

# **Fermentation**

## **Beer, Wine, Vinegar, etc.**

# Ingredient List

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**Water:** “the solvent of life” – facilitates biochemical reactions

**Sugar:** Source of all essential components for our bioreactor

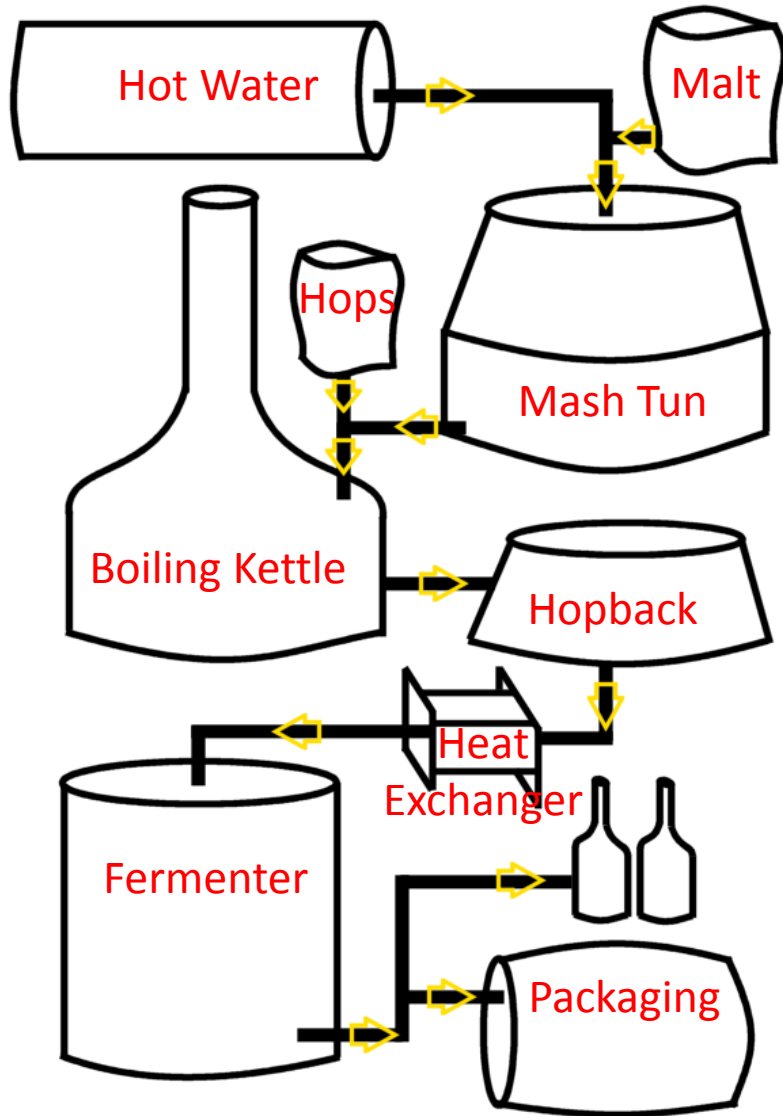
- Sugars (primarily starch)
- Vitamins
- Metals
- Etc.

**Hops (for beer):** resins, flavonoids, essential oils, acids

**Yeast or Bacteria:** Chemical reactor

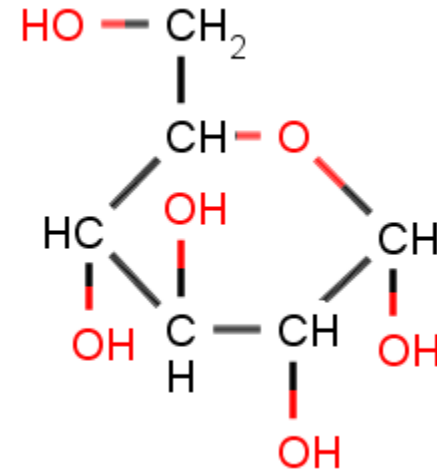
**Overall Goal: Extract all the goodies from our ingredients to maximize the health of the bug.**

