Yeasts Flavour & The Evolution of Beer Styles

Robert Percival
Lallemand Brewing
Content

• Contribution of yeast to beer flavour
• Development of beer styles
• The role of yeasts in beer styles
• Commercial availability and application of dried brewing yeasts
Contribution to Beer Flavour

Yeast?
Importance Of Yeast In Brewing

“Yeast can be the single most important ingredient the brewer selects.

The joke around the brew house is that in reality we work for the yeast.”

- Garrett Oliver
Primary Chemical Change During Fermentation

\[
\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2 \text{CH}_3\text{CH}_2\text{OH} + 2 \text{CO}_2
\]

Glucose \rightarrow \text{Ethanol} + \text{Carbon Dioxide}
Important Reaction Products From Yeast Metabolism

- Higher alcohols
- Organic acids
- Aldehydes and ketones
- Esters
- Lipids
- Sulphur compounds
- Phenols
Variables Affecting Fermentation

- Wort composition & pH
- Wort dissolved oxygen (DO)
- Yeast strain
- Yeast pitch rate
- Yeast quality
- Temperature
- Pressure
- Vessel geometry
Esters

- Lower pitching rate resulted in higher ester production
- Higher temperature led to higher ester production
- Higher gravity resulted in higher ester concentrations
Higher Alcohols

- Higher gravity and higher temperature resulted in increased higher alcohol concentrations.
Manipulation Of Variables

• From just one yeast strain a brewer can manipulate fermentation conditions to produce a vast spectrum of flavours!
The Art of Brewing
Craft Brewing

- Brewing market consolidated => beers were “homogenous”
- In the 80’s a counter movement started in the US

Craft Brewing

- Reviving old beer styles and recipes
- Experimenting with new raw materials
How Did Styles Develop?

- Local barley types
- Different ways of making malt
- Local water source
- Different yeast strains, shared yeast strains
- Different temperature ranges – ability to store cold
- Different cross-cultural influences
- Introduction of hops
Development of beer styles

Availability of materials

Grist, Hops (and flavourings), Liquor

Fermentation by local Microbiological Flora
Refinement of beer styles

Purification and selection of strain(s)

Standardisation of raw materials and brewing conditions

Established beer style
Lager Yeast

• Bavarian origin.
  – 1400s in Munich - cool fermentations (selective pressure)
  – Taken to Pilsen and Copenhagen in 1840s

• Became very popular - displaced ale yeast

• Popularity fueled by advances of Industrial Revolution
  – Steam power, refrigeration, railroads, pasteurization and filtration technology

• Cool fermentation temperatures: 5 to 12 °C

• Natural Hybrid
Characteristics of Lager Beer

- Strains are closely related - common origins

- Beers are more delicate, clean, drinkable, and less aromatic.

- Low bitterness, simple grist composition.
## Lager Yeast

<table>
<thead>
<tr>
<th>Lager</th>
<th>Pilsner</th>
<th>Helles</th>
<th>Vienna</th>
<th>Bock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Schwartzbier</strong></td>
<td><strong>Märzen</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Summary: Diamond Lager Yeast

<table>
<thead>
<tr>
<th>Attenuation</th>
<th>Flavor</th>
<th>Bottle Conditioning</th>
<th>Flocculation</th>
<th>Propagation</th>
<th>Beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Neutral</td>
<td>No</td>
<td>Strong</td>
<td>Yes</td>
<td>Lager</td>
</tr>
</tbody>
</table>
Characteristics of West Coast Ale Yeast

- Aroma: Neutral with a slight ester
- High attenuation
- Fermentation range: 15 – 22°C
- Flocculation: Medium to High
- Popular modern style
Characteristics of West Coast Ale

- 4.5 - 5.5% abv
- Straw like golden to deep amber colour
- Complex malty, bready/biscuity
- Moderate/strong USA hops, citrus & pine
- Medium bodied, moderate/high carbonation
### American West Coast Ale

<table>
<thead>
<tr>
<th></th>
<th>American Barleywine</th>
<th>American Pale Ale</th>
<th>American Amber Ale</th>
<th>American Brown Ale</th>
<th>American IPA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>American Wheat</strong></td>
<td><strong>Blonde Ale</strong></td>
<td><strong>Cream Ale</strong></td>
<td><strong>Kölsch</strong></td>
<td><strong>Imperial IPA</strong></td>
<td></td>
</tr>
<tr>
<td>Irish Red Ale</td>
<td>ESB</td>
<td>Scottish Ale</td>
<td>Strong Scottish Ale</td>
<td>Strong Ale</td>
<td></td>
</tr>
</tbody>
</table>

### SUMMARY: BRY-97 AMERICAN WEST COAST ALE YEAST

<table>
<thead>
<tr>
<th>Attenuation</th>
<th>Flavor</th>
<th>Bottle Conditioning</th>
<th>Flocculation</th>
<th>Propagation</th>
<th>Beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Slightly estery, almost neutral</td>
<td>Yes, for beers up to 12% ABV</td>
<td>Strong</td>
<td>Yes</td>
<td>Ale</td>
</tr>
</tbody>
</table>
Characteristics of British Ale Yeast

- Aroma: Fruity/ester
- Attenuation: Medium
- Fermentation temp: 18-22C
- Flocculation: Medium - High
Characteristics of British Ale (ESB)

- Strong (5-6% abv),
- Full-bodied, mahogany-coloured
- Mellow bitterness
- Complex malty notes - biscuit flavours and soft malt toffee, brewed with Pale Ale and Crystal malts
# British Ale

