

# What Bugs Grow in Wine?

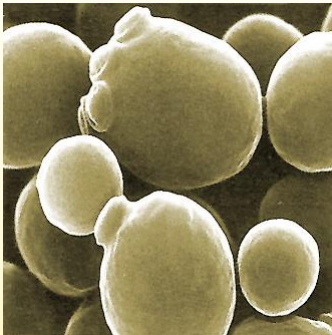
## -The Good, the Bad, and the Ugly!



Presentation by Mark Rashap, CWE



## Bug Number 1: Yeast, *Saccharomyces* \_\_\_\_\_



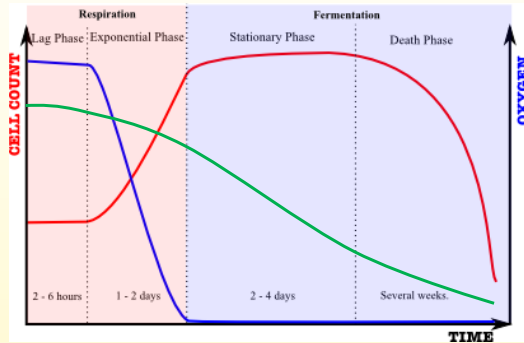
- *Saccharomyces Cerevisiae* most common, but also includes *Bayanus* and other genera
- From Greek, meaning “Sugar fungus”
- These are single-cell organisms from the Fungi Kingdom, bacteria are completely different
- 5-10  $\mu\text{m}$  (micrometers), 1 mL of fermenting must can contain 2-100 million cells
- Reproduces by a splitting process: budding
- Very dependent on Nitrogen and Oxygen for cell multiplication
- *Cerevisiae* of the more tolerant to Alc and  $\text{SO}_2$



# The 4 phases of Yeast Fermentation

Lag phase: yeast acclimate to conditions: high sugar, low pH, must temp, and SO<sub>2</sub>

Exponential Phase: yeast multiple exponentially to reach 100 million/ ml. O<sub>2</sub> and Nitrogen are essential in forming a health cell wall. Sugar is consumed during this phase as well.



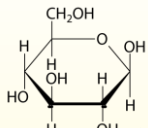
Decline phase: nutrients are scarce, viable yeast cells are exponentially decreasing, toxic byproducts (ethanol) are high

Brix

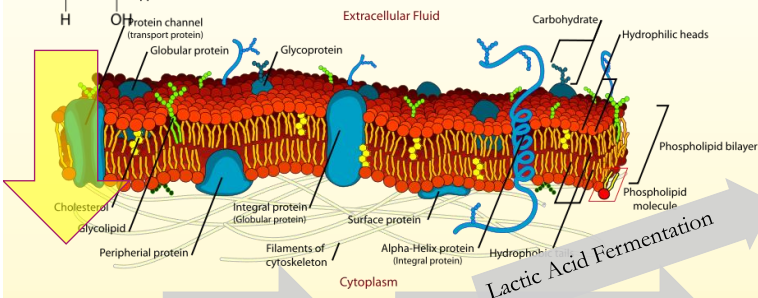
Stationary phase: yeast density at it's maximum and yeast growth equals death. O<sub>2</sub> is not necessary and yeast functions shift to anaerobic fermentation.



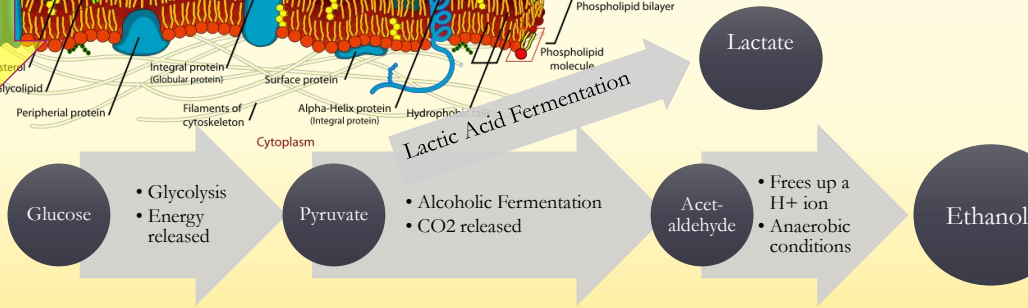
## Healthy Cell Wall/ Membrane



O<sub>2</sub> aids the formation of lipids (principally oleanoic acid) and sterols (ergosterol, and zymosterol) in the membrane wall



