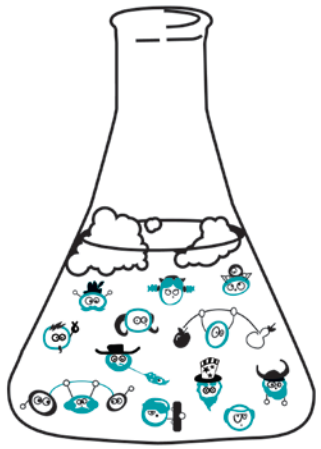
Craft CULTURES
Pure Liquid Yeast

Understanding Yeast Health & Maintenance



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Presentation Overview

- Importance
- History
- Yeast cell structure
- Yeast metabolism + fermentation
  - Fermentable sugars
- Fermentation process controls
- Generations of use
- Storing yeast
- Isolating wild yeast

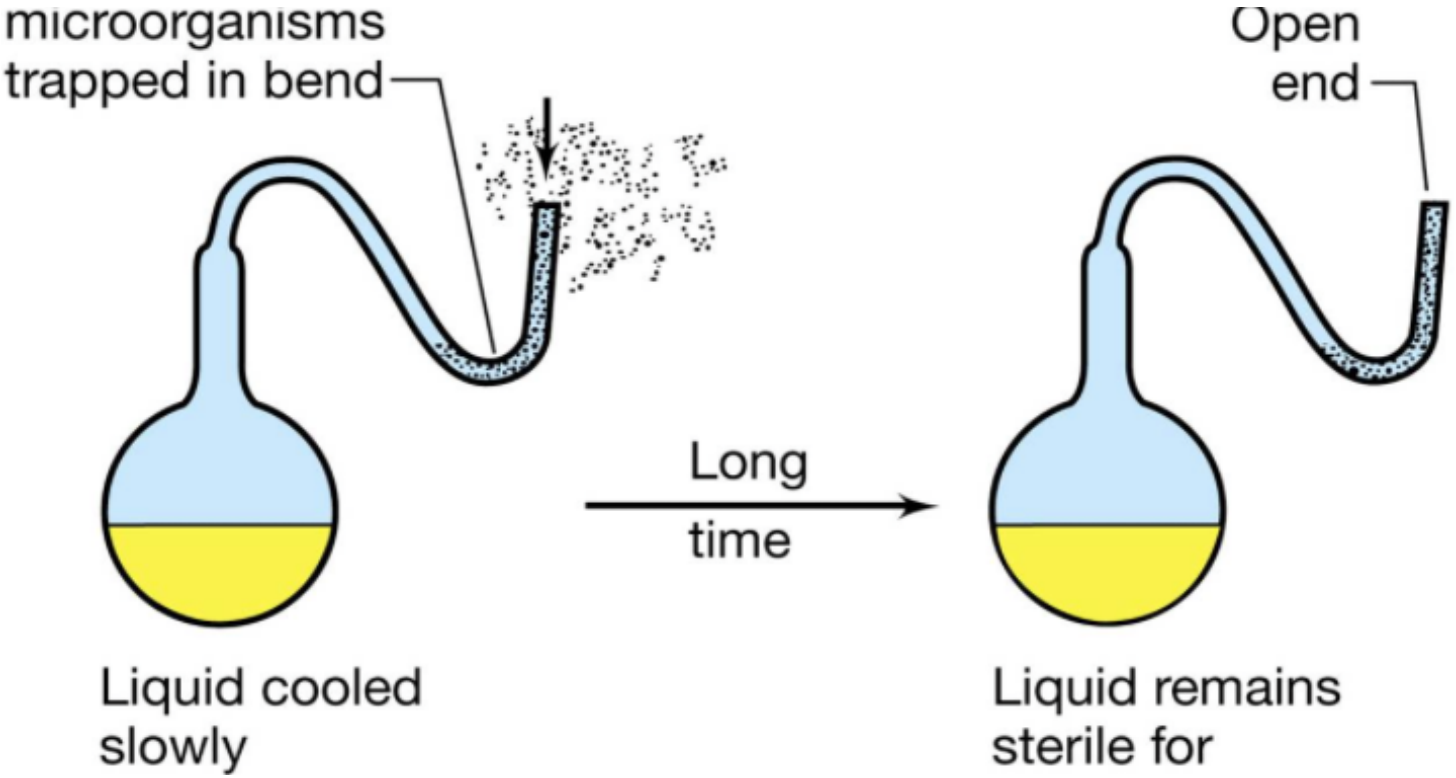
Importance of Understanding Yeast Health

