Levels of Production
**H1.1:** Explains manufacturing processes and technologies used in the production of food products.

| Characteristics of equipment used in different types of production and the factors influencing their selection | describe the processing techniques, equipment, storage and distribution systems used in industry and compare with those used domestically |
Levels of Production

All food manufacturers process and package foods so that it may safely be consumed.

The organisations manufacturing packaged food products vary in their scale of production and the extent to which their systems are automated.

The food processing industry has been one of the slowest industries to adopt computerised systems. This is mainly due to cost.
Processing Equipment

- Food manufacturing equipment varies in size and shape depending on the amount of food to be produced.
- The equipment used in food manufacturing plants completes the same tasks and as appliances and utensils in a domestic kitchen - just on a much larger scale.
- The design of an industrial kitchen needs to be stronger, more durable, hygienic and efficient.
- Industrial equipment must also be energy efficient. Gas is primarily used as it is both efficient and cost effective.
Processing Equipment

- Food Technologists are in charge of managing processes along the production lines.
- They should have an adequate knowledge of the chemical, microbiological and biochemical characteristics of food.
- Equipment is designed to complete the production processes, called unit operations.
- Skilled tradespeople (machinists, electricians) work on the production floor, monitoring the operation of equipment.
- As the new equipment and processing in food manufacturing becomes more automated, the number of unskilled jobs are becoming more limited.
Unit Operations

Processes that occur in a food manufacturing plant.
Manufacturers processing foods on an industrial scale receive their raw materials in bulk. These raw materials are transported by suction through stainless steel pipes into storage vats. A computer controls the pumping of the correct quantities for each batch being made. This is efficient and hygienic.
Transporting liquid, powdered or lightweight solids via stainless steel pipes minimises the risk of contamination. These transport systems are sealed so nothing can get in. They also have built-in cleaning systems that can be activated by the computer. As stated, they are efficient and hygienic, but expensive.
Separation Processes

Separation can be:

- **Physical Separation**: For example; removing skin from an orange.
- **Chemical Separation**: For example; adding chemicals for the separation of whey from the fat and protein in the making of cheese.

There are **THREE** main physical separation processes used in food manufacture; sieving, filtration and centrifuging.
**Physical Separation Processes**

- **Sieving**: process which involves shaking powders/loose solids through mesh to separate out larger particles. It is used to separate foreign substances, such as stones from cereal grains.

- **Filtration**: process of passing liquids through a filter to remove any solid particles. Filtering systems are used to separate cheese curd from water in the manufacture of cheese.

- **Centrifuge**: equipment in which a product is separated into particles of different weights by the use of a spinning bowl. Used to separate cream from whole milk and pulp from orange juice.
Centrifuge

1. Feed: e.g. whole milk enters
2. Light liquid: e.g. skim milk
3. Heavy liquid: e.g. cream

Rotating at high speed

Light liquid

Solids

Heavy liquid

Feed
The basic purpose of chopping, grinding or milling any raw material is to reduce its size.

A reduction in size is necessary to make a raw material easier to handle, to decrease the size of the raw material or to make a completely new product.

**Mill:** A mill is a machine that crushes raw materials between rollers or rotating plates.

The style of mill used depends on the characteristics of the raw material. The mill is completely computerised with all quality control detectors/tests completed online. It operates 24/7. Wheat is milled and turned into products such as; flour, bran, semolina.
Mixing is a process that ensures all the ingredients are evenly distributed throughout a batch of product.

The type of mixer used depends on the size of the batch and the materials being mixed. For instance; different mixing arms are used for bread and cake mixes.
Heat can be transferred to food in three different ways:

1. **Conduction**: Food is heated by direct contact with a hot surface.
2. **Convection**: Food is heated by the movement of liquid, around the food.
3. **Radiation**: A heat source directly above the food heats the food without touching it.

Heating of food products using steam is the most frequently occurring process in the food production plant.
BLANCHING

Blanching is the process of immersing food in boiling water (usually a vegetable or fruit). The food is removed after a brief time and plunged into iced water or placed under cold running water to stop the cooking process.

In the industrial setting, blanching tanks are used for cut vegetables prior to freezing. They are blasted with steam or passed through hot water (88-100 degrees celsius) to destroy enzymes and prevent browning.
HTST (High Temperature, Short Time): A process where food is heated to a high temperature for a short time in order to destroy pathogenic bacteria. For instance; pasteurisation of milk.

The milk is heated using a heat exchanger. It is heated very quickly to **72 degrees celsius for 15 seconds**.

UHT (Ultra Heat Treatment): This is used to create UHT milk which does not require refrigeration. The milk is heated to 140 degrees celsius for a few seconds to kill all heat resistant bacteria.
Heat exchangers allow liquid foods to reach high temperatures within seconds, significantly reducing processing times.
Canning involves preserving food in metal containers.

