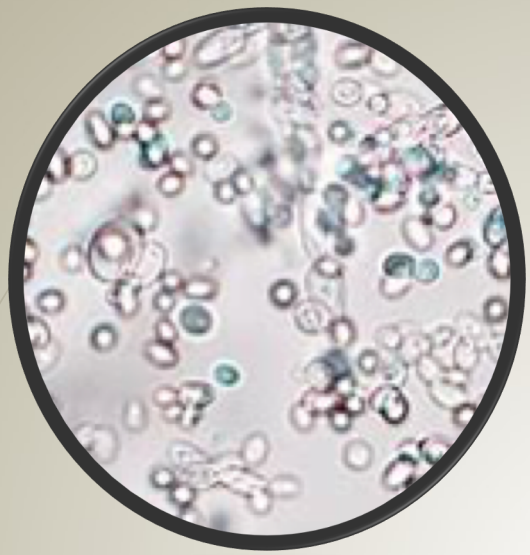
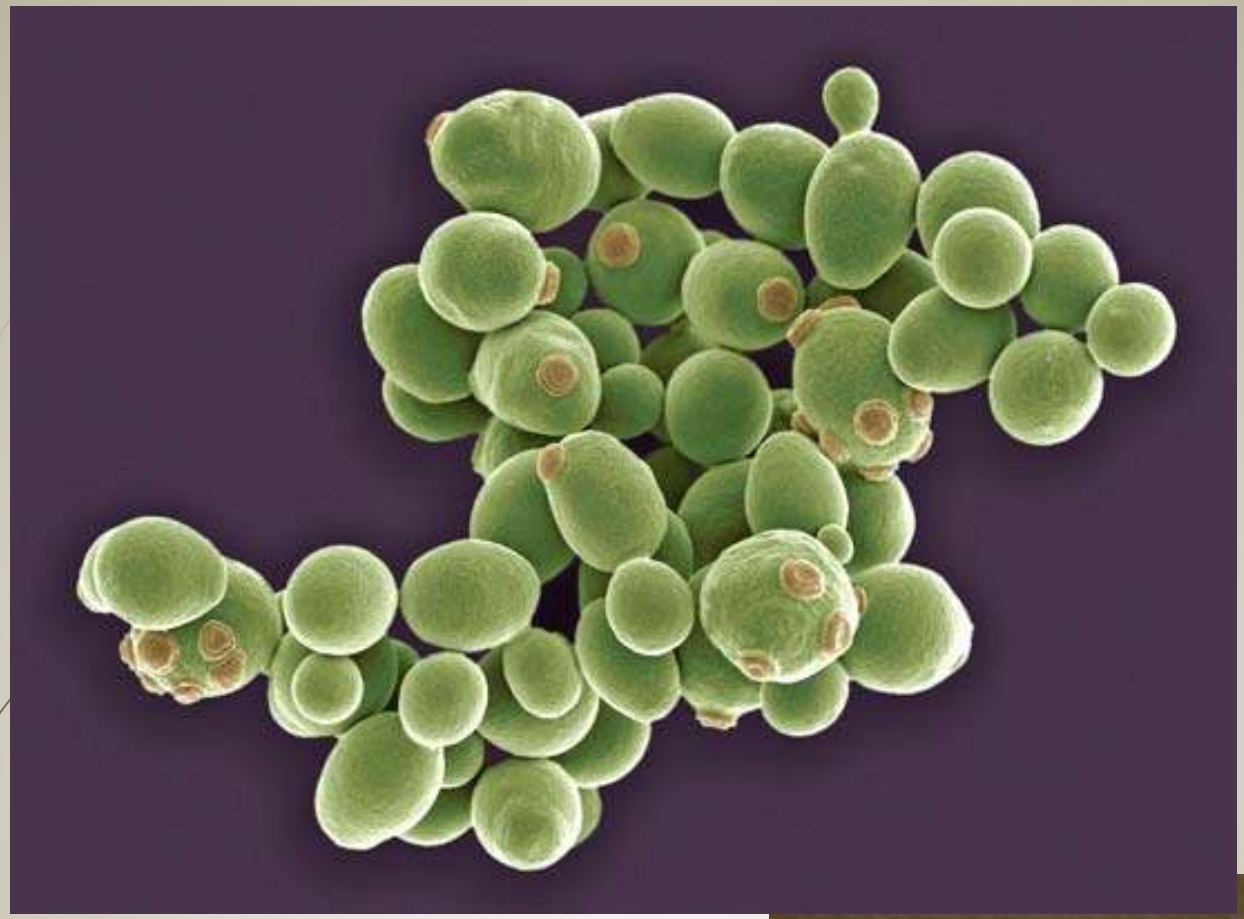
Yeast - How Fermentations are Affected

