

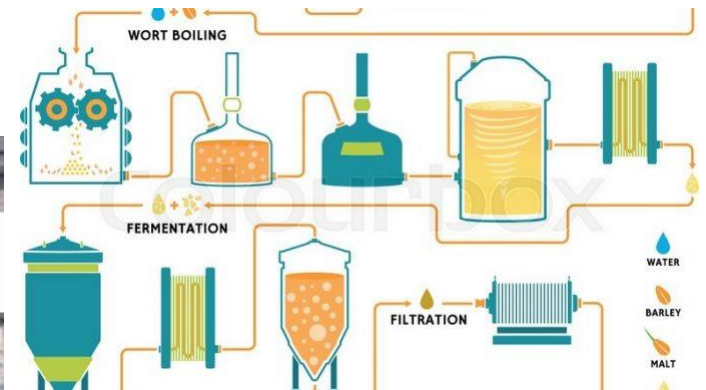
FDE 437

FERMENTATION TECHNOLOGY

Production of Beer



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Beer

Beer is a low-alcohol, carbon dioxide-containing drink obtained by alcoholic fermentation of malt wort aromatized with hops.

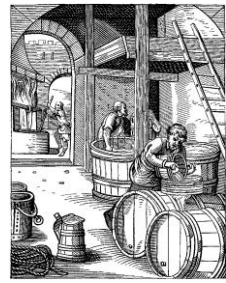
Beer is a carbonated, fermented alcoholic beverage that is usually made from malted cereal grain (especially barley), is flavored with hops, and typically contains less than a 5% alcohol content.

Definition that also expresses the production stages:

Beer is a beverage containing alcohol and CO₂, which is produced by mashing the malt (obtained by germinating and drying barley) with water under certain conditions and by boiling the wort with hops and then subjecting it to alcoholic fermentation.

Beer

(Barley beer)



- ▶ The word beer derives from the Latin word *bibere* meaning to drink.
- ▶ The process of producing beer is known as brewing.
- ▶ Its history can be traced back to between 6000 and 8000 years.
- ▶ Beer brewing from barley was practiced by the ancient Egyptians as far back as 4,000 years ago, but investigations suggest Egyptians learnt the art from the peoples of the Tigris and Euphrates where man's civilization is said to have originated.
- ▶ The use of hops is however much more recent and can be traced back to a few hundred years ago.

Beer



- ▶ Beer is the fermented extract of malted cereal grains, principally barley.
- ▶ Compared to most other alcoholic beverages, beer is relatively low in alcohol. It has an ethanol content of 2-6%.
- ▶ The highest average strength of beer (alcohol by volume (ABV) indicates the millilitres of ethanol per 100 ml of beer) in any country worldwide is 5.1% and the lowest is 3.9%. By contrast, the ABV of wines is typically in the range 11-15%.
 - According to Turkish Food Codex Beer Communiqué, the amount of alcohol by volume should be $>3 - \leq 6$.
- ▶ Beer has a distinctive flavour which arises from constituents of the malt, extracts of hops, and products of yeast metabolism.
- ▶ The final product is generally clear, with a colour that ranges from golden amber to black.
- ▶ Another distinctive property of beer is the formation of a surface layer of white foam (head) when it is poured into a glass.
- ▶ By varying the malt ingredients and process of fermentation, several styles of beer can be produced.

BEER MANUFACTURING PRINCIPLES

- ▶ Despite its ancient origins and long history, and this seemingly short list of ingredients, the manufacture of a quality beer remains a challenging task.
- ▶ In part, this is because beer making consists of several different and distinct processes that are not always easy to control.
- ▶ In addition, some steps taken to improve one aspect of the process - for example, filtering the finished beer to enhance clarity and improve stability, may also remove desirable flavor and body constituents.
- ▶ The actual brewing process involves not only the well-studied yeast fermentation, but also includes other biological, as well as chemical and physical reactions.
- ▶ It is, therefore, convenient to consider the beer manufacturing process as consisting of several distinct phases or steps.

