



Module 3

Food processing: general aspects

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Outline

This chapter is dealing with the main aims of food processing

- General definition
- Main aims
- Main principles of food processing
- Innovative food processes

Learning Outcomes

The objectives of this module is to:

- introduce learner to the general principles of food processing and unit operations
- give the general frame of food processing to study the more specific food processes and applications

LEARNING OUTCOMES

Upon successful completion of this module, the learner will be able to:

- Understand the general aims and classification of food processes
- Understand the specific food technologies developed in the following modules (4, 5, 6 and 7)

General objectives of food processes

- ➔ To make them suitable for human consumption and guarantee their nutritional value (remove anti-nutritional factors, enhance digestibility and bioavailability)
- ➔ To guarantee food safety (sanitising processes, removal anti-nutritional components, avoid contamination)
- ➔ Extraction, separation, selection of components from natural food sources (eg. oil from olives, sucrose from beets)
- ➔ Increase attractiveness and appealing (cooking, formulated foods,
- ➔ Increase stability over time, shelf-life



General objectives of food processes

- ➔ Increase the food convenience and its use
- ➔ Diversification (different flavours, different technological functionalities)
- ➔ Formulation by mixing different raw materials, ingredients



Main food processes classification

Processes for food transformation: these processes have the aim to significantly modify the raw materials and ingredients, as single or in combination to produce new products with different quality and nutritional attributes (eg. cheeses from milk, majonnaise from egg, oil and vinegar): e.g. fermentation, emulsification

Processes to increase food stability and preservation: these processes have the aim to modify the intrinsic characteristics of the food and/or the relative effect of environmental factors that can then inhibit or slow down the rate of degradative processes and reactions (e.g. enzymatic, chemical, physical) and/or kill microorganisms.

Processing and Unit Operations

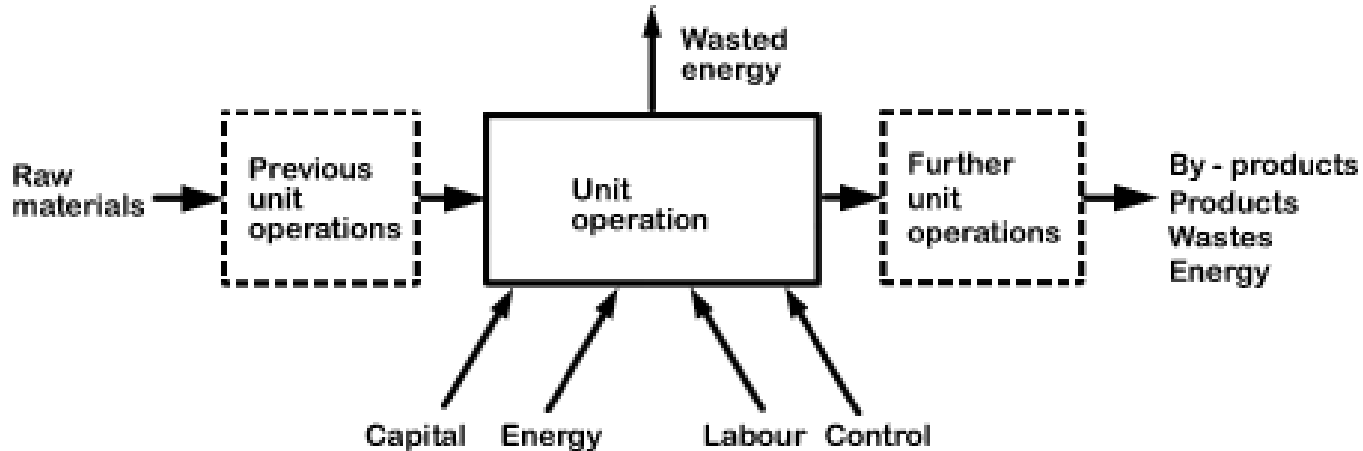
Each product to be produced actually need to undergo to a series of operations (or processing actions) that contribute to the entire process of that product

A food process is, thus, the sum of operations (**= unit operations**), activities, materials and controls that are applied to transform the raw materials and ingredients into a final product.

A «**Unit Operation**» is the technological unit at industrial level that is applied in the processing of a food.