# Summary of the Process

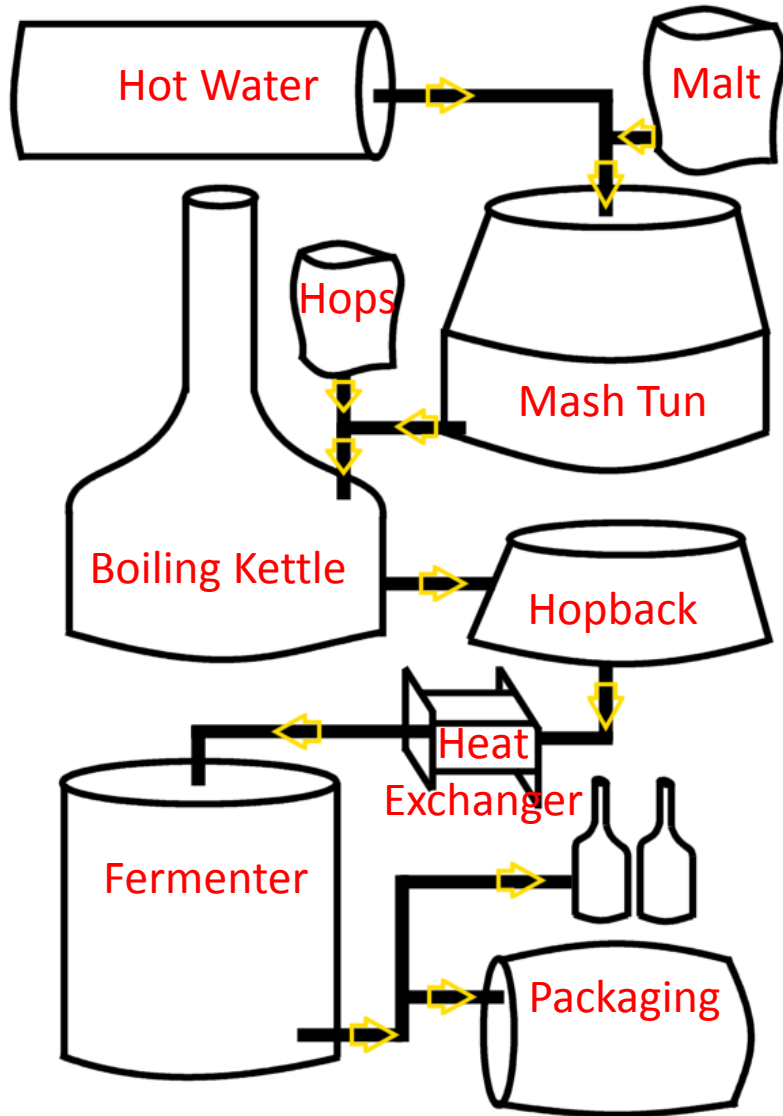


**Malting:** Priming process to prepare grains  
– expose cotyledon

**Mash:** Convert polysaccharide starch chains into fermentable sugars.



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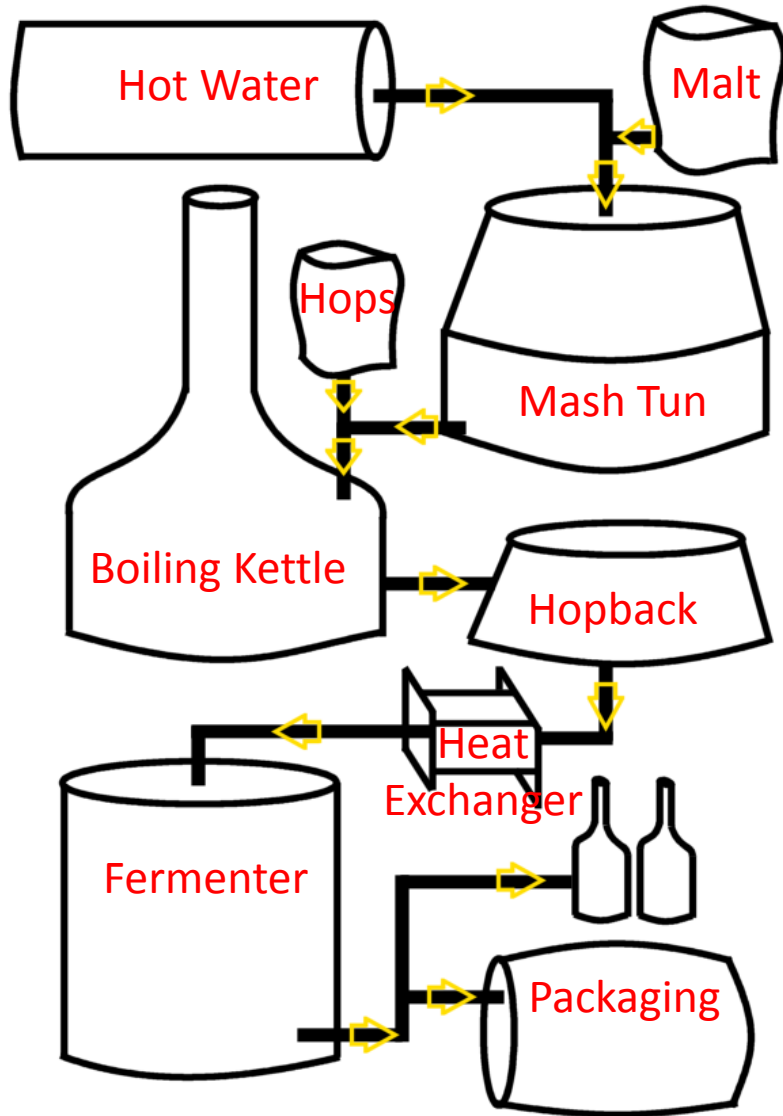
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Most enzymes are derived from grain.