Bruce Hagen - 8/28/2019

Yeast affects how quickly fermentation begins, how fast it goes, and what the finished wine will taste smell and taste like…



Louis Pasteur hypothesized that microbes were responsible for fermentation and variations in flavor…




Freeze-dry yeast

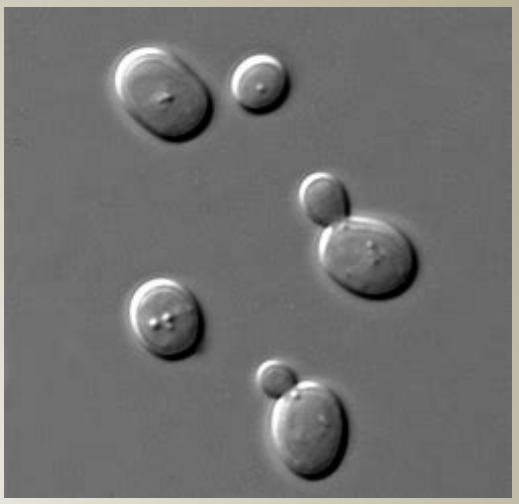
What do they do?

- Convert sugar into alcohol & CO_2
- Rate varies
- Each strain has its own collection of enzymes and produces specific flavors during fermentation
- Certain combinations of grape and yeast can be very appealing
- 1000s of natural strains around the world

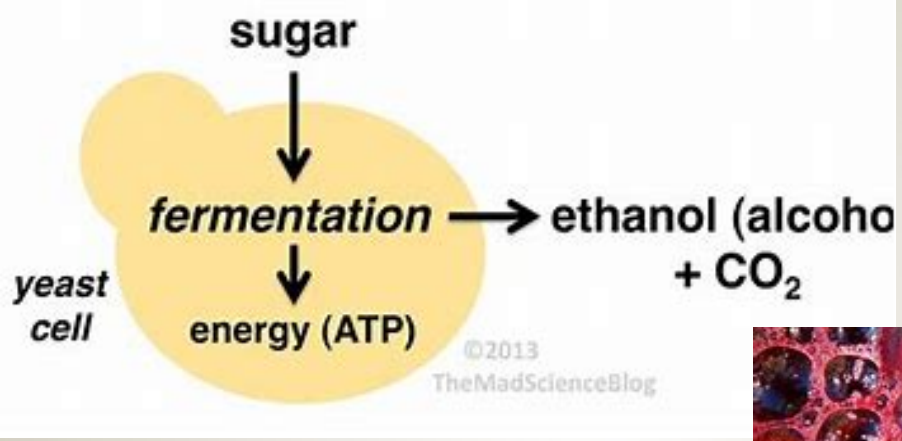
We know now that they:

