Beyond Beer Fermentations

An Overview of Considerations for Alternative Beverage Fermentations
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President/CEO
White Labs, Inc.
Some stats

From CBC 2023 State of the Industry
- Bart Watson

• Non-beer made up ~2% of respondents beer volume
• Non-beer products grew 19% YoY

It is believed that “within 5 years, up to 1/3 of products will not be traditional beer but products including wine, liquor, and non-alcoholic beverages.”
Now more than ever

It becomes more important now to understand alternative beverages and considerations for yeast and fermentation to make these products great and creative.

Why? To generate business growth.
## Beyond Traditional Beer

<table>
<thead>
<tr>
<th>Non-Alcohol/Low Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Seltzer</td>
</tr>
<tr>
<td>Hard Kombucha</td>
</tr>
<tr>
<td>Mead</td>
</tr>
<tr>
<td>Cider</td>
</tr>
<tr>
<td>Sake</td>
</tr>
<tr>
<td>Spirits</td>
</tr>
<tr>
<td>What Else?</td>
</tr>
</tbody>
</table>

### Common Organisms:

- *Saccharomyces cerevisiae*
- *Saccharomyces bayanus*
- *Saccharomycodes ludwigii*
- *Torulaspora delbrueckii*
- *Aspergillus oryzae*
- *Brettanomyces bruxellensis*
- *Acetobacter sp.*
- *Zygosaccharomyces sp.*
- *Lactobacillus sp.*
- *Pediococcus sp.*
- And More!
TTB/FDA Considerations

Each Product Requires Regulatory Research/Considerations

- **Labeling**
  - TTB label approval if malted barely and hops
  - FDA Food labeling if not
    - Nutritional Labeling if not except
    - Ingredients

- **pH**

- **Alcohol**

- **Other flavorings and colorings can be regulated**
Recipe Adjustments

Each Product Requires Unique Considerations

- Sugar content
- Yeast selection
- Nutrient requirements
- Pitch rates
- Fermentation profile/temperature
Flavor Impact

Apart from ethanol and CO$_2$, yeast significantly contributes to the flavor and aroma

- Esters
- Alcohols (fusel)
- Vicinal diketones (diacetyl, 2,3-pentandione)
- Aldehydes (primarily acetaldehyde)
- Phenols
- Organic acids
- Sulfur compounds
- Fatty acids
Lack of nutrients, improper strain selection, miscalculated pitching rates or unregulated fermentation temperature can lead to a poor tasting product.

### Flavor Impact

#### Negative Results

<table>
<thead>
<tr>
<th>Stuck fermentations/High finishing gravity</th>
</tr>
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<tbody>
<tr>
<td>High ester production</td>
</tr>
<tr>
<td>High fusel alcohol production</td>
</tr>
<tr>
<td>Poor conditioning of diacetyl/acetaldehyde</td>
</tr>
<tr>
<td>Unwanted sulfur production</td>
</tr>
</tbody>
</table>
Carbohydrate Source

Differentiates Type of Beverage

Source:
- Grain
- Honey
- Molasses
- Fruit
- Processed sugars

Sugars:
- Sucrose
- Dextrose
- Maltose
- Maltotriose
- Glucose
- Fructose
- Dextrins
Strain Selection

Select a yeast strain that does well in the fermentation environment and produces a desired flavor profile

Considerations:
- Hundreds of choices available
- Dry or Liquid cultures
- Alcohol tolerance
- Ability to ferment abundant carbohydrate
- Speed and performance
- Nutrient requirements (FAN)
- Fermentation temperature range
- **FLAVOR**
Nutrient in Fermentation

- Carbohydrates (carbon-sugars)
- Amino acids (nitrogen)
- Fat (sterols, fatty acids)
- Minerals (Zinc, Calcium, Magnesium)
- Vitamins
- Oxygen (from aeration or agitation)

builds healthy cell membranes for proper fermentations and transport
Nutrient Requirements

Avoiding Stuck Fermentations

- Using malted barley provides the majority of nutrients required by yeast
- Fermentations of simple sugars generally lack the needed nutrition for complete and healthy fermentation
- Yeast nutrient and FAN additions will supply the yeast with the necessary minerals and nitrogen to complete the job
What do organisms do with them?

• Responsible for metabolism aka making energy
• Helps produce other compounds that protect the organism
High in sugar, low in nutrients

This is ok for non-alcoholic kombucha, but need additional nutrients for alcoholic kombucha

Nitrogen: Contains low amounts of amino acids

<table>
<thead>
<tr>
<th>Element</th>
<th>Average daily intake (range) (mg/day)</th>
<th>Element concentrations of tea infusions (mean) (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>5 (2–10)</td>
<td>2.94</td>
</tr>
<tr>
<td>Cu</td>
<td>2.5 (2–3)</td>
<td>0.05</td>
</tr>
<tr>
<td>Fe</td>
<td>15 (10–18)</td>
<td>0.006</td>
</tr>
<tr>
<td>Mn</td>
<td>4 (2–5)</td>
<td>4.6</td>
</tr>
<tr>
<td>Zn</td>
<td>15</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Nutrient Deficiencies

Hard Seltzer

- Devoid of yeast nutrients needed for healthy fermentations

- Yeast require:
  - Fatty acids: build cell membrane
  - Amino acids: build proteins
  - Minerals: cofactor of metabolism

- Nutrients should have:
  - Peptone and yeast extract
    - Provides fatty acids, FAN, nucleic acids, vitamins and minerals
  - With DAP or DAP-free?
Pitch Rates

Pitch rates are dependent on multiple factors including, but not limited to:

- Fermentation temperature
- Gravity
- Oxygen
- Strain
- Nutrition
## Pitch Rates

Sample Pitch Rates for Different Beverages

<table>
<thead>
<tr>
<th>Beverage Type</th>
<th>Pitch Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Alcohol/Low Alcohol</td>
<td>2 – 8 million cells/mL</td>
</tr>
<tr>
<td>Hard Seltzer</td>
<td>0.75 – 1.5 million cells/mL</td>
</tr>
<tr>
<td>Cider</td>
<td>5 – 8 million cells/mL</td>
</tr>
<tr>
<td>Mead</td>
<td>5 – 8 million cells/mL</td>
</tr>
<tr>
<td>Spirits</td>
<td>2 – 20 million cells/mL</td>
</tr>
</tbody>
</table>
## Fermentation Profiles

Sample Pitch Rates for Different Beverages

<table>
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<th>Beverage Type</th>
<th>Pitch Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Alcohol/Low Alcohol</td>
<td>50-65°F (10-18°C)</td>
</tr>
<tr>
<td>Hard Seltzer</td>
<td>63-73°F (17-23°C)</td>
</tr>
<tr>
<td>Cider</td>
<td>68-75°F (20-24°C)</td>
</tr>
<tr>
<td>Mead</td>
<td>68-75°F (20-24°C)</td>
</tr>
<tr>
<td>Spirits</td>
<td>68-86°F (20-30°C)</td>
</tr>
</tbody>
</table>
The Takeaways

• Demand is rising for alternative beverages, and breweries are pivoting. Understanding how to make these beverages well is tantamount.

• Each beverage has a unique set of requirements that can differ slightly or significantly from beer making.

• Understanding yeast requirements, specifically strain selection and nutrition, will aid in creating consistent, healthy, and most importantly, flavorful and high-quality fermentations.
THANKS!