CONTENTS

Unit 1

PREPARATION OF JAM, JELLY AND KETCHUP

Learning Outcomes

- Gaining knowledge about jam, jelly and ketchup preparation
- Obtaining the skill of preparing jam, jelly and ketchup
- Training the students to become entrepreneurs in the field of jam, jelly and ketchup making

1.1. Selection of Fruits for Jam, Jelly and Ketchup Making

i. Fruits and vegetables should be absolutely fresh and Select good quality ripe fruits.

ii. Fruits should be ripe, but firm, and uniformly mature.

iii. Over-ripe fruits should be rejected because they are infected with microorganisms and give a poor quality product.

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iv. Unripe fruits should be rejected because they generally shrivel and toughen.

v. All vegetables except tomatoes should be tender.

vi. Tomatoes should be firm, fully ripe and of deep red colour.

vii. Fruits and vegetables should be free from dirt.

viii. They should be free from blemishes, insect damage or mechanical injury.

1.1.1 Quality of fruits and vegetables based on appearance, colour, texture, flavour and maturity etc

Harvesting of fruits and vegetables at appropriate maturity level is important and one of the basis of close observations, maturity indices is fixed for various commodities. These maturity indices are based on physicochemical characteristics, like their weight, fullness of finger, total soluble solids, sugar to acid ratio and certain arbitrary units like appearance, colour, texture, flavour. heat units and period after blooming.

1.1.2 Fruit and vegetable washing

Fresh fruits and vegetables are a healthy way to incorporate vitamins, minerals, fibre, and antioxidants into the diet. Before using fresh fruits and vegetables, it has long been a recommendation to rinse them well with water to remove any unwanted residues from their surfaces. Washing fresh fruits and vegetables in cool water before eating them is a good practice when it comes to health hygiene and food safety. Washing fruits and vegetables before storing them may create an environment in which bacterial growth is more likely.

Fruit and vegetable washing machines

In the field of food processing, it is very important to configure a good fruit and vegetable washing machine. A high-quality machine will remove all foreign objects on the surface of the fruits and vegetables and make them available for high quality puree, juice, paste and jam.

i) Brush washing machine:

This is used to wash oval and round fruits and vegetables like mango, carrot, pineapple and beetroot.

Notes

ii) Drum washing machine:

This is used to wash cherry, ginger, walnuts and almonds.

iii) Air bubble washing machine:

This is used to wash tomato, apple, banana and passion fruit.

1.1.3 Sorting of fruits and vegetables

Sorting and/or screening (dry and wet) are/is the separation of raw materials and/or food slurries into categories on the basis of shape, size, weight, image and colour. The size sorting and dry cleaning of agricultural raw materials separates solids into two or more fractions on the basis of different sizes, usually by sieving or screening. Size sorting is especially important for food products which have to be heated or cooled, as large differences in size might lead to an over- processing or under-processing of the product.

Sorting also allows the separation at first sight of some (undesirable) additional material (e.g. leaves, stones) or inappropriate raw material (immature or rotted berries), and is aimed at ensuring preserving only good quality fruit, is passed through for further processing.

For size sorting, various types of screens and sieves, with fixed or variable apertures, can be used. The screens may be stationary, rotating or vibrating. Shape sorting can be accomplished manually or mechanically with, for example, a belt-or roller-sorter. Weight sorting is a very accurate method and is therefore used for more valuable foods (cut meats, eggs, tropical fruits, certain vegetables). Image processing is used to sort foods on the basis of length, diameter, and appearance, i.e. surface defects and orientation of food on a conveyor. Colour sorting can be applied at high rates using microprocessor-controlled colour sorters.

Activity 1:

Sort the following according to size, ripeness, firmness and skin colour

a) Tomato

b) Apple

c) Guava

d) Grapes

e) Strawberry

1.2. Peeling and Destoning of Fruits

1.2.1 Objective and Application of Peeling

The objective of peeling is to remove unwanted or inedible material from vegetable raw materials. This improves the appearance and taste of the final product. During peeling, peeling losses need to be minimised by removing as little of the underlying food as possible but still achieving a clean peeled surface.

Field of application

Peeling is applied on an industrial scale to fruits, vegetables, roots, tubers and potatoes.

Description of techniques, methods and equipment

Various methods for peeling exist: flash steam peeling, knife peeling, abrasion peeling, caustic peeling and flame peeling.

a) Steam peeling

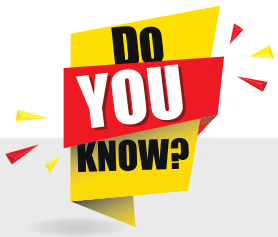
Steam peeling is carried out either as a batch-wise or a continuous process. The raw materials (roots, tubers) are treated in a pressure vessel and exposed to high-pressure steam (180°C to 200°C). In the case of tomatoes, the temperature may be lower (120 -130°C). The high temperature causes a rapid heating and cooking of the surface layer (within 15 to 30s). The pressure is then instantly released, which causes flashing-off of the cooked skin. The continuous steam peeler is a pipe with a screw inside. The steam is feed direct into the pipe (generally at lower pressure than the batch process) and the product is heated during the residence time (adjustable). Most of the peeled material is discharged with the steam. Any remaining traces are sprayed off with water. Tomatoes are peeled using this method.

b) Knife peeling

The materials to be peeled (fruits or vegetables) are placed onto a rotating disc and pressed against stationary or rotating blades to remove the skin. Knife peeling is mostly used for citrus fruits, as the citrus skin is easily removed and the fruit suffers little damage.

c) Abrasion peeling

The material to be peeled is fed onto abrasive rollers or fed into a rotating bowl which is lined with an abrasive. The abrasive



Preserves are made of small, whole fruits or uniform size pieces of fruits in a clear, thick, slightly jellied syrup.