- **Yeast are biological organisms**
  - Optimums
  - Performance based on their health
- **If yeast are 'happy'…**
  - Can rid infection
  - True to style, predictable beers
- **Get the most use out of your yeast**

History of Yeast in Brewing Practices

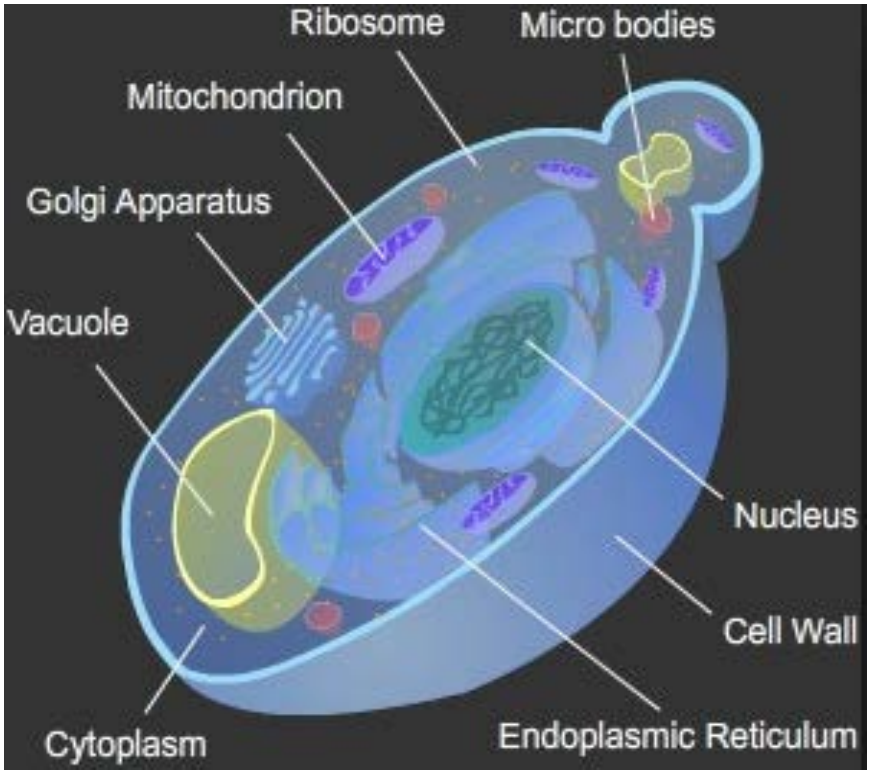
- > thousands of years ago: Mesopotamia
  - Spontaneous generation
- 1516: Bavarians and the Beer Purity Law
- 1680: Anton van Leeuwenhoek
- 1789: Antoine-Laurent Lavoisier

History of Yeast in Brewing Practices

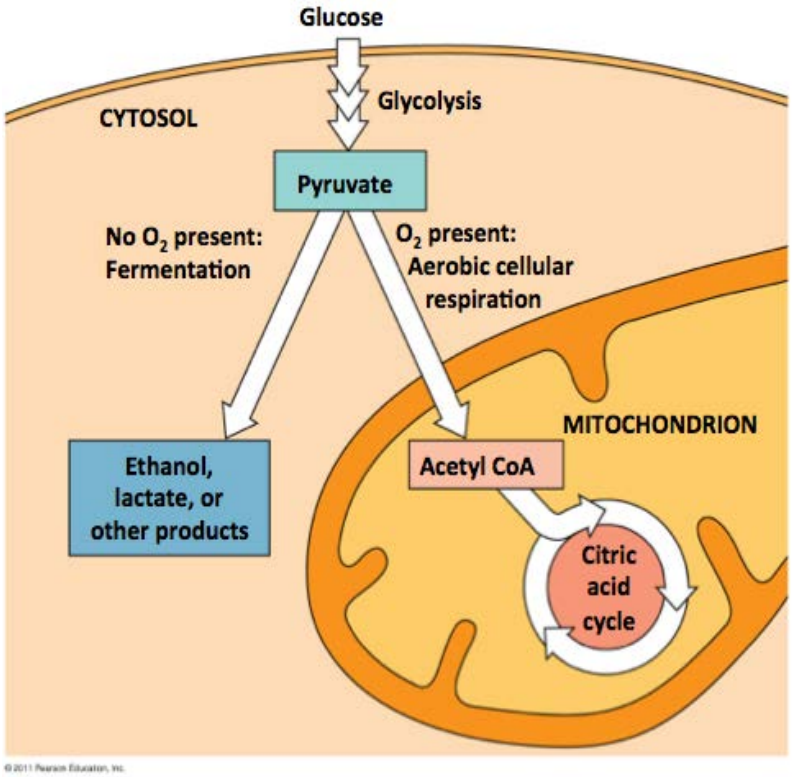


Yeast Cell Structure

- Eukaryotic
- ‘bag of **enzymes**’