Alcohol inhibits N<sub>2</sub> uptake and sugar transport



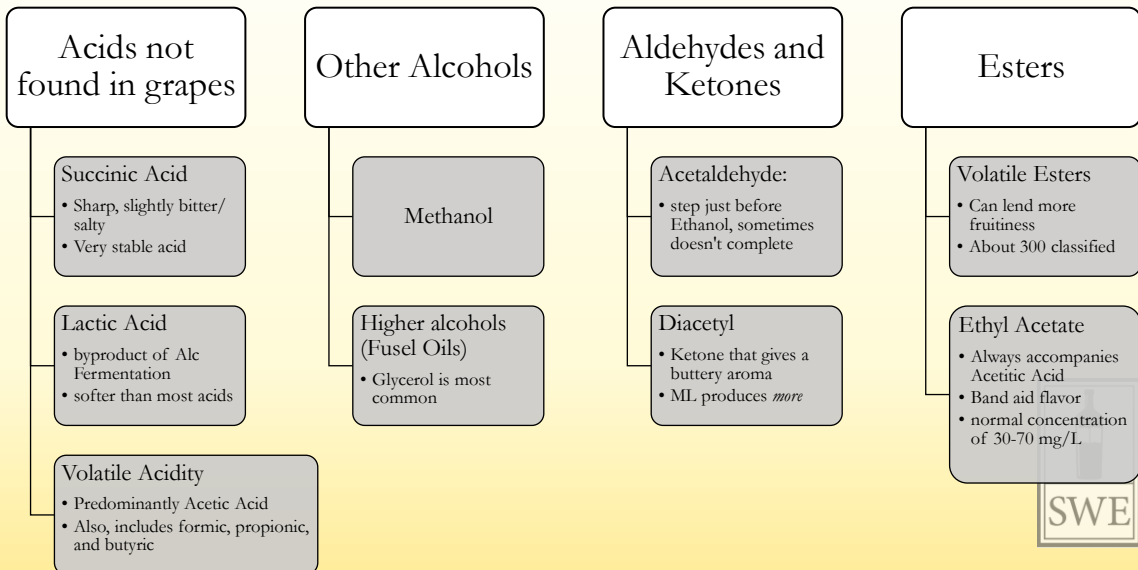
# Getting the YAN (Yeast Assimilable Nitrogen) just right



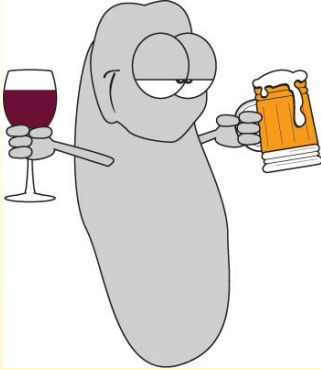
- Amount of YAN that is transferred from soil to must depends on grape variety, rootstock, vineyard soils and viticultural practices (such as the use of fertilizers and canopy management) as well as the climate conditions of particular vintages
- YAN is composed of Free Amino Nitrogen (FAN), ammonia (NH<sub>3</sub>) and ammonium (NH<sub>4</sub><sup>+</sup>)
- DAP, Diammonium Phosphate, is like junk food in providing N but not the other amino acid nutrients, yeast hulls can provide amino acids.
- In absence of N, some yeast will graze the S containing amino acids release the S to become H<sub>2</sub>S (hydrogen Sulfide)
  - 21°Bx = 200 mg N/L
  - 23°Bx = 250 mg N/L
  - 25°Bx = 300 mg N/L
  - 27°Bx = 350 mg N/L
- Sauternes and some regions have very low YAN (Wash State)
- Left over N will be eaten by spoilage bacteria



## Other Byproducts of Alcoholic Fermentation



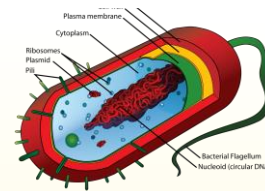
## Bug Number 2: Brettanomyces



- *Brettanomyces* is the Genus/ *Dekkera* describes the sexual form. Both are Yeasts.
- Brettanomyces is a particular danger in wines with residual sugar or leftover nitrogen
- Transferred throughout the winery on equipment/ tanks/ barrels
- Relatively low SO<sub>2</sub> doesn't inhibit growth, can reactivate when SO<sub>2</sub> is bound
- Produces volatile phenols, mainly 4-ethylphenol and 4-ethylguaiacol
- 4-EG is present in low concentrations, but is much more volatile: spicy and smoky
- 4-EP is more plentiful, "medicinal" and "band-aid"