**Boiling Kettle:** Wort is strained and sent to Boiling Kettle.

- Boiled for various times (~60 minutes for standard home brewing)
- Hops added at various intervals

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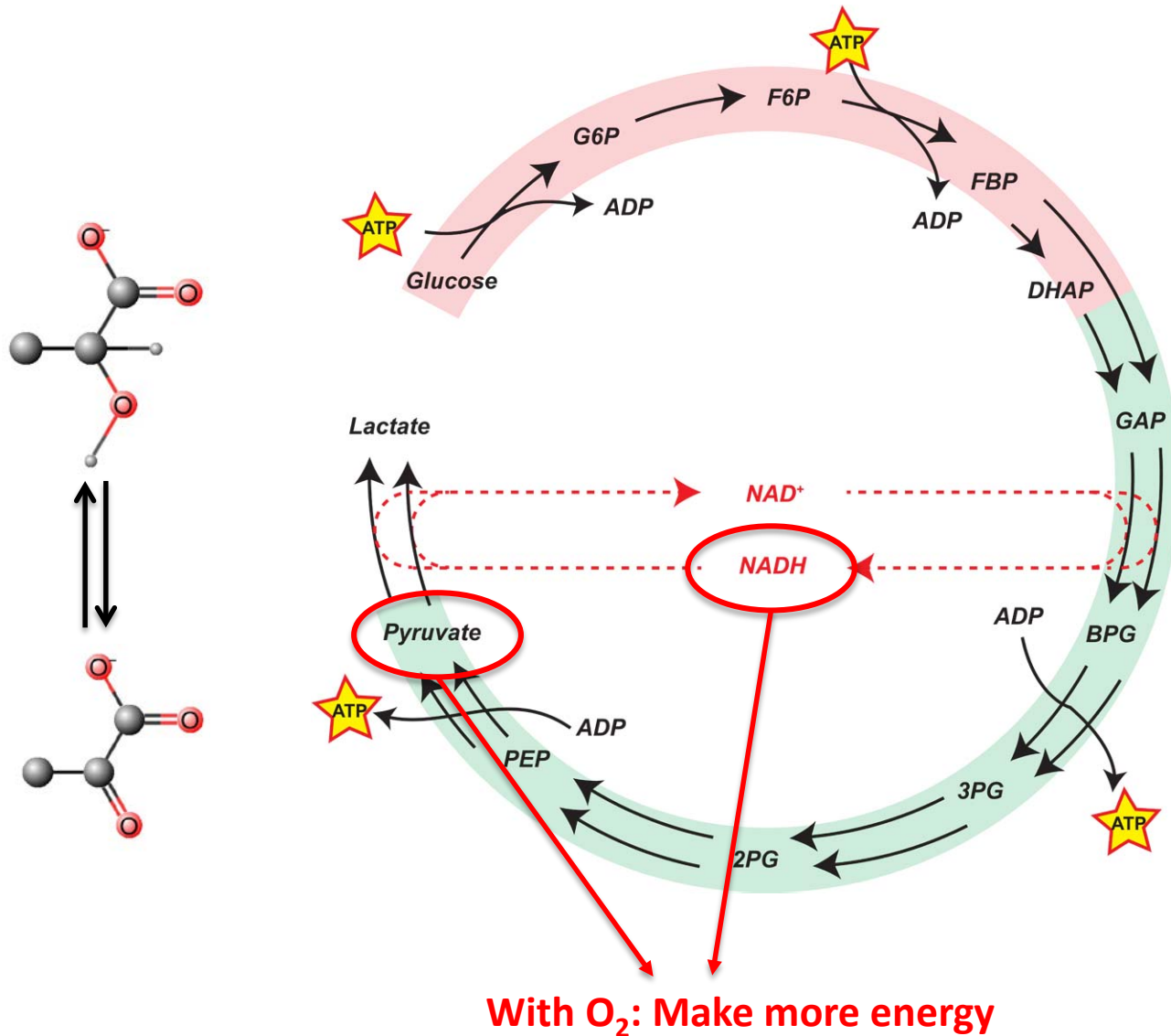
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**Hopback:** Allows additional “finishing” hops to be added to hot water – sealed and pressurized so that Alpha/Beta Acids remain in solution