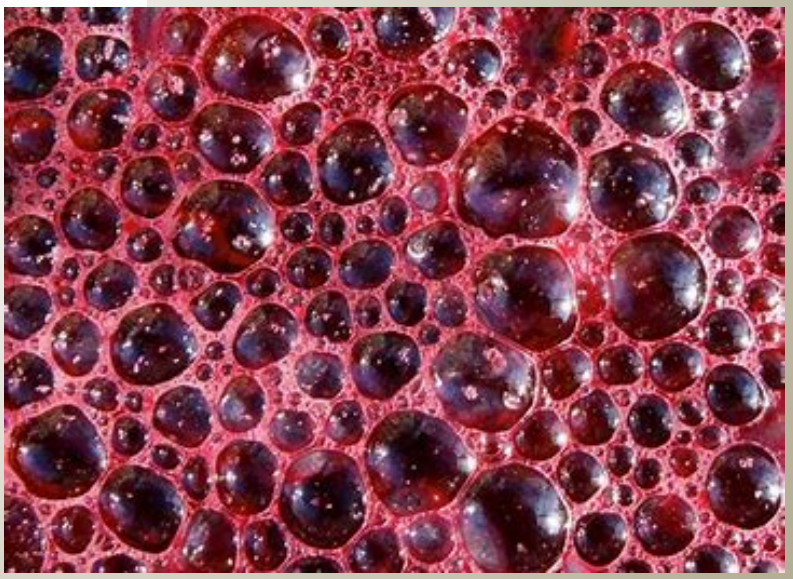
- are single celled -- fungi
- common in most environments

  particularly sugary solutions
- on fruits and berries, grains, flower nectar, plant exudates
- in vineyards, orchards
- in wineries: in the air, on the walls, picking bins, stemmer crushers, presses, etc.
- carried in the air, birds, insects
- by people
- reproduce: asexually (budding), or sexually (genetic recombination)
- produce spores that tolerate drying!



Yeast: convert sugar, carbohydrates to alcohol, releasing carbon dioxide



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Pomace

Wine dates from 7000 BC in China, and around the Mediterranean

For centuries, wines have been made with nothing more than the yeast on the skins …

- 80% of the world wine is made that way
- 1000s of different types of wild yeasts in vineyards throughout the world.
- Most unsuitable for making good wine.
- Most common genera of wild yeasts: *Klockera*, *Hanseniaspora*, *Metschnikowia*, *Candida*, *Pichia*,
- *Saccharomyces cerevisiae* — considered most important.
- It's involved in nearly all fermentations.

What's so unique about Saccharomyces cerevisiae?

- tolerate high levels of alcohol and ferment to dryness
- tolerate low pH and high temp (~100°F)
- most indigenous yeasts can't do that
- 100s of strains from wineries across the globe -- because of their desirable fermentation characteristics
- nearly all are *S. cerevisiae* and a few *S. bayanus*

We make a distinction between natural and cultured yeasts:

- **Native yeasts:** those that occur naturally in vineyards
- **Cultured yeasts:** isolated from fermentations because of their desirable fermentation characteristics and sensory influences
- **Indigenous yeasts:** those that occur in vineyards but may contain cultured yeasts.
- **Feral yeasts:** cultured yeast that have taken up residence in wineries or move from them to vineyards.
- **Microflora**: all of the yeast and bacteria in a vineyard or winery.

What you need to know:

- Each has specific different attributes.
- Not created equal!
- You could use just about any commercial yeast, but results would be all over the board
- Most selected strains have an affinity for specific grape varieties.
- Each produces a particular style of wine, or influences aromas and taste, structure and mouth feel, or color.
- What to look for: lag phase, speed, temperature range, alcohol tolerance, nutrient demand, oxygen demand, etc.
- Killer factor? (effects native yeast and sensitive strains)

Feral yeast in your cellar:

- play a role in both inoculated and spontaneous fermentations.
- often colonize fermentations that were inoculated and may finish the fermentation.
- microflora is constantly changing

Conventional (modern) fermentations:

- Sulfiting -- to kill or stun indigenous yeasts
- high dosage rate of yeast… 1g/gal.
- Use yeast nutrients (Go-Ferm, Fermaid K) when YAN is low to moderate
- Relatively quick -- a week to 10 days
- This is the industry standard, but is it the best way?