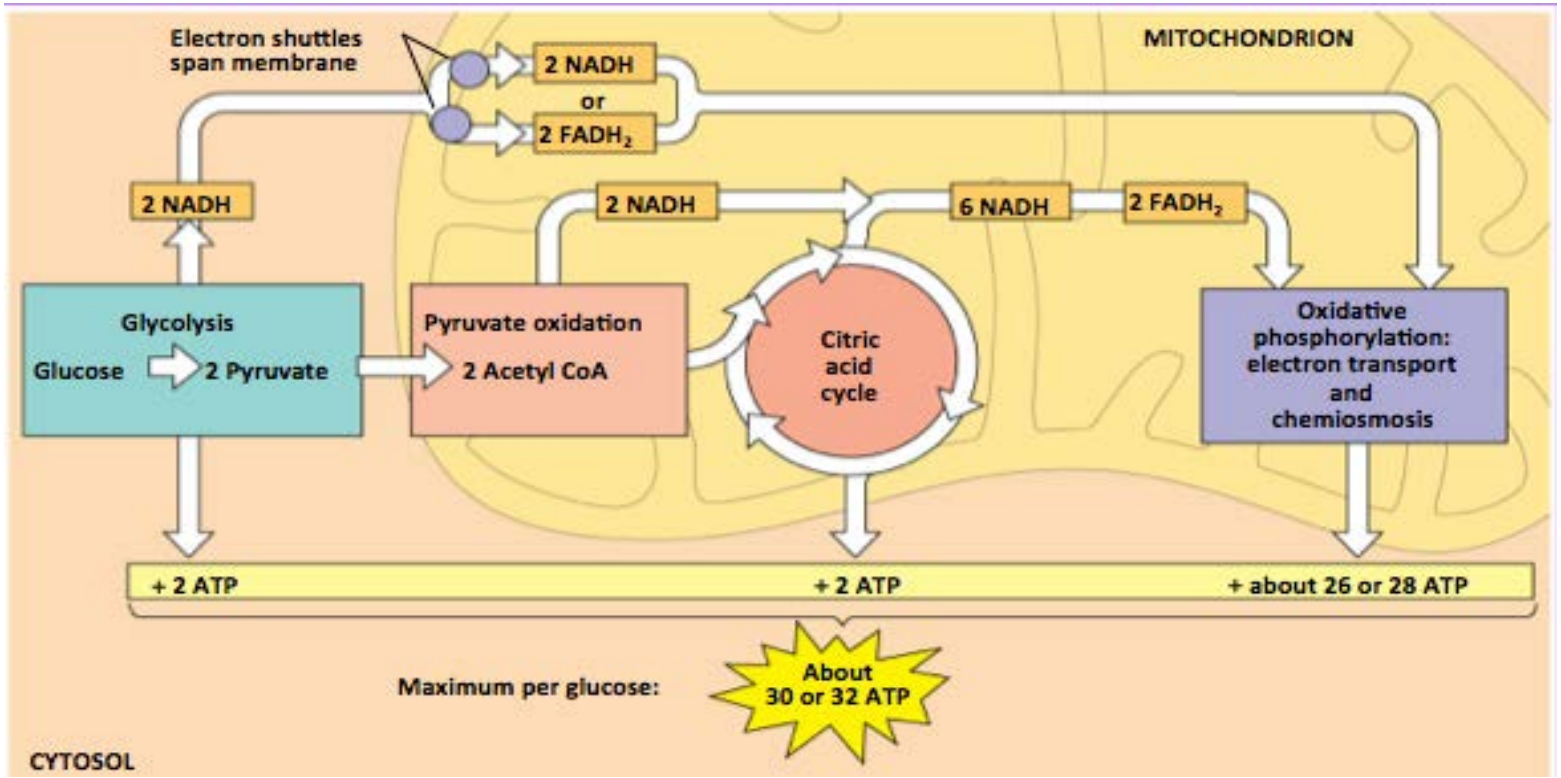


Yeast Metabolism + Fermentation



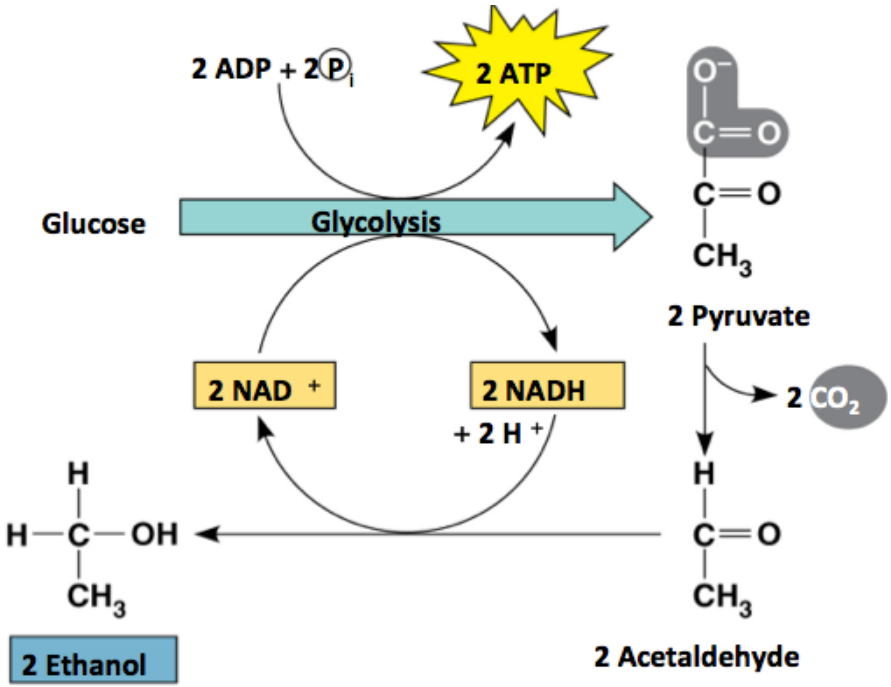
- Facultative anaerobes
- Aerobic respiration vs. fermentation
- Adenosine Triphosphate (ATP)