Each Unit Operation is based on laws and general principles which are independent on the material (ingredient, raw material) used or processed. Mass and energy transfer are taken into account and based on energy and mass balance (in-, out-)

Processing and Unit Operations



Earle and Earle, <http://www.nzifst.org.nz/unitoperations/index.htm>

Classification

- Size reduction
- stabilisation
- Mixing
- Transformation
- Separation
- conditioning

Unit Operations: classification

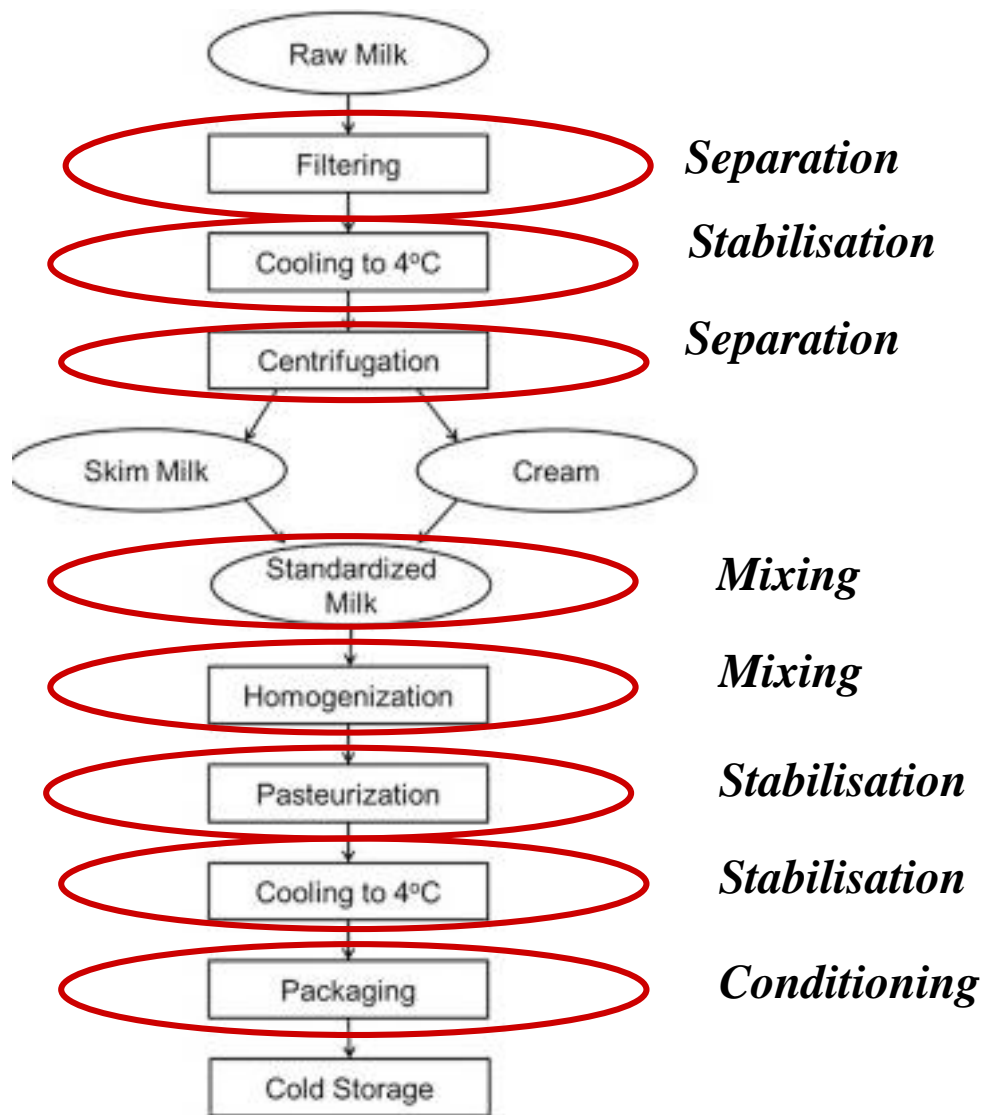
- **Size reduction:** mechanical operations aimed to break an ingredient up to its full disintegration and release of cellular materials content (eg. cutting, grinding, milling)
- **Stabilisation:** operations in which the factor causing the degradation is removed, destroyed or inhibited (enzymes, microorganisms). These can cause modifications of chemical, structural, nutritional and sensory quality attributes of the products (e.g. sterilisation, blanching, pasteurisation)
- **Mixing:** operation that lead to a uniform distribution of two or more components; new structural systems can be formed (e.g. foams, emulsions)

Unit Operations: classification

- **Transformation:** operations in which a significant change of the chemical and quality attributes occur (e.g. cooking, baking, fermentations, chemical and enzymatic processes, gelation)
- **Separation:** operations in which the components of a food material can be separated in two or more components. These include also the isolation of a single compound (e.g. distillation). Separation can be made based on physical and chemical properties (e.g. filtration, centrifugation, osmotic treatments)
- **Conditioning:** these are operations aimed to preserve the food after its production, including packaging, storage conditions (e.g. controlled atmospheres) and actions taken during distribution and transportation (cold or hot chain, chilling).