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SOLFITANTI
Prodotto effervescente granulare
EFFERBARRIQUE
IDEALE PER L'AGGIUNTA DI SOLFOROSA IN BARRIQUE
Quantità predosata - Solubilità immediata - Dispersione omogenea nel vino
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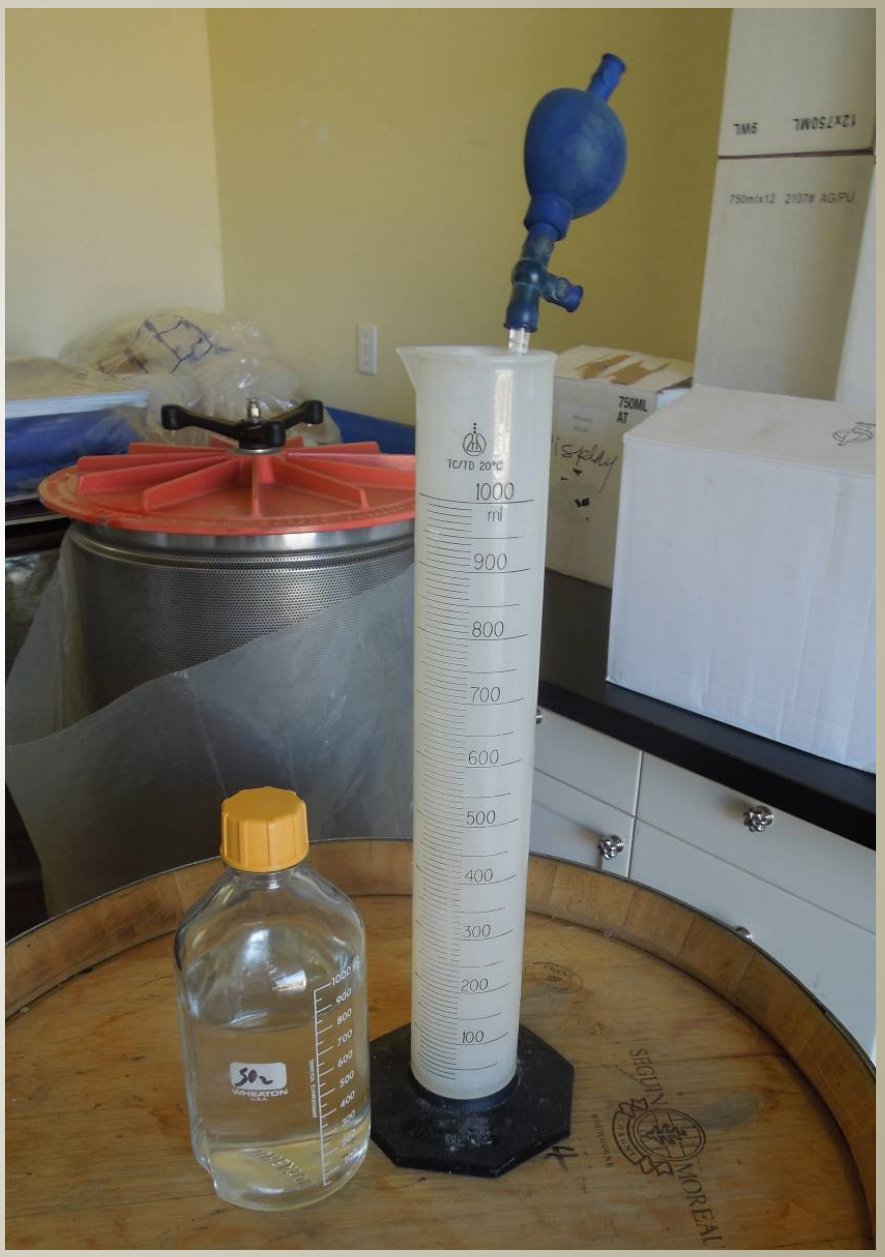
SULPHUR CHEMISTRY
Prodotto effervescente granulare
EFFERGRAN DOSE 5
IDEALE PER L'AGGIUNTA DI SOLFOROSA IN PICCOLI CONTENITORI
Quantità predosata - Solubilità immediata - Dispersione omogenea nel vino
GRANULAR EFFERVESCENT POTASSIUM METABISULPHITE
GRANULÉS EFFERVESCENTS DE MÉTABISULFITE DE POTASSIUM
Dose: 2 g of pure SO2
Dose: 2 g de SO2 pur
Composition:
E224 potassium metabisulphite: 75%
E501 potassium bicarbonate: 25%
Net: 5 g product - 2 g SO2
For alimentary use - For enological use
For professional use only - Ad uso alimentare
Per uso enologico - Esclusivamente per uso
professionale - Pour usage dans les denrées
alimentaires - Pour usage œnologique
Exclusivement à usage professionnel - Para
uso alimenticio - Para uso enologico -
Exclusivamente para uso profesional
SAC/G0070/02


