Yeast-
Gimme Some Sugar

Taxonomy: Common yeast encountered in brewing

- The main cultured brewers yeast is genus Saccharomyces
  - Saccharomyces means “sugar fungus”
  - **S. cerevisiae** is ale yeast
  - **S. pastorianus** is lager yeast
  - **Tarulaspora delbruckii** (formerly known as S. delbruckii) is in the (Weihenstphen) weizen yeast blend along with S. pastorianus

  - There is a debate whether S. pastorianus belongs to the cerevisiae species or not, but currently is considered separate
  - Lager yeast used to be classified as S. uvarum or S. carlsbergensis

Taxonomy: Common yeast encountered in brewing

- Sour and “wild” beers (e. g. Lambics and Brett beers) utilize genus Brettanomyces
  - Brettanomyces means “British fungus” and was originally isolated from English Stock Ale at the Carlsberg brewery in 1904 by their technical director Niels Hjelte Claussen. Some cultures available include:
  - **B. bruxellensis**
  - **B. lambicus**
  - **B. claussenii**

  - Brettanomyces are slow growers that are able to ferment complex sugars that Saccharomyces is not able to utilize

Commercial yeast strain attributes and types

Attributes affecting yeast strain selection:

- Attenuation - how dry the beer is (69 – 80%)
  - Low for British ale yeasts, high for Belgian ale yeasts
  - Apparent attenuation = (OG-FG)/(OG – 1)
- Flocculation – how well yeast drop out of suspension
  - Low for Weizens, high for British Ale yeasts
- Alcohol tolerance (9 – 12%)
  - Low for lagers, high for Belgian ale yeasts
- Fermentation temperature preference (F)
  - Low 50’s for lagers, high 60’s for most ales, 70’s – 80’s for Belgian Ales, low 60’s for hybrids (Kolsch, Altbier, California Common)
- By-product formation – good and bad flavors and aromas

Commercial yeast strain attributes and types

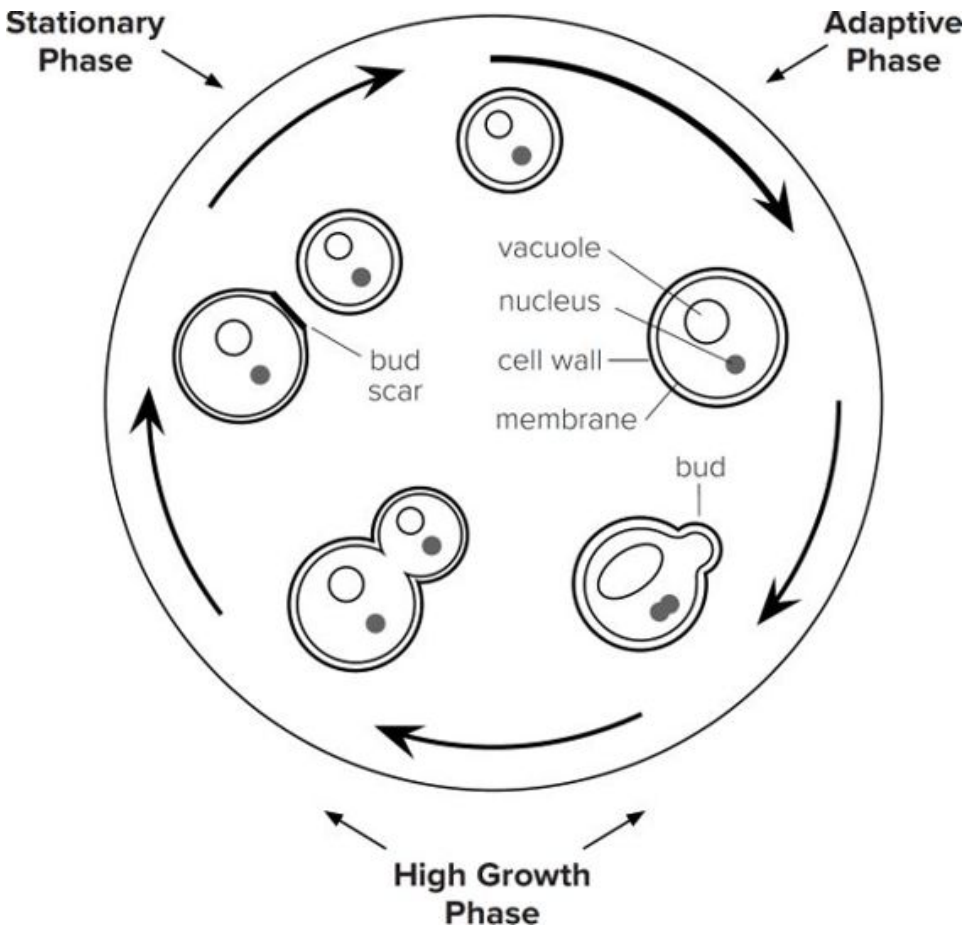
Cultured Yeast Strain Types (Thanks to Fix, White, Zainasheff)

- Ale
  - Clean – low esters: California/American, Scottish, European
  - Fruity – high esters, diacetyl, rapid fermentation, high flocculation: British, Irish, Australian, some Belgian
  - Hybrid – Ale strains fermented at lower temperatures for lager-like cleanness and some sulfur (Kolsch, Altbier) or lager strains fermented at higher temperatures for some esters: (California Common)
  - Phenolic – High attenuation and low flocculation strains producing phenols with peppery and clove flavors: Most Belgian ales and German Weizens (which also produce banana flavors)
  - Eccentric – produce unusual flavor compounds (earthy, barnyard, sour) as well as phenolics and may be super attenuative: Some Belgian strains
- Lager
  - Dry – clean, crisp, refreshing: American, Scandinavian, some German
  - Full – Clean, malty, rounded: Munich Helles and Dunkel, etc.