Yeast Metabolism + Fermentation



$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + 32ATP + 12NAD^+$$

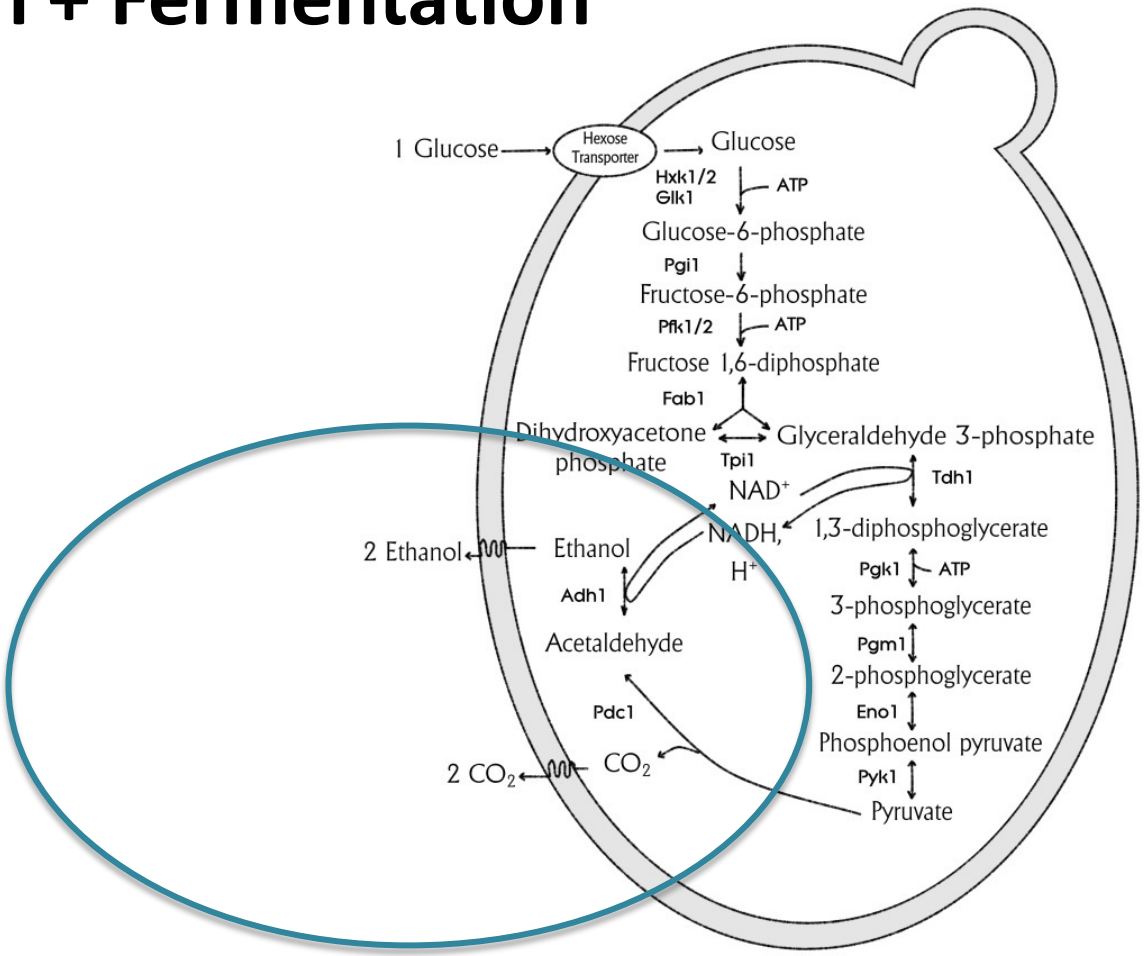
Yeast Metabolism + Fermentation



$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 2ATP + 2NAD^+$

Yeast Metabolism + Fermentation

- Pdc1 enzymes
  Pyruvate decarboxylase
- Adh1 enzymes
  Alcohol dehydrogenase



Yeast Metabolism + Fermentation

- Yeast require carbohydrates, amino acids, vitamins, minerals and oxygen for growth.

- Wort supplies all of these requirements:
  - Carbon from malts
  - Amino acids from malts
  - Nitrogen from malts
  - Vitamins from malt
  - Minerals from water
  - Oxygen supplied by agitation/aeration.

Fermentable Sugars

- Barley malts contain long chain sugars produced during photosynthesis
  - Monosaccharide production
  - Polysaccharide for storage
- The mashing process
  - Base malt
    - Enzymes
      - α-amylase (~160F)
      - β-amylase (~140F)
- Fermentable sugars vs. dextrins

Fermentable Sugars

- Fermentable wort sugars include:
  - From malting process
    - Disaccharide maltose (60%, maltose → **glucose** by maltase)
    - Trisaccharide maltotriose
  - In small amounts from malt
  - Fructose
  - Sucrose

- Preference by *Saccharomyces* sp.

Fermentation Process Controls

- After preparation of wort there are only three process controls for fermentation.
  - Temperature
  - Pitching Rate
  - Oxygenation of wort