Unit Operations: examples

Figure: Flow diagram of the unit operations for pasteurized milk



Unit Operations: examples

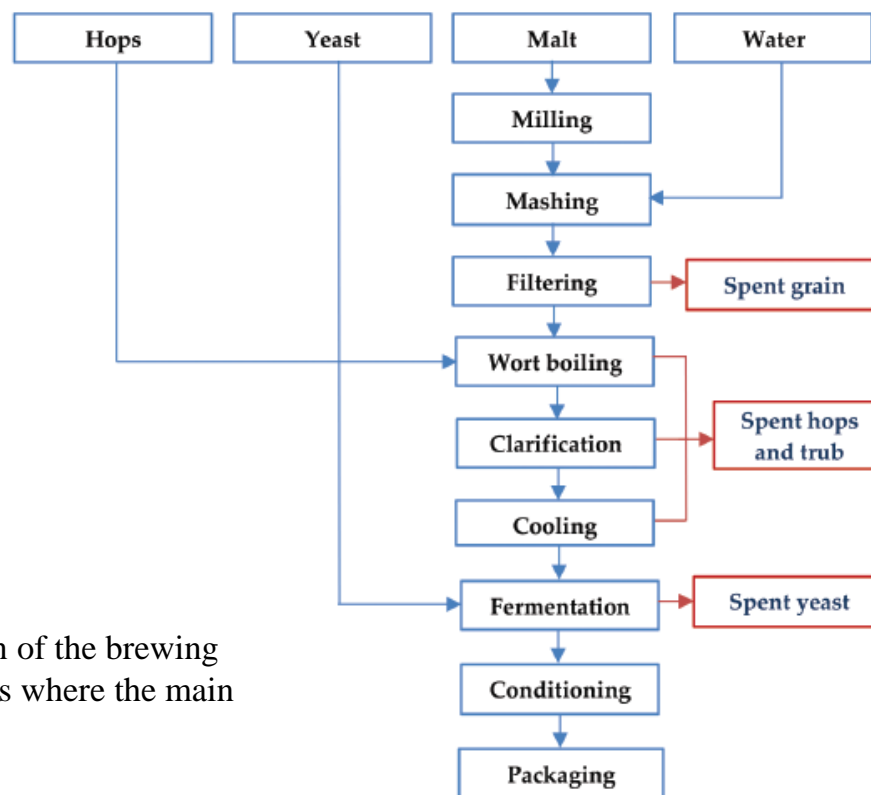


Figure: Schematic representation of the brewing process unit operations and points where the main by-products are generated.

Farkas et al., 2017, Chapter 7: Exploitation of Brewing Industry Wastes to Produce

Functional Ingredients

<https://www.intechopen.com/books/brewing-technology/exploitation-of-brewing-industry-wastes-to-produce-functional-ingredients>