TC/TD 20°C
1000
ml
900
800
700
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400
300
200
100
WHEATON
750ML
AT

Using cultured yeasts is:

- Convenient
- Expedient
- Safe
- Reliable
- Predictable
- Less foaming
- Lees settle quickly

A study in Oregon: which yeasts are involved in natural fermentations:

- Wild yeasts initially involved
- Others yeasts were present from day one
- At around 10% sugar <u>all</u> vineyard yeasts gone!
- <u>Conclusion</u>: the yeasts that finished the fermentations were those from the winery.
- In another experiment, using a commercial strain, other yeasts often took over at about midway
- By the end, inoculated strain was gone
- What they found: certain strains spiked early, and then others dominated for a while until one ended the 'game'

- In general, wild yeast work in concert or at least in sequence up to a point…
- One will dominate for a while and then another will take over until conditions become unfavorable.
- Most yeasts were present for a short time and then others, perhaps some from the vineyard or winery took over.

Another study in New York: different results:

- tracked the strains of yeast that appeared in a number of winery fermentations
- identified 85 strains of yeast—mostly *Saccharomyces*—and a few commercial strains
- particular yeasts appeared to be associated with particular harvest sites, rather than dwelling in the winery from vintage to vintage.
- None of the fermentations from a number of vineyard sites had similar yeasts.
- Even blocks that were in close proximity had almost completely different microflora.

- Conclusion: it didn't appear they were dealing with residual yeast cultures in the cellar.
- In addition, the microflora were consistent within each block from one vintage to the next
- It's safe to say that subject is complex, and variable, depending on: location, environmental conditions, vegetation type, climate, and perhaps research methodology

Additional information:

- Most wild yeasts become inactive or die when the alcohol level reaches ~4%.
- At that point, a strain or strains of *S. cerevisiae*, <u>if present</u>, build ups and the fermentation resumes.
- They have a competitive advantage over other genera of yeasts. (alcohol, heat and pH)
- The ability of inoculated *S.cerevisiae* yeast to suppress the wild microflora allows them to dominate the process once they build up to sufficient levels.
- Some winemaker inoculate when a wild fermentation begins to lag, to avoid lengthy a delay.

- Yeasts in a particular area appear to be relatively stable year-to-year.
- Late season rain or new introductions can result in variation.
- The microflora in region like Burgundy has become much the same, over many generations of winemaking.
- Most fermentation there are spontaneous and involve roughly the same yeasts.
- Variations in the wine may be due local environmental conditions, farming and winery practices.
- Dumping pomace or lees in or near vineyards, result in the buildup of cultured yeast strains in the wild/feral flora.

- Indigenous yeast (on grapes or in your winery (good, bad, or indifferent) end up fermenting the must.
- Sulfites are commonly added to kill or inhibit the growth of these yeasts and spoilage bacteria.
- Low pH, high alcohol, and high temperatures also can retard the development of wild yeast.
- The dosage rate of yeast is large to ensure that the fermentation gets off to a quick start, and that a single strain dominates
- Added or indigenous strains of *S. cereviciae* usually dominate. (i.e. Rockpile)
- Commercially strains can be found on grapes, particularly when introduced into vineyards close to wineries or where lees and pomace are dumped.
- The yeast you start with may not be the one that finishes

Now let's talk about natural (spontaneous)fermentations:

- We know that you don't have to add anything.
- So, inoculation is not really a matter of necessity.
- Why do natural or spontaneous fermentations?
  - for stylistic reasons
  - to make wine as naturally as possible
  - for the nuances that wild fermentations seem to produce.