**Heat Exchanger:** Cool to optimal temperature for yeast

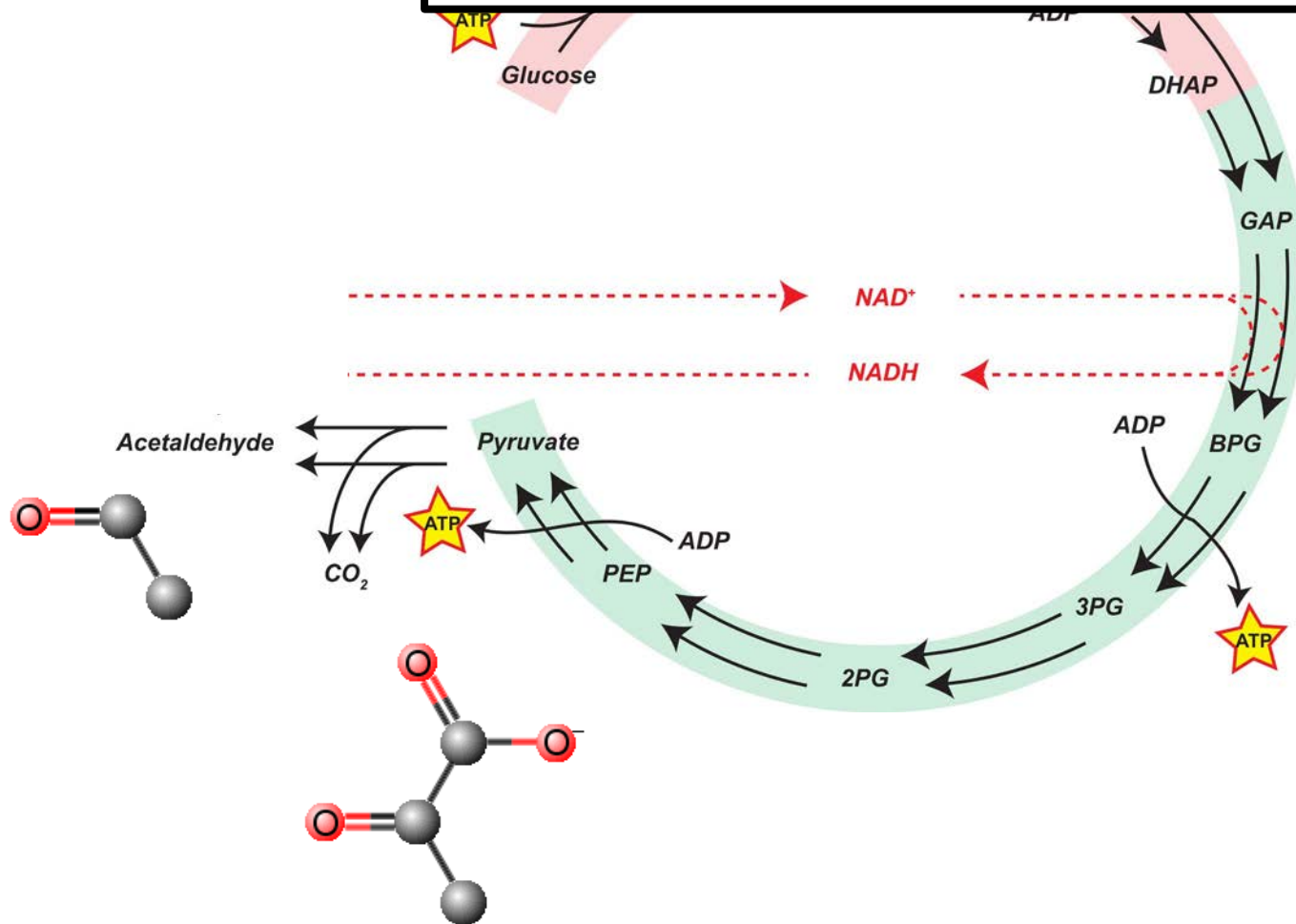
**Fermenter:** Yeast is added

# Respiration in Muscle Tissue

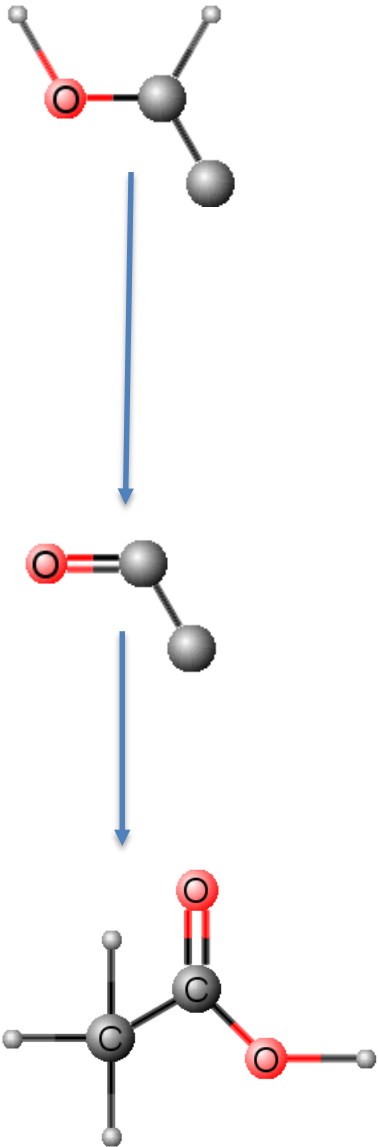


# Alcoholic Fermentation (anaerobic resp. in Yeast)

Vinegar Making: 2 steps  
