Choosing the Right Yeast

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<table>
<thead>
<tr>
<th>Part One: The Importance of Yeast and Fermentation</th>
<th>Yeast Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Two: Biology, Enzymes, and Esters</td>
<td>Yeast Strains</td>
</tr>
<tr>
<td><strong>Part Three: How to Choose the Right Yeast</strong></td>
<td>Multiple Strains</td>
</tr>
<tr>
<td>Selection Criteria</td>
<td><strong>Brettanomyces</strong></td>
</tr>
<tr>
<td>Beer Styles and</td>
<td>Part Four: Fermentation</td>
</tr>
<tr>
<td></td>
<td>Part Five: Yeast Growth, Handling, and</td>
</tr>
<tr>
<td></td>
<td>Part Six: Your Own Yeast Lab</td>
</tr>
<tr>
<td></td>
<td>Part Seven: Troubleshooting</td>
</tr>
</tbody>
</table>
Yeast Fermentation

Figure 2.3
Species vs. Strain

Kingdom
Phylum
Class
Order
Family
Genus
Species

Strain
Diversity of yeast cell morphology

- spherical
- oval
- elongated
- dimorphic
- cylindrical
- curved
- apiculate
- bipolar
- bottle (flask-shaped)
- triangular

Graeme Walker, 2009
Ale Yeast

‘Warm’ fermentation temperatures
Ferments clean to fruity
Variable flocculation
Usually good top cropper
Produces a great variety of beers
Storage is good.
Ale Yeast, Specialty

- Hefeweizen Yeast
  Ferments with wild character.
  Low flocculation
  Low diacetyl
  Can produce sulfur.
  Ferments very rapidly, but not greater cell #.
  Top cropping is best way to collect slurry.
  Produce a small variety of beers.
Ale Yeast, Specialty

- Belgian Yeast
  - Ferments with very unusual character-wild like
  - Low flocculation
  - Bottling with it?
  - Low diacetyl
  - Can produce sulfur.
  - Ferments very rapidly
  - Can be very fruity
  - Produce a good variety of beers.
Lager Yeast Types

‘Cold’ fermentation temperatures
Ferments with clean character
Not drop out quickly.
Will produce diacetyl.
Will produce sulfur.
Ferments slowly, and not grow very well.
Usually not top crop.
Produce a medium variety of beers.
Brettanomyces is the main wild yeast used identified in *strong* English stock beer:

Claussen 1904 showed a brett inoculation of a 1.055 specific gravity beer would achieve the “English” character.

Shimwell 1947 confirmed the conditions: a 1.060 OG beer was essential to achieve a “vinous” wine like flavor, a beer under 1.050 would produce an unpalatable and turbid beer with insipid flavor and aroma. Shimwell said Brett can behave “as a desirable organism in one beer and an undesirable one at one and the same brewery”.

Usually used in secondary and bottle condition
Classification of Brett

Brettanomyces category grew as many new strains added. Many different synonyms.

Dekkera and Brettanomyces: same thing, but Dekkera is the sexual form, it forms spores. Brettanomyces is non spore forming, just as brewing yeast.

- Multilateral budding
- SO$_2$ sensitive
- Maltose and dextrin utilization variable
Classification of Brett

5 species, based on ribosomal DNA sequence homology:

- **B. bruxellensis** includes **B. intermedia**
  - **B. lambicus**
  - **B. custersii**

- **B. anomalus** includes **B. claussenii**
  - **B. custersianus**
  - **B. naardenesis**
  - **B. nanus**

newest classification, added to the other 4 in 1990’s
**Flavor Characteristics of Brett**

*Brettanomyces* have the enzyme B-glucosidase.

B-glucosidase breaks down the wood sugar cellobiose, to produce glucose.

Cellobiose in barrels occurs as a result of the firing process used to toast the barrels.

B-glucosidase is inhibited by ethanol, and pH optimum is 5-6, temperature optimum 40-50°C.

New barrels contain higher amounts of cellobiose than used barrels, and therefore have the potential to support higher *Brettanomyces* populations. Wineries are encouraged to destroy barrels if Brett develops. Fruity-like flavors from glucosidase activity?
Flavor Characteristics of Brett

Isovaleric acid, guaiacol, plastic like compounds; 4-ethyl guaiacol (4EG) and 4-ethyl phenol (4EP) produced by the decarboxylation of the hydroxycinnamic acids p-coumaric and ferulic acid 4EP used to confirm Brett presence.
Bacteria Types

Usually beer spoilage organisms
10% of the size of yeast
Much simpler organism
Lactobacillus

Pediococcus

Acetic Acid Bacteria
Bacterial differences

- **Aerobic vs. anaerobic**
- **Gram positive vs. Gram negative**
  - Gram staining - req. special stains and microscope with oil immersion capability
  - Easy test → 3% KOH solution
    - Increased viscosity → Gram negative
    - No viscosity → Gram positive
# Bacterial I.D.

