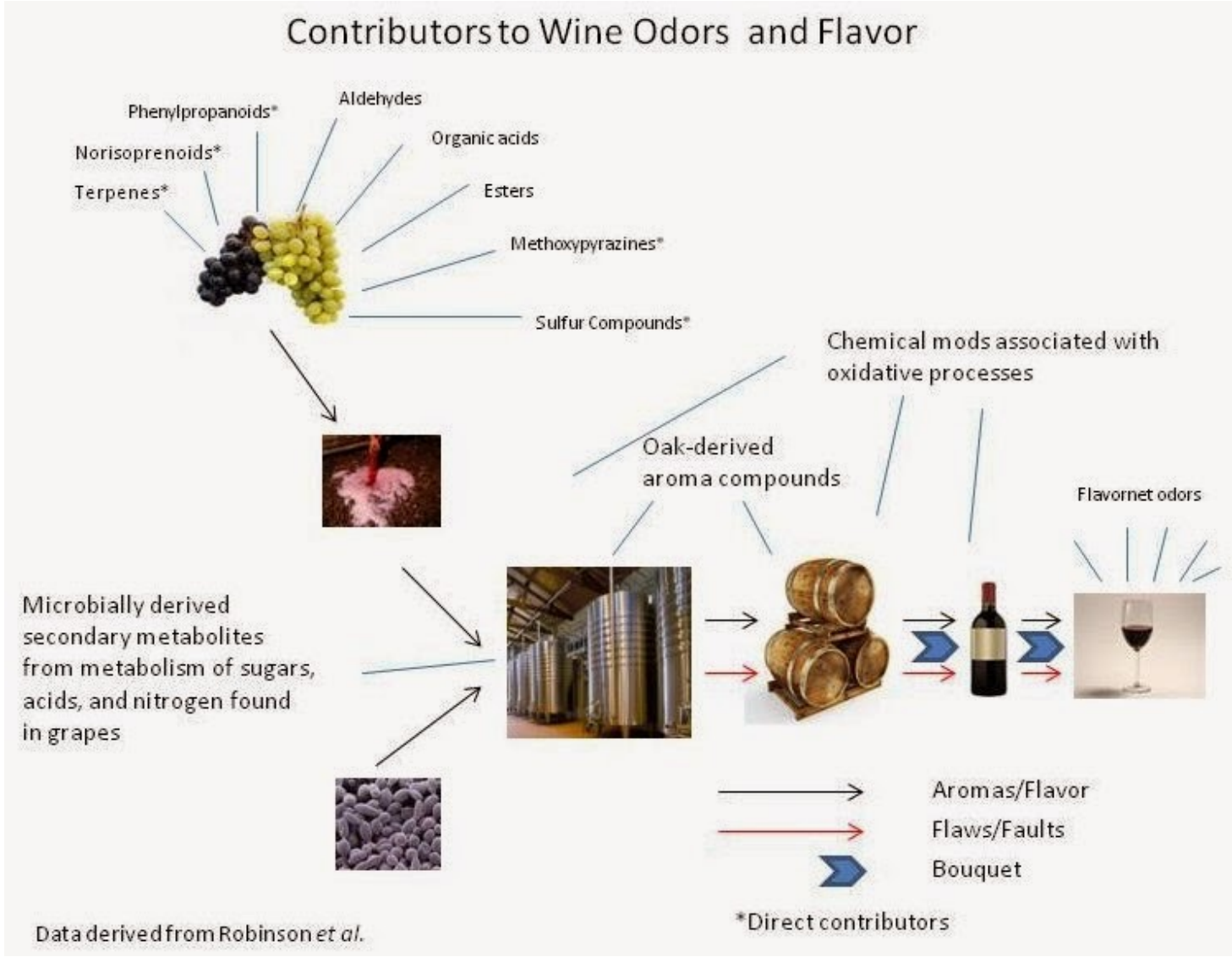
FAULTS: generally due to winemaking errors

Flaws and faults may be present at different levels

Visually

On the Nose

On the Palate



REASONS FOR FLAWS & FAULTS

Dirty glassware

Excessive or lack of oxygen in winemaking

- Over racking
- Ullage in barrels/tanks
- Not enough oxygen during production

Excessive/insufficient use of sulphur

Overextended pre/post maceration, over-extraction with excessive heat

Poor stabilization, fining, filtration

Dirty wood barrels or poor sanitation in general

Poor quality closure

Poor storage and aging

MOST COMMON FAULTS

Most Faults Occur due to:

Sulfurous Compounds

Sanitation

Spoilage Organisms – LAB, Acetic Acid Bacteria, etc.