BEER MANUFACTURING PRINCIPLES

- ▶ The primary purpose of the first general series of steps is to transform non-fermentable starch into sugars that the yeast can ferment.
- ▶ The process, which is enzymatic in nature, involves several biochemical events that begin first with the conversion of cereal grain, usually barley, into malt.
- ▶ The malt is then used to make a mash, ultimately resulting in the formation of a nutrient-rich growth medium, called wort.
- ▶ Although other grains, such as sorghum, maize, and wheat can also be malted, barley is by far the most frequently malted cereal grain.

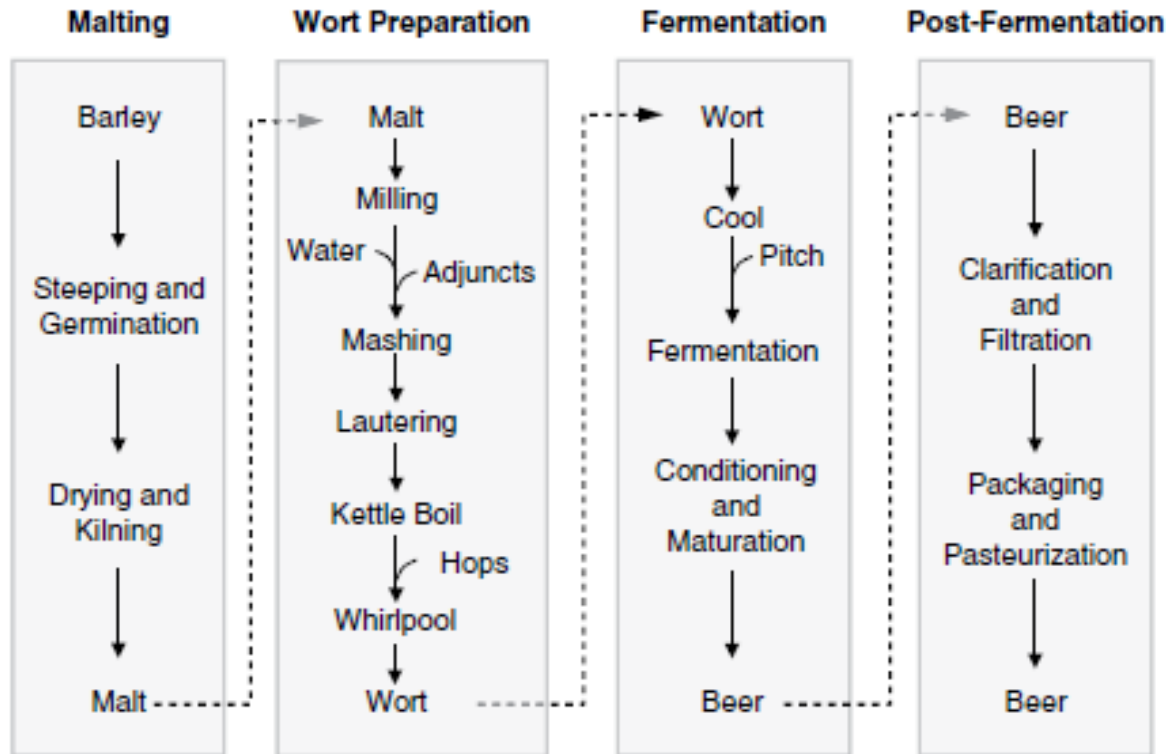
BEER MANUFACTURING PRINCIPLES

- ▶ Next, in the fermentation phase, the wort sugars, amino acids, and other nutrients are used to support growth of yeasts that have been inoculated into the wort.
- ▶ Yeast growth is then accompanied by fermentation of sugars and formation of the main end products, ethanol and CO₂ (under anaerobic conditions).
- ▶ Technically speaking, the fermentation step results in beer that could then be consumed.
- ▶ However, at this point, the beer contains yeast cells, insoluble protein complexes, and other materials that together result in a cloudy or hazy appearance.
- ▶ In addition, most of the carbon dioxide is lost during the fermentation.
- ▶ Beer at this stage is also microbiologically unstable and susceptible to spoilage.

BEER MANUFACTURING PRINCIPLES

- ▶ Therefore, additional measures are almost always taken to remove yeasts, other microorganisms, and any other substances that would otherwise affect product quality and shelf-life.
- ▶ A final phase, consisting of important post-fermentation activities (clarification, filtration, packaging, pasteurization) are among the most important, since they have a profound effect on the appearance, flavor, and stability of the finished product.

