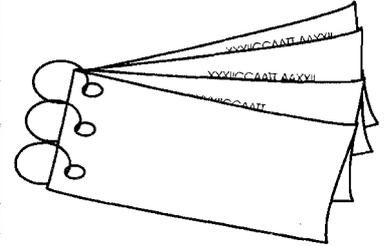


UNIT 5 FOOD PROCESSING AND PRESERVATION

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- A wide variety of methods are available to maintain and enhance the appearance and taste of food. Food processing and preservation methods create products that are convenient for consumers such as products that are ready-to-eat or require minimal preparation and cooking.
- Despite new products and the increasing reliance of consumers on processed food, the fundamental purpose of food processing remains the same — to make food available when and where it is needed.

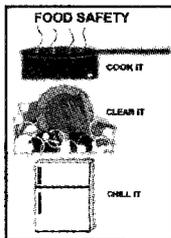
5.1 Need for Food Processing

There are several factors which promote the need for food processing. Some of the factors are as follows:

- Meets consumer expectations for food that is safe, unspoiled, nutritious, convenient, enjoyable, available in wide variety and affordable.
- Preservation accomplished by inactivating enzyme action, microbial action, oxidation as well as prevention of damage by insects, animals, mechanical causes etc.
- Nutrition is preserved or enhanced; digestibility is improved.
- Ready-to-serve convenience or prepared mixes, frozen foods.
- Variety in choices
- Affordability

5.2 What is Food Processing?

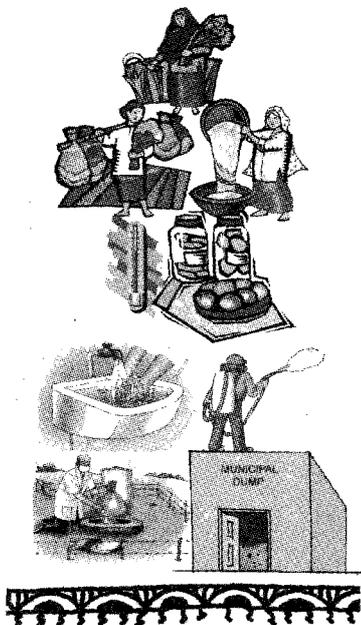
- Food processing encompasses all the steps that food goes through from the time it is harvested to the time it arrives on supermarket shelves.
- There are various levels of food processing which are:
 - Primary : Harvesting crops, slaughtering livestock, killing game or fish followed by cutting, cleaning, packing and refrigeration of these raw foods.
 - Secondary : Applying complex techniques and ingredients to create a whole array of food products from canned and frozen vegetables to fully prepared dinners, baked breads, cheeses, milk, chocolate bars, biscuits, convenience meats and a variety of other products.



Main Methods of Secondary Food Processing

The following table summarizes the major methods of food processing at the secondary level:

Method	Description
1. Heating	<p><i>Pasteurization:</i> At least 72°C for 15 seconds to kill most food-borne pathogens and then quickly cooling to 5°C. Food not totally sterilized; refrigeration required, shelf life limited.</p> <p><i>Sterilization:</i> At least 120°C for a couple of seconds followed by rapid cooling to kill most microbes and inactivate enzymes. Significantly increases shelf life; reduces need for refrigeration in unopened packages.</p>
2. Cooling	Refrigeration, freezing maintain food at controlled, low temperatures to keep enzymes inactive and inhibit the growth of microbes. Temperature control critical through transport, retail, sale and storage at home.
3. Drying	Produces stable foods by reducing water content, denying microbes the environment needed for reproduction
4. Smoking	Dries food, adds extra flavour
5. Fermentation	Process by which microbes produce alcohol or acid, which act as preserving agents
6. Food additives	Prevent spoilage, rancidity, promote stabilization
7. Pickling	Use of vinegar to lower pH
8. Addition of sugar or salt	Addition of large quantities of sugar inhibits growth of microorganisms by making water unavailable to them.