  Common practice within the industry and even some home winemakers like it

  Downside: unpredictable.

Natural fermentations:

- those allowed to start with <u>only</u> the yeast on the skins, and whatever's present in the winery.
- sulfites typically not added or only a small doses
- It takes longer for indigenous yeast to colonize the must because they are relatively few in number.
- may take up to a week to get rolling, leaving the grapes open to spoilage and oxidation.
- trick is to get the fermentation going quickly before the other microbes become active.

Natural fermentations:

- Seem to heighten fruity notes and increase complexity, structure, and texture.
- Are significantly slower – usually weeks to months
- Greater skin contact would increase body, depth of character, color, and varietal fruit.
- Very real potential for spoilage, oxidation, or a stuck fermentation.
- Obviously, this is not always the case, otherwise wineries would have abandoned the practice long ago.

Avoiding the long lag phase:

- Keep the juice relatively cool until fermentation begins to minimize the development of spoilage organisms.
- Blanket the juice with inert gas or CO_2 (dry ice) to exclude air.
- Or make a starter culture (*Pied de cuve)*

If you prefer to use a selected yeast strain, you can slow the fermentation by:

- cold-soaking to extend skin contact
- using a slow to medium slow yeast
- managing fermentation temperatures
- split fermenting to increase complexity
- adding less yeast than recommended for a longer buildup period.

Grapes will ferment without any intervention, but …

- Making good wine with wild yeast takes a watchful eye and informed decision-making.
- Requires attention to detail and patience
- Should monitor sugar and temperature, check for off-aromas
- Worse-case scenario, may not ferment to dryness, may oxidize or develop off-aromas.

Preparing the yeast:

- Need to hydrate
- Warmer temperatures encourage normal development and survival
- Yeast mixture needs to be gradually cooled to within to 10°F
- Add to the juice/must and stir
- Yeast need nutrients to multiply and function normally optimally. If grapes are over-ripe, consider your nutrient levels low. Some options:
  - GoFerm during hydration followed by Fermaid K
  - Nutriferm energy at first bubble followed by Nutriferm Advance at 1/3
- Stay within temperature of the yeast strain

It starts in the vineyard

Preparing for harvest:

- Source grapes
- Clean and organize cellar, clear space
- Inventory and sanitize equipment, fermenters, barrels
- Inventory supplies:
  - K_2SO_3
  - Pectolytic enzymes for clarification or maceration (skin breakdown)
  - Fermenting tannins (antioxidants)
  - Yeast, yeast nutrients(Fermaid K, Go-Ferm, Nutriferm Energy, Nutriferm Advance, yeast-derived polysaccharides (Opti-white, Opti-Red, Noblesse, Pro-Blanco, Pro-Round)
  - Preemptive fining agents: Bentonite fining agent Claril SP, Bentolact S
- ML starter, ML nutrient
- Stab-Micro M

Protect against oxidation:

- SO_2 inhibits enzymatic oxidation
- ascorbic acid, fermentation tannins
- slow oxidation by chilling grapes, cold room
- fine to remove oxidation precursors, oxidized molecules – Claril SP

Tannins at crush

- act as antioxidants
- help remove proteins
- some enhance fruit, structure
- examples: Scott: FT Blanc, FT Blanc Soft; Enartis: Tan Blanc, Tan Elagance
- AST: sulfite, Ascorbic acid, gallic tannins


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BRUTE

Why cold-settling?

- removes heavy lees
- cleaner, fresher
- less off-aromas and flavors
- Eliminates elemental sulfur
- at or below 55F


59
COOLBOT
57


Savannah

Yeast Nutrients

Yeast hydration and nutrition:

- Go-Ferm
- heat to 104°F, add yeast—20 min.
- Add small amount of juice to acclimate yeast
- cool to about 75F before adding
- temp differential >18 F is harmful
- stir daily