<table>
<thead>
<tr>
<th>ESB</th>
<th>Cream Ale</th>
<th>Blonde Ale</th>
<th>Bitter</th>
<th>Special/Best Bitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scottish Ale</td>
<td><strong>Irish Red Ale</strong></td>
<td><strong>Brown Ale</strong></td>
<td><strong>Porter</strong></td>
<td><strong>Sweet Stout</strong></td>
</tr>
<tr>
<td>English IPA</td>
<td>Old Ale</td>
<td>Mild</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Fermentation:** Vigorous fermentation complete within 3-5 days.
- **Attenuation:** Medium attenuation preserves some beer complexity
- **Flavour:** Well balanced aromatic profile, moderate ester.
Beer styles based around yeast: Weissbier/Hefeweizen

- Origins in C16th Bavaria.
- Favoured by royals, later gaining widespread popularity.
- Nearly dies out by C19th but revived by G.Schneider.
- Top fermenting ale yeast, fermented at warm temps.
Characteristics of Bavarian Wheat Beers

• Unique yeast with complex flavour profile.
• Prominent esters – Banana, vanillia, bubblegum, apple.
• Phenols often present – 4VG (clove, ferulic acid), spices.
• Low hopping, simple grist composition.
## Wheat Beer Yeast

<table>
<thead>
<tr>
<th>Weizen</th>
<th>Hefeweizen</th>
<th>Dunkelweizen</th>
<th>Weizenbock</th>
<th>American Style Hefeweizen</th>
</tr>
</thead>
</table>

**MUNICH CLASSIC WHEAT BEER YEAST**

- Natural
- Kosher (500g)
- GMO Free

Commercial and Technical Inquiries: BREWING@LALLEMAND.COM

GMO FREE

500 g Net 17.6 oz
Beer styles based around yeast: Saison

- French/Belgian origins (Wallonia).
- Farm house ales traditionally brewed in winter, stored until summer.
- Seasonal farm workers ‘Saisonnaires’.
- Top fermenting, warm temps.
Characteristics of Saison Beers

• Robust yeast with complex ester flavour profile (lemon/orange).
• Prominent ‘earthy’ yeast notes and spices (pepper).
• Very dry finish; high attenuation.
• Low hopping, simple grist composition.
# Belgian Saison Style Beer yeast

<table>
<thead>
<tr>
<th>Saison</th>
<th>Bière de Garde</th>
<th>Belgian style beers</th>
</tr>
</thead>
</table>

## Summary

**BELLE SAISON BELGIAN SAISON-STYLE BEER YEAST**

<table>
<thead>
<tr>
<th>Attenuation</th>
<th>Flavor</th>
<th>Bottle Conditioning</th>
<th>Flocculation</th>
<th>Propagation</th>
<th>Beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Fruity, spicy, peppery</td>
<td>Yes, for beers up to 14% ABV</td>
<td>Strong</td>
<td>Yes</td>
<td>Ale</td>
</tr>
</tbody>
</table>
Wild Yeast: Brettanomyces

- Can utilise broad range of sugars (inc. dextrins)
- Diverse sub species
- Does not contribute a lot of acidity on its own
- Slow acting
- Secondary Fermentation
Characteristics of ‘Wild’ Beers

- Robust yeasts with complex flavour profile (species dependent)
- Prominent ‘funky’ yeast notes and spices (phenolics).
- Typically dry finish; high attenuation.
- Low hopping, often used in sour beer styles.
# Brettanomyces

<table>
<thead>
<tr>
<th>Saison</th>
<th>Bière de Garde</th>
<th>American Wild</th>
<th>Sour Beer Styles</th>
<th>Imperial Stout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trappist beer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Bottle of Orval Trappist Ale](image)
Yeast hybrids – potential

- Development of Interspecific hybrids:

  \[ S. \text{cerevisiae} \times S.\text{euybayanus, S.mitakae, S.kudriavzevii} \]

= Novel strain characteristics
Yeast hybrids – potential

- Greater fermentation efficiency
  - + Fermentation speed
  - + Thermal tolerance
  - + Ethanol tolerance

- Greater diversity in sensory expression
  - + Flavour
  - + Aroma
# Yeast hybrids – potential

<table>
<thead>
<tr>
<th>Origin</th>
<th>Efficiency</th>
<th>Aroma</th>
<th>POF</th>
<th>Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. cerevisiae</em> × <em>S. eubayanus</em></td>
<td>--</td>
<td>Clean, slightly fruity aroma</td>
<td>-</td>
<td>Low/High</td>
</tr>
<tr>
<td><em>S. cerevisiae</em> × <em>S. eubayanus</em></td>
<td>--</td>
<td>Clean, fruity aroma</td>
<td>+ (slight)</td>
<td>Low/High</td>
</tr>
<tr>
<td><em>S. cerevisiae</em> × <em>S. eubayanus</em></td>
<td>++</td>
<td>Neutral to slightly fruity aroma</td>
<td>+ (slight)</td>
<td>Low/High</td>
</tr>
<tr>
<td><em>S. cerevisiae</em> × <em>S. mikatae</em></td>
<td>++</td>
<td>Extremely fruity</td>
<td>+ (slight)</td>
<td>Low/High</td>
</tr>
</tbody>
</table>
Are there New Styles to be developed?

- Yes! Beer styles are changing as we speak
- Brewers (and Marketers) like to try new things
- Driven by home-brewers, beer enthusiasts and pro brewers
- Brewers want to sell more beer, want to keep consumers interested in their brands
- Consumers want an experience in drinking, not just beer as a thirst quencher
- Brewers must still bear in mind “drinkability”
Commercial Availability of Yeast

• Anyone can brew any style!