Yeast Autolysis & Wild Yeasts

Oxidation

Re-fermentation

Environmental

FAULTED (OR NOT?)

Most wine faults can be detected by the nose

- Although with oxidation most can be detected visually
- Most oxidation can be detected by yellowing and browning in color.
- Discoloration of the wine and particles can be a sign of excessive copper, iron or proteins that were not removed during fining or filtering or became sediment during aging

Faults are usually confirmed on the palate

Wines with unusual colors that are not indicative of the variety or wine region can indicate:

- Excessive or insufficient maceration
- Poor temperature control during fermentation
- Purposeful oxidation or maturation

10% of visual issues is due to haze from protein/copper-protein related

SANITATION IN THE WINERY

Good cleaning and sanitation will prevent issues from occurring

Basic Sanitation will ensure that surfaces are free from microbial growth, eliminates potential spoilage organisms.

- Proper cleaning chemicals: Oxy or Proxy clean, no Chlorinated products uses.
- Wood Pallets – wet, damaged – used can carry TCA

Fermenters

Hoses

Bottle fillers

Filter plates

Bottle filler nozzle

Gaskets

Overflow tub

Bottles

Used equipment

- Considerations taken for all contact points as well.

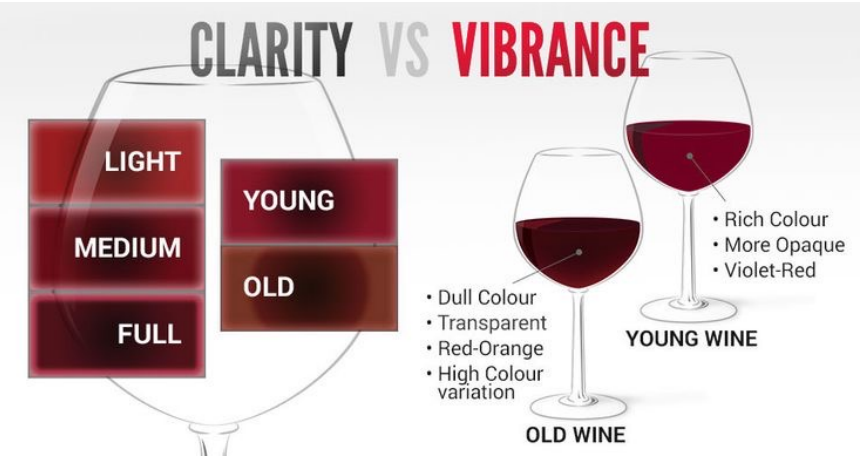
VISUAL FAULTS

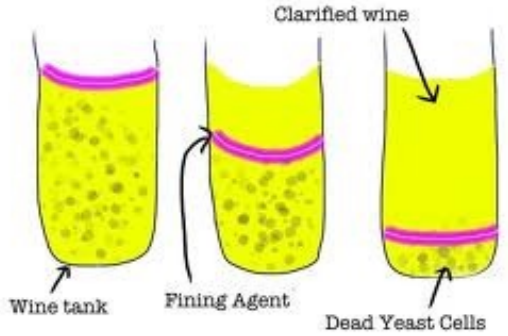
Casses: breakdown of coloring matter – caused by excess of copper, iron or protein – unstable cloudiness due to heat