5.3 Types of Processing Methods

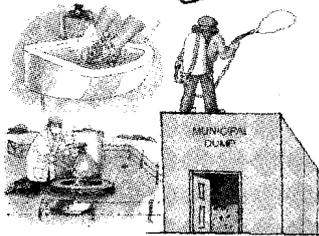
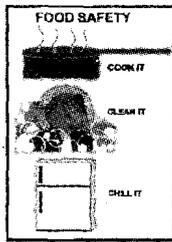
The various methods of food processing are listed in the following table:

Ambient Temperature Processing	Processing by Application of Heat	Processing by Removal of Heat
<ul style="list-style-type: none"> ● Size reduction ● Mixing and forming ● Separation and concentration <ul style="list-style-type: none"> – Centrifugation – Filtration – Extraction – Membrane concentration (Ultra Filtration) ● Bio-processing (Pickling, Fermentation and Enzyme technology) ● Irradiation ● Pulsed electric field processing ● High pressure processing ● Processing using pulsed light ● Processing using ultra sound 	<ul style="list-style-type: none"> ● Heat processing using steam or water <ul style="list-style-type: none"> – Blanching – Pasteurization – Heat sterilization – Evaporation and distillation – Extrusion ● Heat processing using hot air <ul style="list-style-type: none"> – Dehydration – Baking and roasting ● Heat processing using hot oils <ul style="list-style-type: none"> – Frying ● Heat processing by direct and radiated energy ● Dielectric heating (micro wave and radio frequency heating) <ul style="list-style-type: none"> – Ohmic heating – Infrared heating 	<ul style="list-style-type: none"> ● Chilling ● Controlled or modified atmosphere storage and packing ● Freezing ● Freeze drying and concentration

5.4 Food Preservation Methods

- Food preservation refers specifically to the processing techniques that are used to keep food from spoiling. Spoilage is any change that makes food unfit for consumption and includes chemical and physical changes such as bruising and browning, infestation by insects or other pests or growth of microorganisms such as bacteria, yeasts and moulds.

- Some food preservation techniques destroy enzymes, proteins that are present in all raw foods which are responsible for the chemical and physical changes that naturally occur after harvesting.
- Food preservation techniques also help eliminate the moisture or temperature conditions that are favourable for the growth of microorganisms.
- As they multiply and grow, microorganisms are capable of causing food-borne illness. They also break down foods, producing unpleasant changes in taste, texture, and appearance—changes that we recognize as spoilage.
- The various methods for preserving foods are as follows:



- Curing and smoking;
- Drying: Sun-drying, hot air drying (blast of hot air), freeze drying (frozen food in a vacuum chamber to draw out water);
- Pasteurization;
- Sterilization;
- Canning: Heating, in air tight, vacuum-sealed containers; process removes oxygen; destroys enzymes involved in food spoilage; kills most microorganisms present in food; popular because already partially prepared and cooked; canning affects colour, texture, flavour, nutrient content of foods (loss of water-soluble vitamins).
- Additives: Improve appearance and taste; maintain or improve nutritive value; maintain freshness and help in processing and preparation; prevent or slow chemical changes and microbial growth; use of anti-caking agents, humectants, emulsifiers, stabilizers and thickeners.
- Freezing and Refrigeration: Refrigeration (0 to 4°C) advantageous because it causes no chemical or physical changes; Freezing (=0°C) allows longer storage inhibiting enzyme activity and microbial growth to a greater degree; methods of freezing include blast freezing (constant steady stream of cold air = - 40°C in a tunnel or cabinet), scraped heat exchange (product scraped against cooled surface and immediately scraped away), cryogenic freezing (liquid nitrogen or carbon dioxide sprayed directly on small food items causing instant freezing).
- Controlled Atmosphere Storage: Storage in sealed warehouses where humidity and temperature are closely controlled, composition of gases in the atmosphere is altered to minimize spoilage; usually oxygen concentration reduced, carbon dioxide increased, ethylene removed to

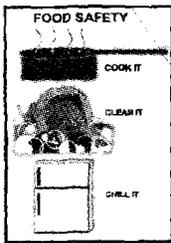
prevent ripening – if ripening is required ethylene may be added.