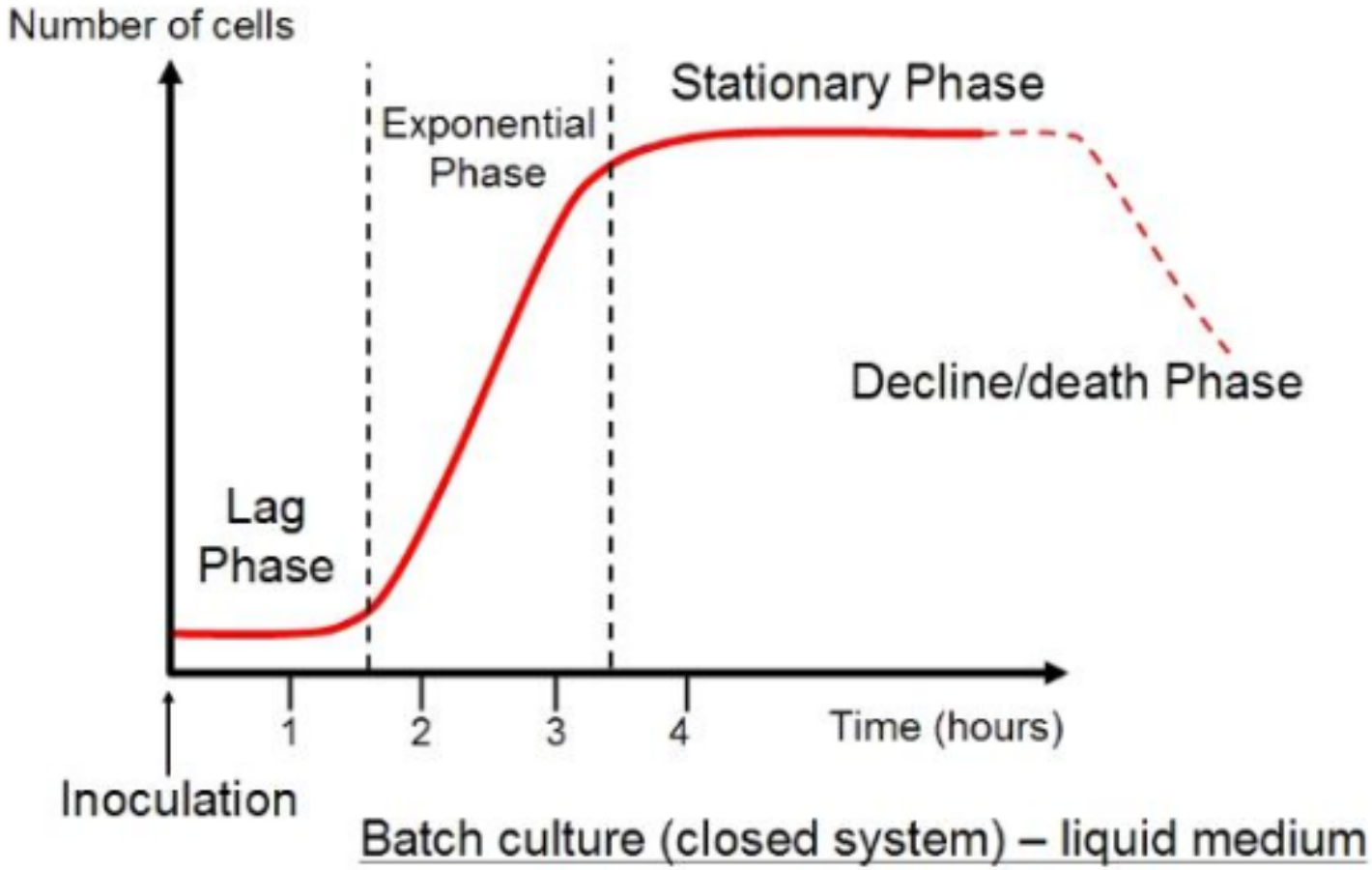
Process Controls: Temperature

- Temperature has the GREATEST impact on beer flavor variations during fermentation
- Each Yeast strain has optimal temperatures for fermentation (and proper metabolic pathways to be utilized).
    - Ales: 68-72F
    - Lagers: 45-55F
- Regulating Temperature is very important
    - Fermentation is exothermic
    - ~10F increase for ~5gal
- Maintaining and regulating temperature may speed up fermentation

Process Controls: Pitching Rates

- Be consistent!
  - By volume or weight
  - Same methods of cropping
- 1 million cells / mL / degree plato
- How to calculate correct volume to pitch:
  - Volume of wort in mL (119,240.471mL / BBL)
  - Degree plato (4pts SG to ~1/2 degree plato)
    - 12 degree plato = 1.048 SG
    - http://lvhb.org/specific.html
  - Concentration (cell density) of slurry
    - Cell counts with hemacytometer

Process Controls: Pitching Rates



Process Controls: Oxygenation of wort

- Recommended @ 10ppm, DO meter
- Too little oxygen will not support yeast health during fermentation
  - Creating unpredictable flavors, and aromas
- Slightly over oxygenating does not affect flavor/aroma, but delays the switch from aerobic respiration to fermentation
- Too much oxygen will prevent fermentation and cause cells to aerobically respire, producing a completely different subset of flavors (usually unfavorable) and a lack of etOH production

Generations of Use

Recommended up to 16 generations for **ale** strains.

Recommended up to 12 generations for **lager** strains.

- Based on:
  - Viability (% alive)
    - » Greater than 90%
  - Purity (free of contamination)

- Hesitant to re-pitch?
- Do not guess, there is a lot at stake!
- Check simultaneously!

Storing Yeast

- Sanitized containers NOT in cone
  - Nalgene HDPP bottles/jugs are recommended
  - Scratch free is best
- Store at 35F, allow to warm before re-pitching
- Rinsing procedures
- Acid washing
- Revitalizing procedures

Isolating Wild Yeast.

- Solid media in sterile Petri dishes
- Easy to make, media can be expensive
- Craft Cultures can work with you on this!
- Place topless plates in cool, moist places of interest or roll fruits on to plat surfaces
- Isolate yeast from mixed culture on original plates to new plates using pure culture technique or send us the plates and we can purify your wild isolate!


Yeast are biological, keep them healthy and they will perform best!

Thank You!

Questions?