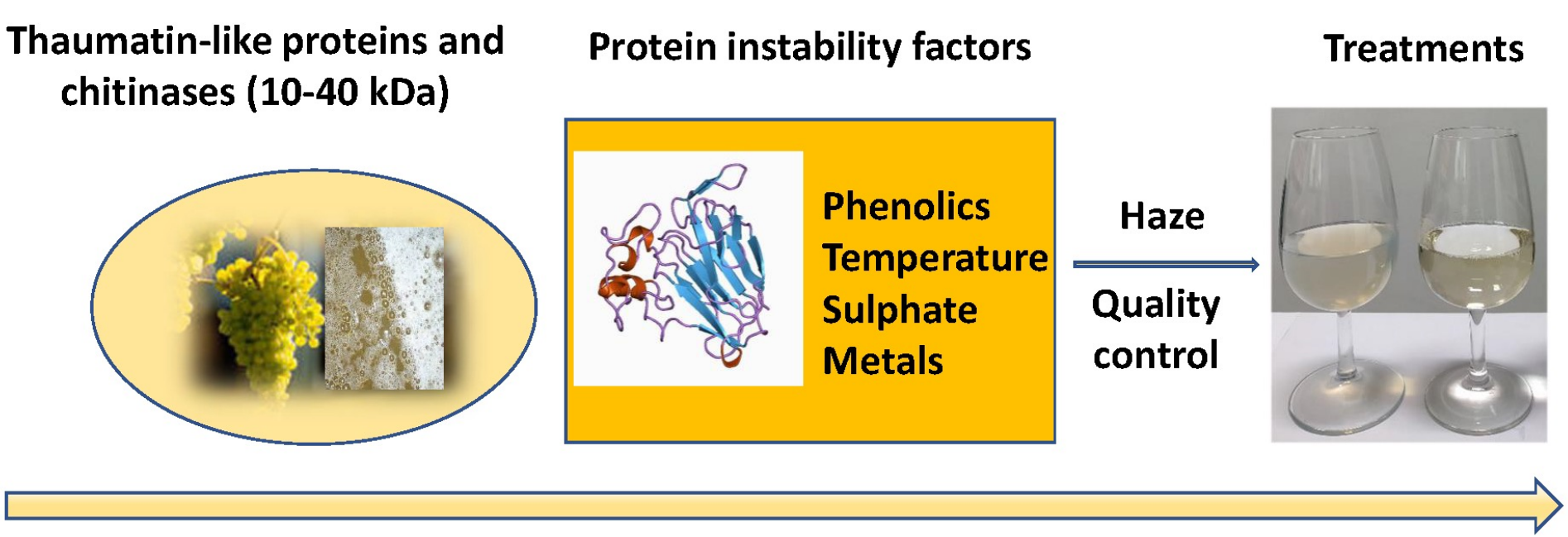
Lack of color/Wrong color: high yields, poor vintage, poor extraction or vinification methods, over extraction, temperature during fermentation was too high

Premature yellowing/browning: oxidation due to lack of SO2, poor storage conditions, defective closure, or heat

Sign of gas: poor racking, re-fermentation from (primary and or malo-lactic) yeast and sugar remaining or unfinished ML conversion







Protein instability is usually prevented by the elimination of unstable proteins from wine using specific **fining** agents.
Fining agents are substances that have an electric charge (negative or positive) and come in contact with the wine

This flocculates and precipitates the particles/compounds with an opposite electrical charge allowing particles to drop out.

Bentonite fining is the most-used process to avoid protein instability in white wine,

However, bentonite fining can affect wine aromas by removal of color and aroma compounds affecting wine sensory characteristics

OXIDATIVE FAULTS

Oxidation

- Poor storage conditions
- Poor closure – insufficient seal
- Un-topped barrels (ullage)
- Premature ageing due to a lack of protection from oxygen

AROMAS: Smells of cooked apples, walnuts, dirty dish water

- **Properly protect wine during production**
- **Check SO2 levels**
- **Maintain oxygen control**
- **Storage and aging monitored**

Maderization - oxidation caused by heat damage

- Wine can become oxidized due to sunlight, heat and exposure to high temperatures during storage
- Named after **Madeira** – the fortified wine that is purposefully oxidized through fermentation at high temperatures

AROMAS: Cooked fruit, walnuts/almonds dried fruit, dirty sour wine aromas

- **Maintain proper temperatures during all stages of production and storage of wine.**

FAULTS - RELATED TO OXIDATION

Acetic acid (Volatile Acidity or VA) - usually via acetic acid bacteria (*acetobacter*) or lactic acid bacteria-ethanol converts to acetic acid

- Natural by-product of winemaking
- Sometimes due to excess of oxygen - generally from headspace in tanks or barrels.