## Bug Number 3: Lactic Acid Bacteria Aka Malo-lactic acid bacteria



### The Good: *Oenococcus-oeni*

- They live on glucose and other organic acids
- Fermentation refers to CO<sub>2</sub> production no energy is produced
- Mystery as to why this occurs, maybe the increased pH makes a more hospitable environment
- Can increase pH by .1-.2, TA 1-3 gr/L
- Lactic acid is main product, with byproducts: diacetyl, acetoin, and volatile esters
- Can undergo ML in bottle if not done in the winery, microbial stability
- Diacetyl: 1.5 mg/L no ML ferm, 3 mg/L with ML ferm, above 5 mg/L fault

### The Bad: *Lactobacillus* and *Pediococcus*

- Produce elevated acetic acid, 2-3 g/L (Legal limit 1.2 g/L)
- Slower fermenters
- They can feed off of less than 1% RS
- Can produce Geranium aroma from using Sorbic acid as a substrate
- Can also ferment Tartaric acid, really wreaking havoc in barrel
- *Vin Tourné*: wine "sickness" the French called the increased VA, cloudiness, gassiness, and other off-odors
- Have the ability to produce Biogenic Amines



## How to Stop the Bad Bugs

*pH*: Lower pH inhibits these bacteria. Above 3.6 is dangerous!

*Nutrients*: making sure nutrients such as N and others are consumed during normal fermentation

$SO_2$ : Sulfur Dioxide is an excellent inhibitor of MLB 10-30 ppm  $SO_2$  is shown to be very effective inhibitor (at 3.5 pH)



*Inhibitors*: Fumaric Acid and some fatty acids have shown to inhibit MLB

*Temperature*: Below 59°F growth is inhibited. 68-77 is ideal for them

*Note*: MLB do not require Oxygen to create VA



## Bug Number 4: Acetobacter



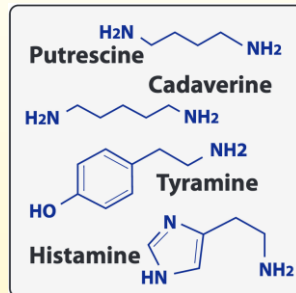
- *Acetobacter* and *Gluconobacter*: completely unrelated to MLB
- They live off of oxidizing Ethanol to make Acetic Acid. They can further oxidize to  $CO_2$  and water
- Oxygen is completely necessary
- Top up your barrels
- pH, Alcohol, and temperature are all limiting factors
- $SO_2$  has very little effect on VA
- VA is always accompanied by the more volatile ester Ethyl Acetate.



## The Real Ugly: Biogenic Amines

Formed through the decarboxylation of naturally occurring amino acids

Bacteria that matches the amino acid must be present



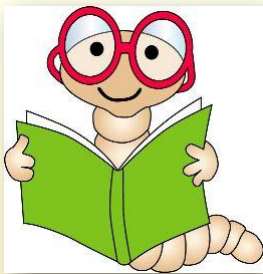
Presence of BA implies unsanitary condition

Some consideration is being given to regulating BAs, still no consensus

Foods likely to contain high levels of biogenic amines include fish, fish products and fermented foodstuffs (meat, dairy, vegetables, beers and wines)



## Other defects non-microbial



- Halo-anisoles
  - 2,4,6 -Trichloroanisole (TCA)
  - 2,3,4,6 -Tetrachloroanisole (TeCA)
  - Pentachloroanisole (PCA)
  - 2,4,6 -Tribromoanisole (TBA)
  - Sensory Threshold 2-6 ng/L, Testing ability .5 ng/L for TCA and 1 ng/L for other
  - Releasable TCA, corks release TCA until there is an equilibrium, which is this value
  - New Research on TCA about inhibiting olfaction pathways
- Sulfur issues
  - Sulfur Dioxide (SO<sub>2</sub>)
  - Hydrogen sulfide (H<sub>2</sub>S)
  - Mercaptan
- Other
  - Oxidized
  - Maderized
  - Yeasty over exposure to yeast



## Let's Review!



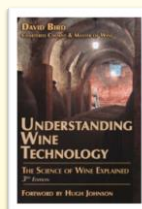
1. Beneficial yeasts are from the genera *Saccharomyces*, and harmful yeast of *Brettanomyces*
2. Beneficial bacteria are from the genera *Oenococcus*, and harmful bacteria from *Lactobacillus*, *Pediococcus*, and *Acetobacter*
3. Nitrogen and Oxygen are the keys to a healthy yeast population and strong cell membrane's to ferment to dryness.
4. Acetic Acid is the main component of VA with Ethyl Acetate always accompanying.
5. All wine is a balance of these microbial reactions
6. A flaw becomes a fault when it crosses an acceptable threshold!



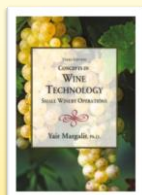
Thank You:  
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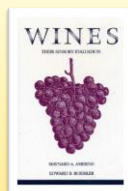
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