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Growth</th>
<th>Gram</th>
<th>KOH result</th>
<th>Cell morphology</th>
<th>Catalase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetobacter</td>
<td>Strictly aerobic</td>
<td>Negative</td>
<td>viscous</td>
<td>short rods</td>
<td>positive</td>
</tr>
<tr>
<td>Gluconobacter</td>
<td>Strictly aerobic</td>
<td>Negative</td>
<td>viscous</td>
<td>short rods</td>
<td>positive</td>
</tr>
<tr>
<td>Obesumbacterium</td>
<td>facul. Anaerobic</td>
<td>Negative</td>
<td>viscous</td>
<td>Rods</td>
<td>positive</td>
</tr>
<tr>
<td>Rahnella</td>
<td>facul. Anaerobic</td>
<td>Negative</td>
<td>viscous</td>
<td>Rods</td>
<td>positive</td>
</tr>
<tr>
<td>Lactobacillus</td>
<td>Anaerobic</td>
<td>Positive/variable</td>
<td>non-viscous</td>
<td>Rods</td>
<td>negative</td>
</tr>
<tr>
<td>Pediococcus</td>
<td>Anaerobic</td>
<td>Positive</td>
<td>non-viscous</td>
<td>Cocci</td>
<td>negative</td>
</tr>
</tbody>
</table>
Bacterial Flavors/Contribution

*Lactobacillus delbrueckii*

acidity, sourness

*Pediococcus damnosus*

acidity, sourness and diacetyl
Why Choose the Right Yeast?

- Does it matter?
- Creativity, the desire to produce the best beer possible
Easily Proven

- Ferment the same wort with multiple yeast strains

- Different resulting beers even with high gravity, high hops, etc.
Yeast Behavior

- Different strains can show differences in:
  - Oxygen requirements
  - Fermentation time line
  - Cell counts in tank
  - Aroma
  - Viability
  - Nutrient requirements
  - Diacetyl rest
  - Yeast collection
  - Yeast storage
  - To name a few…

- Does not need to be completely mapped out in beginning.
Strain Selection Process

- Jamil method
  - Simple, straightforward
  - There is no magic
- Set goals for the beer
  - Parameters (ABV, IBU, SRM)
  - Flavor concept (malty, hoppy, other?)
  - Determine at least one or two key requirements
- Select likely yeast candidates
  - You can try them all
  - Or use goals and key requirements to narrow choices
- Test batches
  - Keep tests consistent, adjust later
Determining Key Requirements

- **Flavor, often the most important**
  - Bitterness, hop character
  - Malt sweetness, malt character
  - Alcohols, esters, and others

- **Alcohol tolerance**
  - Extreme beer?
  - Most yeasts handle considerable ABV

- **Attenuation**
  - ABV target, residual sweetness

- **Fermentation temperature**
  - Some Belgian strains require temp push

- **Other considerations**
  - Speed of fermentation, storage, flocculation
Example: Smoked Belgian

- **Goal in mind**
  - 7-8% ABV
  - Slight but evident smoke character
  - Dark, rich malty character
  - Some malty sweetness
  - Balancing bitterness, no hop character

- **Recipe**
  - Pils, Munich, Rauch, Special B, Carafa Special, Sugar
  - Hallertau
  - 17 °P, 23 IBU, 19 SRM
Example: Key Flavor Considerations

- Smoke phenol from grist
  - Plus fermentation, could be overwhelming
  - Low phenol, complimentary phenol yeast
- Need some additional complexity
  - Fruity esters, “Belgian” character
- Malt character
  - Enhanced malt character, with subtle smoke character
  - Some yeasts enhance, others subdue
- Malt sweetness
  - Avoiding too heavy and sweet or too dry
- Attenuation
  - 75 – 86% to result in 7 – 8% ABV
Example: Test Batches

- Pitch rate 0.75 M/°P/ml, 68 °F to 74 °F, 8-10 ppm O2

- **Antwerp (WLP515)**
  - 75% Apparent, 4.3 °P, 7.0 %ABV
  - Malty, rich, full, more rauch character

- **Abbey (WLP530)**
  - 77% Apparent, 3.8 °P, 7.3 %ABV
  - Slightly full, drier than 515, fruity

- **Belgian Strong (WLP545)**
  - 92% Apparent, 1.3 °P, 8.6 %ABV
  - Dry, spicy, alcohol evident, lowest malt character
Example: Adjustments

- **Antwerp (WLP515)**
  - Increase attenuation without losing malt character
  - Second yeast? Mash adjustment? Grist?

- **Abbey (WLP530)**
  - Reduce fruity character, let rauch be more evident

- **Belgian Strong (WLP545)**
  - Refine alcohol character, less dry
  - O2? Pitch rate? Temp? Mash?

- **Blending?**
- **Worthwhile?**
Thank you!

Questions?

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