AROMA: (volatile); pungent, sweaty to sharp vinegar and nose-burn.

- **Thin/sharp mouthfeel; often perceived on finish of wine.**

Acetaldehyde – related to wine oxidation, formed by yeast and acetic acid bacteria

- Oxidation of ethanol – usually via *acetobacter* or film yeast
- Oxidation of phenolic compounds
- Threshold in wine ranges between 100-125 mg/L.

AROMA: sherry, rotten apple, rotten vegetal, grassy, nutty – almond, pungent.

- Binds readily to SO2

Ethyl acetate (Also considered in VA)

- Microbial spoilage (*acetobacter*) and an indication of oxidation.
- Esterification of ethanol (acetaldehyde) + acetic acid.

AROMA: Sweet smell at low concentrations, fruity, grape/cherry with nail polish remover, solvent and sharp at high concentrations.

- Maintenance of SO2 levels
- Ullage in vessels – fill or blanket with inert gas.

ACETIC ACID BACTERIA

VOLATILE ACIDITY (VA)

The average level of acetic acid in a new dry table wine is less than .4 g/L

But levels may vary and be undetectable up to 3g/L.

U.S. legal limits of Volatile Acidity:

Red Table Wine 1.2 g/L

White Table Wine 1.1 g/L

The aroma threshold for acetic acid in red wine varies from .6 g/L and .9 g/L, depending on the variety and style.

Acetic acid bacteria (e.g. Acetobacter aceti - used to make vinegar) **can convert both glucose and ethanol to acetic acid.**

Yeasts in the vineyard + damaged grapes form acetic acid and ethyl acetate during fermentation

Dessert wines from botrytized (noble rot) grapes often have higher levels of acetic acid.

THRESHOLDS FOR ACETALDEHYDE

Acetaldehyde levels	
Type	**Acetaldehyde (mg/L)**
Red Wine	4 – 212
White Wine	11 – 493
Sweet wine	188 – 248
Sherry	90 – 500
Brandy	63 – 308
Cognac	105
aData summarized from Liu *et. al.* (2000).	

On average, red wines contain 30 mg/L, white 80 mg/L, Sherries 300 mg/L.

SULFUROUS COMPOUNDS

Sulphur Dioxide SO2

Cause: Overuse of SO2 to grapes, must or finished wine, over sulfiting wine can cause these smells

Hydrogen Sulfide H2S

Cause: Stressed yeast/sluggish fermentation

Low nitrogen during fermentation

Mercaptans

Cause: Hydrogen Sulfide left untreated

Sulfur Dioxide (SO2) – used in wine production

Acts as an antioxidant and for anti-microbial spoilage, pH dependent, does not react directly

AROMA: Sharp, pungent, burnt match, felt as a nose burn

Due to free molecular sulfur

FLAW not a fault

FAULTS - SULFUROUS RELATED

Hydrogen Sulfide (H2S) - reduction (by yeast) of elemental sulfur, amino acids and other particles into hydrogen sulfide (H2S)

- Elemental sulfur can be found in grapes and soil
- Yeast stress due to lack of nutrients: nitrogen, temperature stress, lack of oxygen during fermentation

  AROMA: Rotten egg, pungent, offensive cabbage smell
- **Easily detected on the nose and can dissipate with aeration**

Ethyl Mercaptan (Ethane Thiol)- reaction of H_2S with ethane into mercaptans

- Can involve yeast metabolism
- Surfaces during fermentation or aging if H2S is not dealt with

  AROMA: Rotten cabbage, vegetal, garlic/onion, burnt rubber, sweaty, fecal, putrid aromas
- **Can be treated with copper fining**

Dimethyl Sulfide & Dimethyl Disulfide - Oxidation and stabilization of thiols (ethane thiol and methane thiol).

AROMAS: Canned corn, cooked cabbage, onion, garlic, burnt rubber; less pungent than thiols, harder to treat.