Canning is a heat process which sterilises the food within the package, giving it a shelf-life of more than two years.

Hydrostatic retorts use steam to heat the cans as they move through the retorts chamber. As the cans constantly move during this process, the food rotates within the package, lowering the cooking times required. Cans are cooled and their seals checked before being dried and labelled.
Baking is the process of using radiant heat in an oven. The most commonly used type of oven in the food industry is known as the tunnel oven. It is used to bake breads, cakes and biscuits. The oven may be heated by gas-fired burners from above and below the conveyor. Some commercial bakeries also use microwave heating to remove the last remaining moisture from cracker biscuits after they have been baked.
Evaporation

- Evaporating involves changing the liquid in a food to steam or vapour.
- The temperature of the product is raised to boiling point and held at this temperature until the desired concentration is reached.
- An evaporator is used to convert tomato juice into tomato paste and when making condensed milk.
Cooling Processes

**Chilling**

- Cooling is the reduction of temperature of a production. It is used to slow down the activity of micro-organisms and enzymes, and therefore, slow the process of food spoilage.
- The refrigerator is a commonly used cooling equipment.
- Blast chillers are also used by manufacturers.
- Cooling is commonly used in confectionary manufacture and in fruit and vegetable cold storage warehouses.
Freezing

- The fastest method of freezing is desirable in order to reduce the size of ice crystals that are formed.
- There are FOUR categories of freezing equipment for food products;
  - Air Blast Freezers
  - Plate Freezers
  - Tunnel Freezers
  - Immersion Freezers
Fast freezing

cell wall

small ice crystals contained within the cell wall

Slow freezing

breaks in the cell wall cause loss of liquid when ice crystals thaw.
Air Blast Freezers

- Air blast freezers use cold air at high velocities. It is used on meat, frozen meals and cakes.
Plate Freezers

- Plate freezing involves bringing the food product in direct contact with plates that are maintained at the desired freezing temperature.
- Used for freezing fish, meat products and vegetables.
Tunnel Freezers

- Used for quick freezing.
- Food is placed on a mesh belt where it is moved through a tunnel and blasted with cold air.
- It is used for high volume products on automated production lines.
Immersion freezing involves bringing the product into direct contact with a low temperature refrigerant, such as brine or liquid nitrogen. The temperature of liquid nitrogen is -196 degrees celsius. It is referred as snap freezing. Stick ice creams are immersed in brine to quick freeze and berries are snap frozen in liquid nitrogen.
Dehydration

- Dehydration is a method that provides convenient food for consumers.
- Dehydration reduces the moisture content of the product to a level that limits microbial growth or other reactions.
- The moisture is removed by heating the product.
- All foods must be in optimum condition before being dried or their colour and flavour will be distorted as a result of enzyme activity during processing.
- Most fruits and vegetables are blanched prior to drying to deactivate surface enzymes and preserve colour.
Cabinet Drying involves placing foods such as herbs, fruits and vegetables on wooden trays into a confined space where hot air is circulated.

The process is slow.

This is similar to drying foods in a domestic oven.
Tunnel dryers are used in automated production lines.
Food moves along a conveyor through a narrow, enclosed space.
Tunnel drying is used for fruits, vegetables and meats.
Sun Drying

- Sun drying is the oldest form of drying and is still used in many countries to domestically preserve food.
- Because sun drying is a slower method of processing, the enzymes in the food are active for longer and the food develops a stronger flavour and darker appearance.
- Sun drying is also more labour intensive as the food needs to be turned.
Spray Drying

- Spray drying is a technique in which the product being dried must be in the form of a liquid. The liquid food is forced through an atomiser that emits a fine spray of liquid into a how draught.
- Instant drying occurs and fine powders are formed.
- Instant coffee, powdered milk and food additives (flavours) are produced in this way.
● A more expensive form of drying foods.
● In the first stage, food is frozen using normal fast freezing techniques. In the second stage, the temperature of the food is gradually raised under low pressure. This causes the ice to sublime.
● Sublimation is the conversion of a solid directly into gas without going through the liquid phase.
● The food is lighter and easier to transport and it does not require cold storage. It also maintains the texture of the food.
● Some coffees, teas, herbs, meats, milk, some soups and vegetables are dried in this way.
Freeze Dried: 97%
Dehydrated: 60%
Canned: 40%

HOW FREEZE DRYING PAYS FOR ITSELF

FREEZE DRIED FOOD up to 25 years
DEHYDRATED FOOD up to 4 years
CANNED FOOD up to 3 years
FROZEN FOOD up to 2 years