

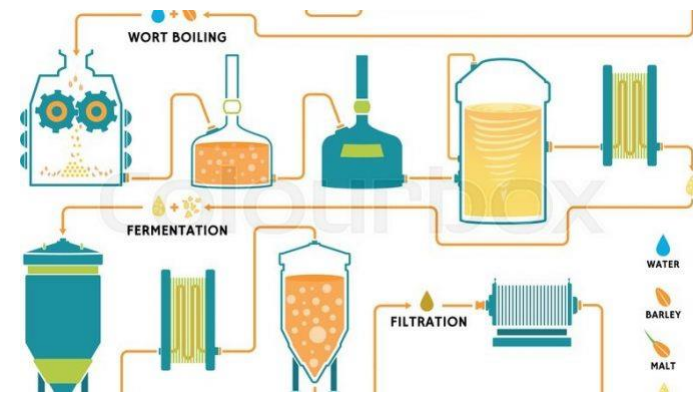
FDE 437

FERMENTATION TECHNOLOGY

Production of Beer-Part II

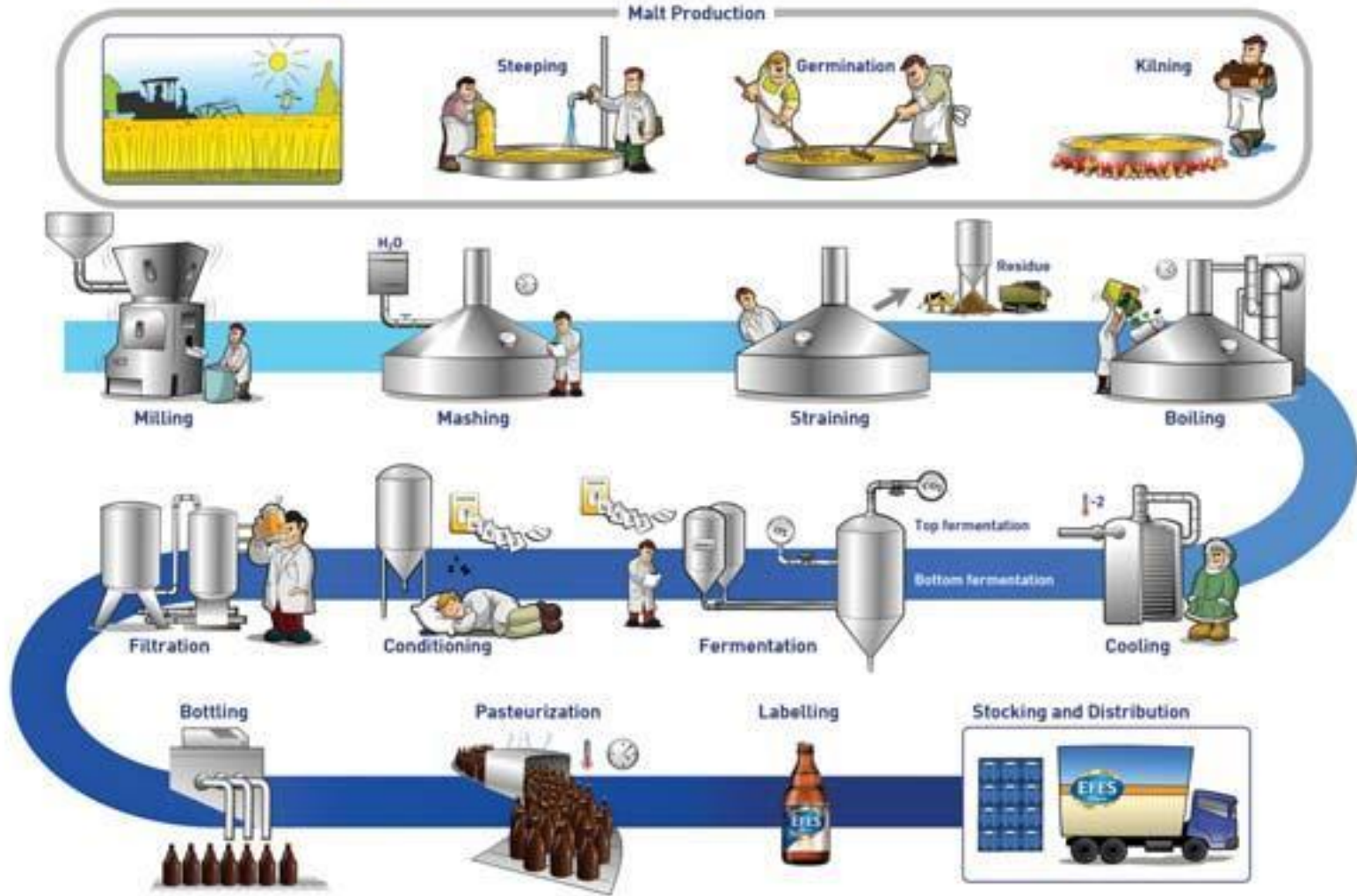


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BEER PRODUCTION PROCESS



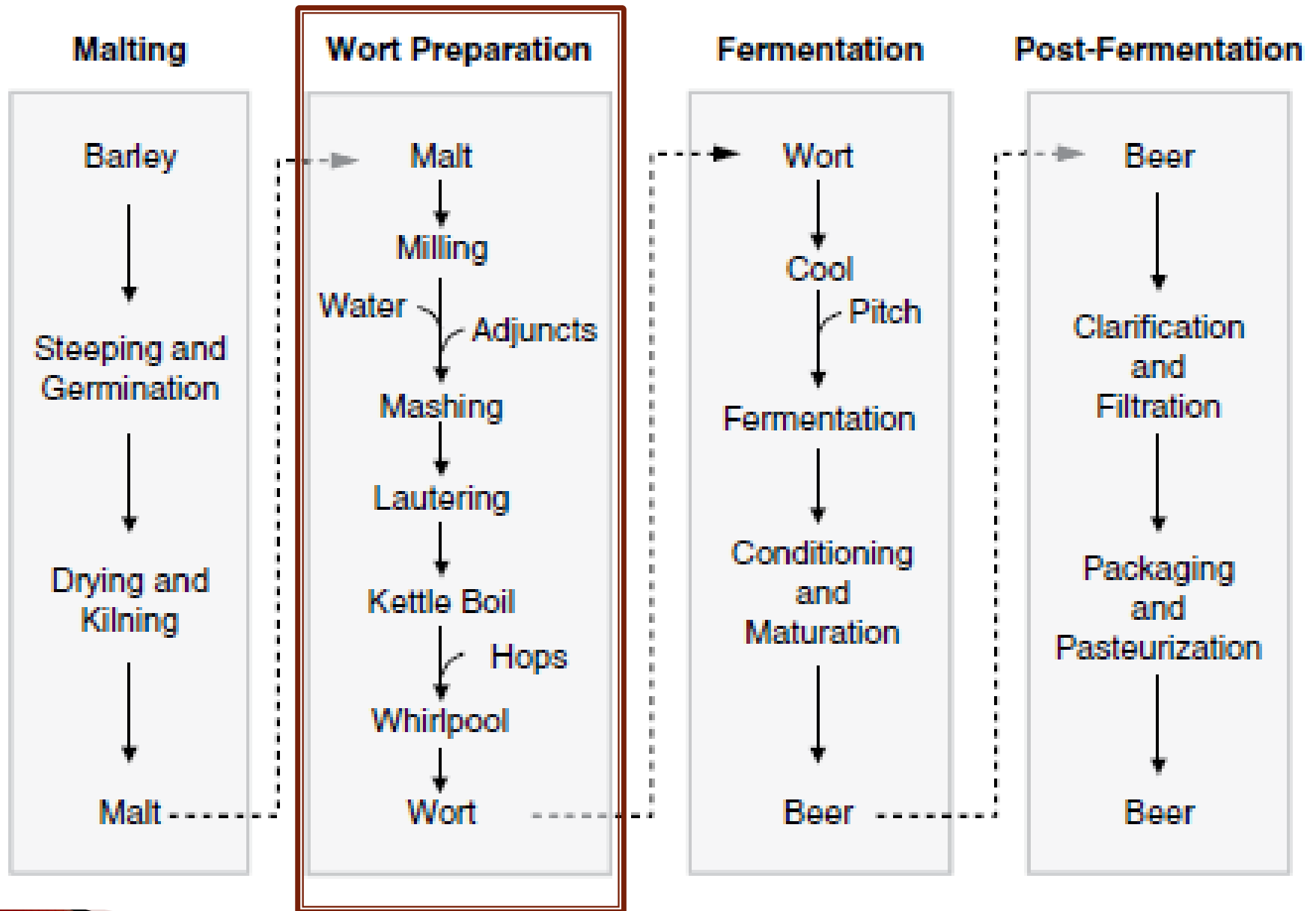
Steps in the brewing process

MALT

Steeping, Germination, Kilning

BEER

Milling, Mashing, Straining/Lautering, Boiling, Addition of hops, Cooling, Fermentation, Conditioning, Filtration, Bottling, Pasteurization



Mashing and Wort Preparation

- 1. Milling of Malt**
- 2. Mashing**
- 3. Lautering**
- 4. Boiling of wort with hops**
- 5. Separating out the hot trub (Whirlpooling)**

Starch breakdown during mashing

Temperature optima of alpha- and beta-amylases

<i>Enzyme</i>	<i>Optimum temperature</i>	<i>Temperature of destruction</i>	<i>Optimal pH</i>
Alpha-amylase	70°C	80°C	5.8
Beta-amylase	60-65°C	75°C	5.4

*Enzymes hydrolyzing starch used to be called collectively **diastase**. With increased knowledge about them, they are now called **amylases**.*

Protein breakdown during mashing

- ▶ Proteins are also hydrolyzed by malt proteases during mashing, yielding **free amino acids and small peptides**.
- ▶ The breakdown of the malt proteins, albumins, globulins, hordeins, and gluteins starts during malting and continues during mashing by proteases which breakdown proteins through peptones to polypeptides and polypeptidases which breakdown the polypeptides to amino acids.
- ▶ Protein breakdown has no pronounced optimum temperature, but during mashing it occurs evenly up to 60°C, beyond which temperature proteases and polypeptidases are greatly retarded.
- ▶ Proteolytic activity in wort is however dependent on pH and for this reason wort pH is maintained at 5.2-5.5 with lactic acid, mineral acids, or calcium sulphate.