- **Requires ascorbic acid pretreatment with copper fining, not always effective**

REASONS FOR SULFUROUS COMPOUNDS FORMING

Possible Causes of Sulfide Problems in Wine

- Residues from vineyard spray programs
- High turbidity in water
- Rogue yeast strains in the vineyard or winery
- Nitrogen deficiencies in fermenting wine
- Other nutritional deficiencies in fermenting wine
- High fermentation temperatures
- Inadequate aeration during fermentation
- Gross lees contact and extended lees contact

Reductive

Wine reduced of varietal aromas and smelling of H_2S

COMPOUND	SENSORY AROMA	REASONS
Hydrogen Sulfide	**Rotten Egg, Sewage**	**Produced naturally**
Ethyl Mercaptan	Burnt rubber, earthy-vegetal	Mercaptans may be oxidized
Methyl Mercaptan	Rotten cabbage	Reactions involving H2S
Diethyl Sulfide	Rubbery	Breakdown of amino acids
Dimethyl Sulfide	Canned corn, cabbage	Related to amino acids
Diethyl Disulfide	Garlic, burnt rubber	Oxidation of sulfides
Dimethyl Disulfide	Vegetal, onion-like	Oxidation of sulfides

BRETTANOMYCES

4-Ethyl phenol (4-EP) & 4-Ethyl guaiacol (4-EG)- Characteristic aroma from ***Brettanomyces*** (spoilage yeast).

AROMA:

- Woody, smoky, clove, sweet, spicy, pungent, sweaty horse saddle (4EG)
- Medicine cabinet, Band-Aid, iodine(4EP)

CORRECTIONS:

- Proper sanitation, maintaining SO2 levels
- Sterile bottling methods and cross flow filtration.

~ **NOTE:** Brettanomyces is a strong producer of acetic acid.

2,4,6 TRICHLOROANISOLE

Trichloroanisole (TCA or cork taint)

Airborn Fungi (molds) reaction with chlorine or trichlorophenols

- Fungus found in cork can reside in the bark of the tree or in paper products and wood.
- Reactions occur with microbiome from the cork trees (*Quercus Suber*)
  AROMA: Musty, moldy, damp cellar, wet cardboard, wet dog
- Avoid chlorinated solvents, bleach, and high levels of Chlorine in production water

TCA Can be caused by:

- Six chemical compounds are found to contribute: but most significant is 2,4,6 trichloroanisole (chlorine and mold react in cork)
- The conversion of chlorophenols to chloroanisole by fungi in the presence of moisture. Chlorophenols have been used as pesticides and as wood preservatives and are common environmental pollutants
- The smallest amounts of chlorophenol by cork tree bark during any stage during growth or manufactured into cork will create the potential for cork taint production.

OTHER ISSUES

Geraniol – Generally produced by lactic acid bacteria combined with sorbic acid (potassium sorbate)

- Distinctive geranium odor, floral/herbal, sweet green
- Maintain proper levels of SO2 to inhibit LAB when using sorbate

Diacetyl – From secondary fermentation by lactic acid bacteria (Oenococcus but usually from *Lactobacillus* and *Pediococcus*) often produced from citric acid.

- Buttery or earthy smell, sweet, musty, pungent
- Eliminate use of citric acid during wine production and aging, use proper MLB inoculation rates, maintain SO2 levels in finished wines.

OAK BARRELS

Compounds imparted during maturation in Oak Barrels:

Ellagitanins (Antioxidants, bitterness, astringency)

Phenolic aldehydes (vanillin)

Volatile phenols

- Eugenol – clove aroma)
- Guaiacol (smoky charred wood)
- 4-methylguaiacol (spicy and charred wood)

Lactones (freshly cut wood aromas)

Furfural (sweet butterscotch)

5-Methylfurfural (caramel, almond-nutty)

Ethyl- and vinylphenols

American Oak is characterized by coconut aroma (lactone)

Described as vanilla, caramel, nutty, woody, spicy, and sweet

“DIFFERENT” WINES

Some styles of wine are difficult to understand

- Local tradition
- Cultural styles
- Family techniques
- Regional necessities
- Historical reasoning

A MATTER OF PERCEPTION

Most of these "unusual" odors are not defined in our brain

- We associate bad aromas in wine with vinegary, volatile aromas
- Blending of aromas will also confuse the smells
- Noticing the nuances of OTHER flavors that come from the wine – flavors that are pleasant and characteristic of tertiary aromas
- TERTIARY is the key!

THANK YOU!

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Hope to see you again sometime!

REGGIE WINE