Fermentation and the yeast life cycle

← Zero to 15 Hours →	← Four hours to 4 days →			← 3 to 10 days →	← 4 to 6 weeks →
Lag Phase (Latent)	Accelerating Phase (Low Kraŭsen)	Exponential Phase (High Kraŭsen)	Decelerating Phase (Late Kraŭsen)	Stationary Phase	Lagering Phase (May be combined with Stationary)
Yeast use energy from glycogen stores to make enzymes for growth and fermentation. Survey sugars, amino acids, nutrients, and oxygen in environment. Transport components in and make missing ones.	Yeast reproduce through budding, doubling 1 – 3 times depending on initial cell count and environment. Rate of cell division increases. Oxygen and sterols are used to make cell wall membranes. If wort contains more than 0.4% glucose it ferments that and bypasses sterol pathway.	Growth rate is constant at maximum for yeast strain and conditions. Transport of amino acids and sugars is very rapid. Esters formed from fatty acids and alcohols. Fusel alcohols will be formed if certain amino acids are in low supply.	Growth rate is decreasing. Ale yeast will have metabolized most sugars, but lagers still reducing them. Fermentation by-products (like diacetyl) are being metabolized. May need to raise temperature up to 68F for a diacetyl rest to help with this, especially for lagers and hybrids.	Number of yeast cells remains constant. The kraŭsen begins to fall, the gravity approaches FG, and the yeast begins to flocculate. Racking off the trub and yeast will help prevent off flavors due to autolysis.	For lagers or hybrids, an additional cold storage of 4 – 6 weeks will help smooth out the flavors. The yeast must be active during this time, so don't reduce temperature by more than 5 F per day.

Yeast Lifecycle



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Yeast by-products and how to influence their production

Usually Desirable Yeast Derived Aromas and Flavors

- Fruity Esters from Ale Strains – apple, pear, cherry, plum, citrus, banana
- Faint pleasant sulfur smell from lager strains
- Pleasant phenolic compounds with peppery or clove aroma from Belgian and German wheat (weizen) strains
- Pleasant earthy, barnyard, and sour aromas from Belgian strains

Yeast by-products and how to influence their production

Usually Undesirable Yeast Derived Aromas and Flavors

- Green apple aroma from acetaldehyde (okay in Budweiser/American Standard Lager style)
- Buttery/butterscotch aroma from diacetyl (okay in some English, Irish, and Scottish styles)
- Soft and spicy flavors from low levels of fusel (C3+) alcohols (okay in barleywine and some strong Belgian styles)
- Vinegar aroma from acetic acid (okay in Flanders Red style)

Yeast by-products and how to influence their production

Always Undesirable Yeast Derived Aromas and Flavors

- Solvent (like fingernail polish remover) aroma from ethyl acetate
- Rubbery, rotten eggs aromas from yeast autolysis (proteolysis of dead yeast cells)
- Harsh, hot, and solvent flavors from high levels of fusel (C3+) alcohols
- Medicinal/bandaid aromas from wild yeast infection

Creating healthy yeast
For optimum fermentation

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You need enough yeast cells to efficiently process the sugars

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Underpitching leads to stressed yeast which leads to poor fermentation

Pitching Rate Calculator

http://www.mrmalty.com/calc/calc.html

Creating healthy yeast
For optimum fermentation

How do we get more cells economically?

Let’s Make a Starter

Step 1

Make some fake wort using DME

Dry Malt Extract

Step 1

Rule of Thumb:

About 100 grams per Liter of water

Or ¾ cup

Step 1

Rule of Thumb:

1 ½ cup for 2 Liter starter

Step 1

Boil 10 minutes

Step 2

Cool wort and pour into a flask

Then pitch yeast

Step 2

Agitate by hand to oxygenate

or better yet, use a stir plate

Step 2

Ferment for 24-48 hours

Step 3

Chill your mixture.

Yeast cake firms at bottom

Step 4

Decant

Remove Excess DME wort

Step 5

Pitch

(or build additional starter)

Active Fermentation

12 hours from pitching

Vigorous Fermentation

36 hours from pitching

Tips for optimum fermentation

In most cases it’s hard to overpitch

Tips for optimum fermentation

In most cases it’s hard to overpitch

Pitch and ferment on the cool side

Tips for optimum fermentation

In most cases it’s hard to overpitch

Pitch and ferment on the cool side

Raise temp to finish fermentation

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Thanks!