- Aseptic Packaging: Heat sterilization of food where package and food are sterilized separately unlike in canning; this helps foods to be sterilized more rapidly at low temperatures and enables use of hydrogen peroxide to sterilize containers such as plastic bags and foil-lined cartons which would be destroyed by heat sterilization; such containers cost less and also weigh less reducing transport costs.
- Irradiation: Microwave cooking uses non-ionizing radiation radio waves with shorter wavelengths and higher frequencies; cause water and other polar molecules to vibrate 25 billion times per second (Causing heating through molecular friction). Irradiation means exposure to radiation or radiant energy- gamma rays, X rays or electrons; used for prevention of sprouting; killing or sterilizing insects, retarding of ripening and ageing of fruits and vegetables, prolonging shelf life, preventing food-borne diseases by reducing number of viable microorganisms.
- Bioprocessing: Fermentation and use of enzymes; three steps in process – acquisition and pre-treatment of raw materials, incubation to allow bioprocess to take place and a product recovery/ post-processing phase; enzymes catalyze a number of specific reactions producing changes in food constituents leading to enhancement of texture, safety, appearance, nutritional value and flavours in foods.

5.5 Effects of Processing Treatments

- Many operations, especially those that do not involve heat, have little or no effect on the nutritional quality of foods e.g. mixing, cleaning, sorting, freeze-drying.
- Unit operations intentionally separating components of foods alter nutritional quality of each fraction compared with raw material.
- Blanching and drip losses from roasted or frozen foods causes unintentional separation of minerals, water-soluble vitamins and sugars.
- Heat processing changes nutritional properties of foods e.g. gelatinization of starches, coagulation of proteins, destruction of anti-nutritional compounds such as trypsin inhibitor in legumes.
- Heat also destroys some heat-labile vitamins, reduces biological value of proteins (owing to destruction of amino acids or maillard browning reactions), promotes lipid oxidation (and consequent degeneration/ conversion to toxic compounds).

- The main advantages of heat processing include improvement of taste and flavour, preservative effect producing shelf-stable foods, improvement in availability of some nutrients.
- The process of blanching inactivates plant enzymes that destroy desirable colour, texture, flavour and nutrients. It also kills surface microorganisms. Steam blanching is better than water blanching as there is less loss of water-soluble constituents.
- Drying techniques reduce the amount of free water in common products. Although dried foods have a long shelf life, there is substantial loss of nutrients such as vitamin C and carotene.
- Chill processing maintains food in as fresh or raw condition as possible helping to preserve sensory characteristics and nutritive value.
- Refrigeration when associated with other methods like pasteurization, humidity control and modified atmosphere packaging (MAP) can dramatically extend shelf life e.g. pasteurization and refrigeration extending shelf life of dairy products and controlled humidity with MAP extending shelf life of fruits and vegetables.



5.6 Minimal Processing

- Minimal processing leads to 'minimal' change in chemical nature of food but hazards from pathogenic organisms may not be completely eradicated if proper care is not taken.
- Refrigeration does not hinder growth of psychrophilic bacteria. Sous-vide processing improves on this by vacuum sealing fresh food in heat-stable, high barrier bags or plastic pouches to remove all air and then pasteurizing, rapidly chilling and storing in chilled condition.
- Some of the developments in the area of non-thermal processing include high electric fields, oscillating magnetic field pulses, intense light pulses and ultrahigh hydrostatic pressure.

Key Terms

Food additives : In its broadest sense, a food additive is any substance added to food. Food additives are chemicals that are added to food in small amounts which affect the characteristics of any food directly or indirectly.

Smoking : Smoking, a flavouring technique and preservation method, is commonly used with curing. Smoking involves cooking meat or fish very slowly over a low wood fire.

Curing : Curing involves adding some combination of salt, sugar, spices, vinegar, or sodium nitrite to animal foods .

Food processing : Food processing encompasses all the steps that food goes through from the time it is harvested to the time it arrives on supermarket shelves.

Blanching : Heating food, such as raw vegetables, for a certain length of time to stop the action of enzymes.

Fermentation : Biological sequence of enzymatic reactions that convert sugars to carbon dioxide and alcohol in the absence of free oxygen. It is the process by which microbes produce alcohol or acid, which act as preserving agents.

Preservation : Ways of extending the shelf life of foods by controlling the temperature, pH or water content, which inhibits the growth of microorganisms or the action of enzymes.

Sterilization : The complete destruction of all microorganisms, including spores. It can be achieved by dry heat or steam under pressure.



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