General environmental conditions affecting mashing

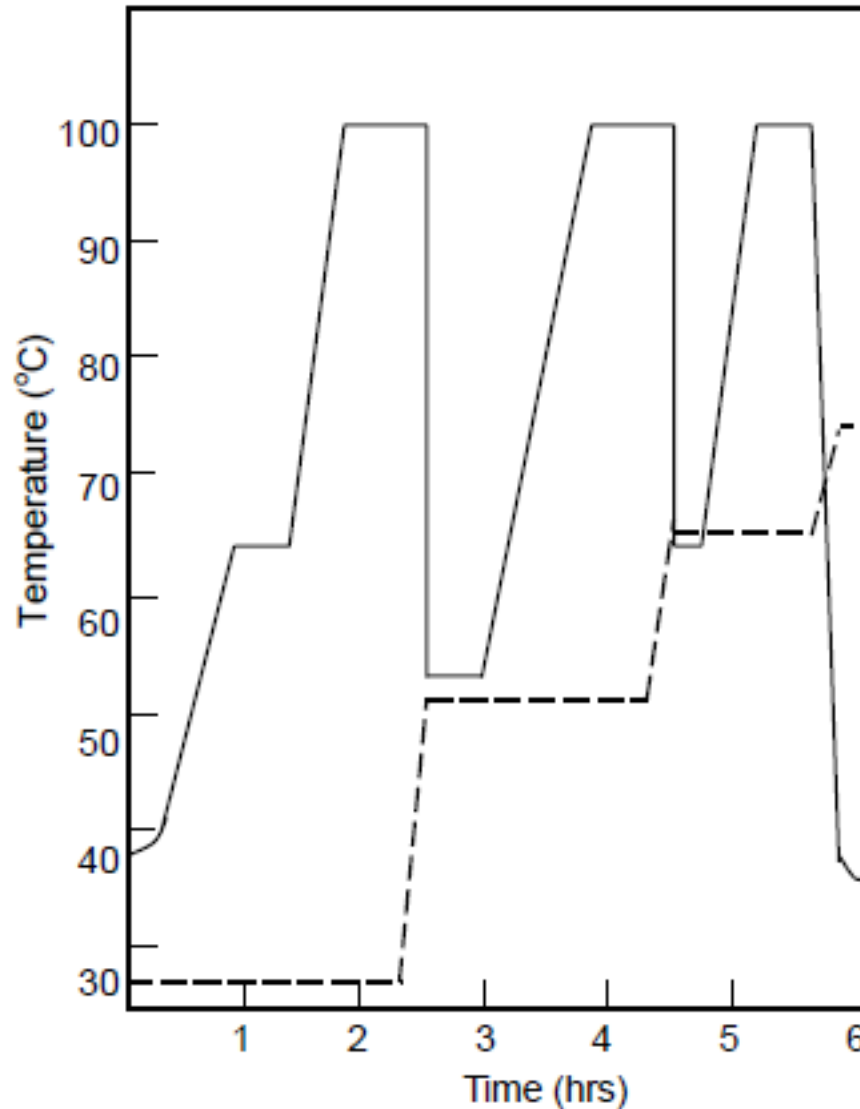
- ▶ The progress of mashing is affected by a combination of temperature, pH, time, and concentration of the wort.
- ▶ Temperature, time: When the temperature is held at 60-65°C for long periods a wort rich in maltose occurs because beta amylase activity is at its optimum and this enzyme yields mainly maltose. On the other hand, when a higher temperature around 70°C is employed dextrins predominate. Dextrins contribute to the body of the beer but are not utilized by yeast. Mash exposed to too high a temperature will therefore be low in alcohol due to insufficient maltose production.
- ▶ pH: The optimum pH for beta-amylase activity is about the same as that of proteolysis and a fortunate coincidence for the maximum production of maltose and the breakdown of protein.
- ▶ Concentration of the wort: The concentration of the mash is important. The thinner the mash the higher the extract (i.e., the materials dissolved from the malt) and the maltose content.

Mashing Methods

There are three broad mashing methods:

1. **Decoction methods**, where part of the mash is transferred from the mash tun to the mash kettle where it is boiled.
2. **Infusion methods**, where the mash is never boiled, but the temperature is gradually raised.
3. **The double mash method** in where the starchy adjuncts are boiled and added to the malt.

Three-stage Decoction Method



Broken lines indicate temperature of main mash
Unbroken lines indicate temperature of added portion of mash

- ▶ Eventually, when the brewer has determined that sufficient saccharification has occurred in the mash tun, the temperature is raised to about 75° C.
- ▶ This effectively inactivates most enzymatic activity.

Factors that play role in the selection of the mashing method;

- **the type of beer,**
- **the type of malt, and**
- **the nature of the adjunct**
- **time and energy cost**