Manufacture of Beer



The beer manufacture process consists of four distinct stages:

1. malting, in which barley is converted to malt;
2. wort preparation, where enzyme and substrate extraction and reactions occur (mashing) and a suitable growth medium is prepared;
3. fermentation, where wort sugars are fermented to beer; and
4. post-fermentation, in which the beer is made suitable for consumption.

Steps in the brewing process

MALT

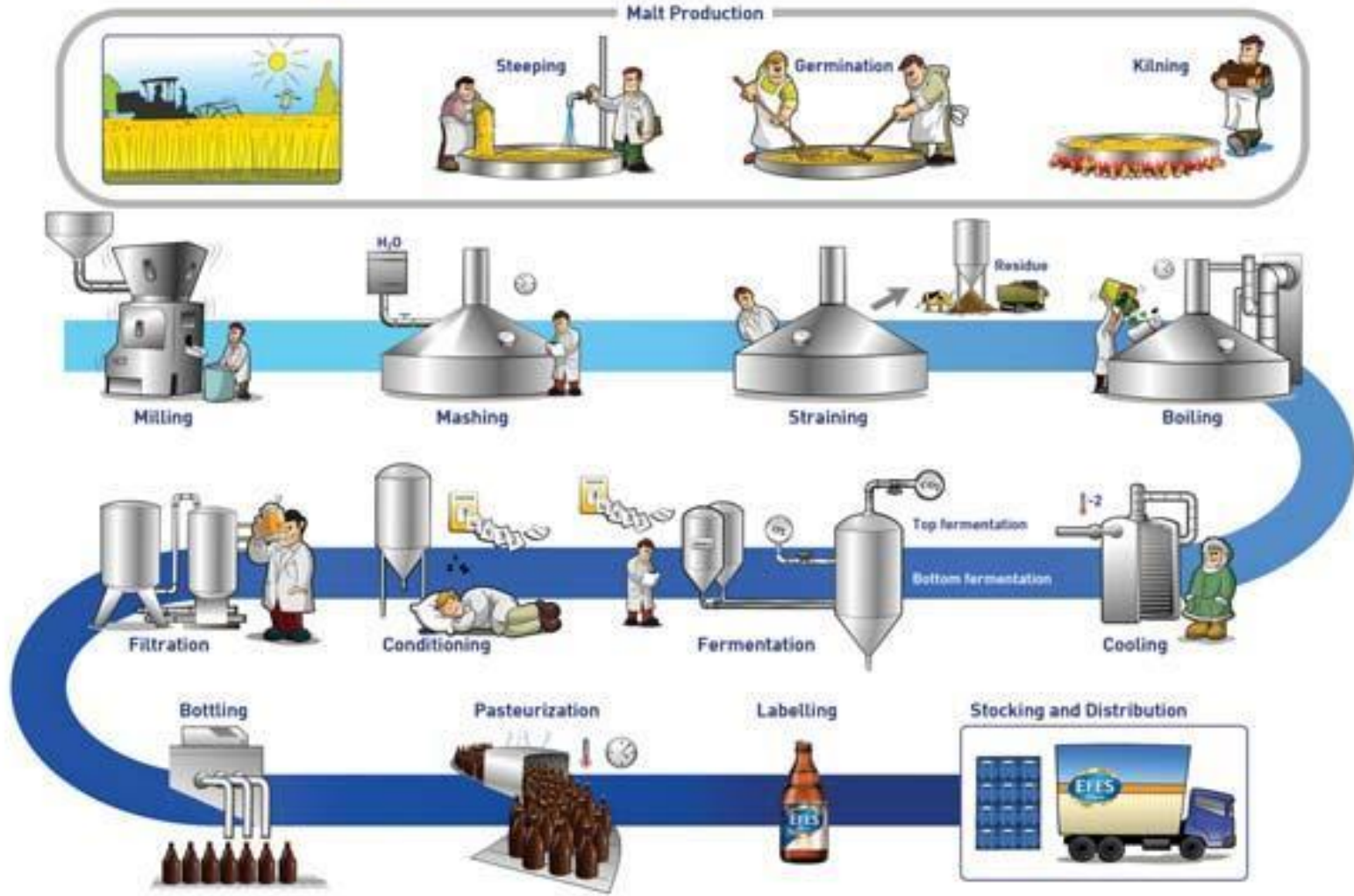
Steeping, Germination, Kilning

BEER

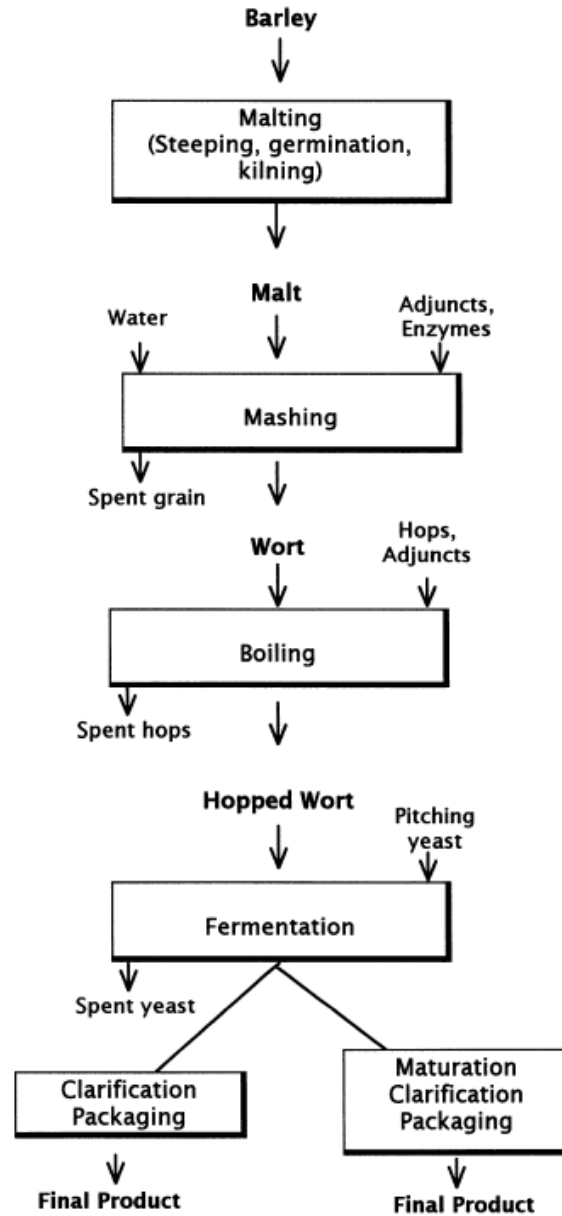
Milling, Mashing, Straining/Lautering, Boiling, Addition of hops, Cooling, Fermentation, Conditioning, Filtration, Bottling, Pasteurization