1. Anaerobic – yeast produces ethanol  
2. Aerobic – acetobacter makes acetic acid

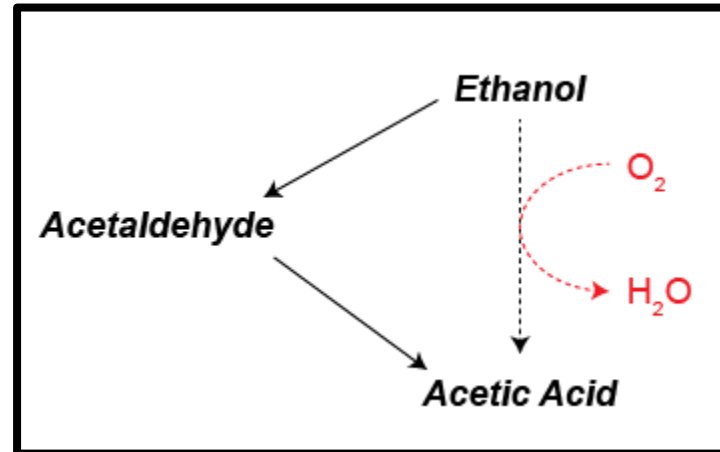


# Vinegar Production...needs bacteria and yeast



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Acetobacter (acetic acid producing bacteria)