Main food processes classification

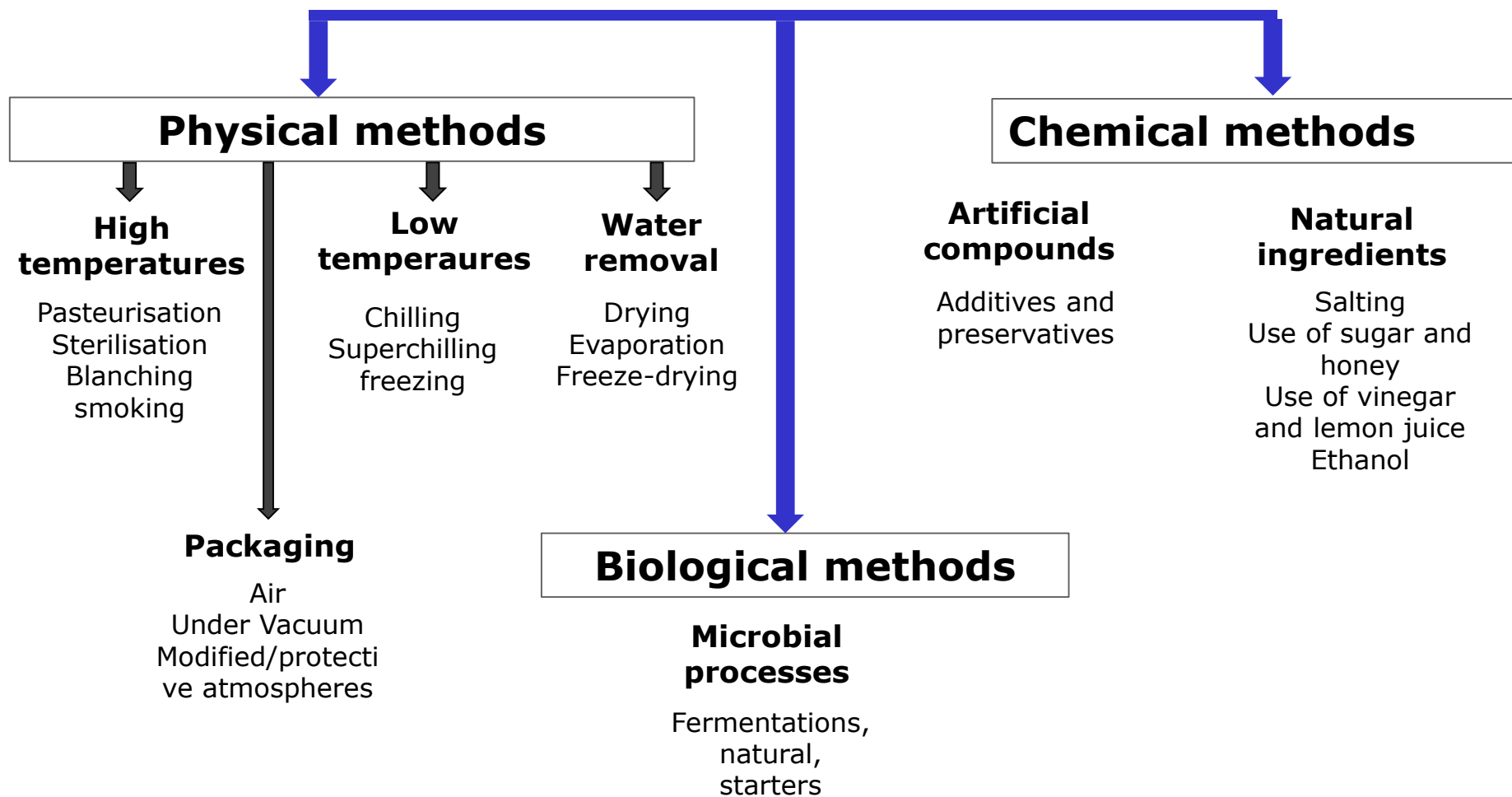
Level 1 Main aim	Level 2 Sub-groups	Level 3 Main technological/process applications
Preservation	Short-shelf-life	Chilling Mild Technologies
	Medium-to-long shelf-life	Freezing, sterilisation, drying
Transformation	Fractioning/separation	Mechanical separation (filtration) Physical separations (distillation) Chemical separation
	Size reduction	Grinding Homogeneisation
	Formulation	Mixing Emulsion
	Chemical transformations	Heat-induced reactions Enzymatic and biochemical processes (fermentations) Microbial processes

Principles of food processes

Processes and technologies have been developed based on physical, chemical and biological principles

- **Physical:** they are based on the application and/or change of physical properties of the food to such a level they inhibit or induce the removal of the factor causing the degradation. In particular: temperature (high, low), pressure (high pressure, hydrostatic, dynamic), packaging (physical barrier towards the environmental contamination), electromagnetic fields (radiofrequency, ohmic heating, microwaves).
- **Biological:** they are based on the activity of enzymes and microorganisms either naturally present or added.
- **Chemical:** they are based on the application and activity of pure chemical compounds or ingredients that modify the chemical and physico-chemical properties of the product so the degradation is reduced and/or avoided. It includes the use of additives and preservatives and of many natural compounds like salt, sugars, ethanol.

Main traditional food preservation processes



Novel food technologies

- Unconventional heating
 - ⇒ Ohmic Heating
 - ⇒ Microwave heating
 - ⇒ Radiofrequency heating
 - ⇒ Infrared heating
- High Pressure Processing (use of Pressures > 100 Mpa)
- Pulsed Electric Field
- Ultrasonics
- Pulsed Light Technology
- Pulsed X-rays
- Irradiation
- Oscillating Magnetic Field

Food categories (French classification)

On the basis of the degree of processing, processed foods for trade purposes are categorised in 5 different categories

1. Fresh foods: unprocessed raw vegetables, meat, fish, ...

2. Preserves: heat-processed foods

3. Frozen foods



4. Minimally processed foods (ready-to-eat fresh washed salads, fruits): products that do not undergo heat treatments and retain their quality characteristics. They have a short shelf-life under chilling conditions and need to be consumed within a few days.

5. Cooked-chilled ready-to-eat foods and dishes: semi-finished fruit and vegetables, already cooked, packaged and ready for consumption. They undergo thermal cooking treatment and generally packed. Short shelf-life.

References

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- Zeuthen P., Bogh-Sorensen L. 2003. Food preservation techniques. CRC Press .
- Earle R.L., and Earle M.D. Unit Operations in Food processing.
<http://www.nzifst.org.nz/unitoperations/index.htm>



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