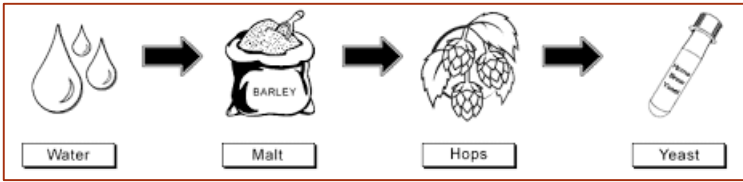


BEER PRODUCTION PROCESS



Outline of process for beer production





Raw Materials for Brewing



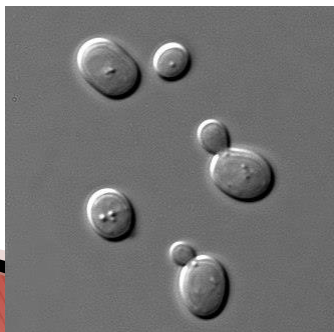
- Barley Malt



- Hops



- Water



- Brewer's yeasts

- Adjuncts

Processing barley into malt (Malting)

The three stages of commercial malting are;

(1) *steeping*, which brings the moisture content of the grain to a level sufficient to allow metabolism to be triggered in the grain;

(2) *germination*, during which the contents of the starchy endosperm are substantially degraded (*'modification'*) resulting in a softening of the grain;

(3) *kilning*, in which the moisture is reduced to a level low enough to arrest modification.