Fruit butters are made from fruit pulp cooked with sugar until thickened to a spreadable consistency.

surface removes the skin, which is then washed away with water. The process is normally carried out at ambient temperature.

d) Caustic peeling

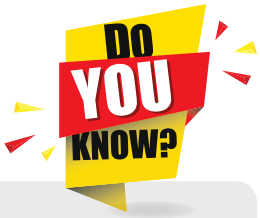
The material to be peeled is passed through a dilute solution (1 to 2%) of sodium hydroxide. This treatment softens the skin, which can then be removed by high-pressure water sprays. A new development in caustic peeling is dry caustic peeling. The material is dipped in a 10 % sodium hydroxide solution. The softened skin is then removed by rubber discs or rollers. A drawback of caustic peeling is that it causes decolourisation of the product.

e) Flame peeling

A flame peeler utilises a conveyer belt to transport and rotate the material through a furnace heated to temperatures above 1000°C. The skin (e.g. paper shell, root hairs) is burned off and then removed by high-pressure water sprays. Flame peeling is used, for example, for peeling onions.

f) Lye peeling

It is one of the oldest methods used in the food industry. This method is used mainly for peeling fruits and vegetables. The typical process consists of an open tank of caustic heated to 170–220 °F (76–105 °C) by live steam. The target caustic concentration can vary from 3 to 15 %. Exposure time for the product is usually 5 minutes or less, after which the skin is peeled. Lye peeling has been used extensively in peaches, tomato, kiwi and potato.



S.No.	Peeling method	Commodity
1.	Knife peeling (manual)	All fruit and vegetables
2.	Mechanical knife peeling	Apple, pear, pineapple
3.	Hot water peeling	Tomato
4.	High pressure steam/water peeling	Potato, tomato
5.	Abrasive peeling	Potato, ginger, carrots
6.	Flame peeling	Brinjal, onion, garlic
7.	Lye peeling	Orange segments, peach, apricot, nectarines, pears.

Activity 2:

Find the types and manufactures of Jams, Jellies and Tomato ketchup in the market.

Notes

1.2.2 Destoning or Deseeding

Destoning means removing the stones or seeds from fruits such as plums and apricots before using in cooking or before eating.

The destoning machine can process all stone fruits and berries. It has the capacity for up to 5000lb of fruit per hour.

Figure 1.5. Destoning Machine

The bin tipper lifts the cherries and drops them into a water bath before heading up the elevator. They are directed down a chute and into the top of the destoner. Then, it separates the flesh of the fruit from the pit, resulting in a puree.

1.3 Fruit Pulp and Juice

Fruit

It means all of the recognized fruits and vegetables that are used in making jams, including but not limited to those fruits mentioned in this Standard, either fresh, frozen, canned, concentrated, dried, or otherwise processed and/or preserved which shall be sound, wholesome and clean and of suitable ripeness but free from deterioration and containing all its essential characteristics except that it has been trimmed, sorted and otherwise treated to remove any blemishes, bruises, toppings, tailings, cores, pits (stones) and may or may not be peeled.

Fruit Pulp

The edible part of the whole fruit, without the peel, skin, seeds and pips which may have been sliced or crushed but which has not been reduced to a puree.

Notes

Fruit Puree

The edible part of the whole fruit, without the peel, skin, seeds and pips which has been reduced to a puree by sieving or other processes.

Fruit Juice

After fresh fruit, one of the most common fruit products is fruit juice. Fruit juice can take on many forms, including a natural-style cloudy product, a "nectar"-type product containing suspended solids, a fully clarified juice, juice concentrate, and fruit drinks.

Juice extraction

Preparation

Fruit is prepared for juice extraction by removing unwanted parts. This may include pitting operations for stone fruit such as apricots, cherries, or plums or peeling for such fruits as pineapples. In one large class of fruit, citrus fruit, juice extraction and separation from the peel are combined. Two major juice extraction systems for citrus existm control disintegration so that the particle size of the mash is compatible with the press system.

Pressing

Many different types of press are used for juice extraction. The most traditional is a rack-and-frame press, in which ground fruit (mash) is pumped into cloth partitions, called cheeses, which are separated by wooden or metallic racks. After a stack of cheeses has been produced, the press is activated and the juice expressed from the assembly.

Many variations of the rack-and-frame press exist. These include the continuous belt press, the bladder press, and the basket press.

Liquefaction

As an alternative to press systems, some processors have gone to total enzymatic liquefaction of the fruit mash. Cellulose and pectinase enzymes are added, and the mash is heated in order to accelerate the enzyme's performance.

Notes

Activity 3:

Peel the following using the methods mentioned

a) Tomato

b) Apple

c) Pear

d) Pineapple

e) Orange

1.3.1 Introduction and Pulping Machines

Fruits and vegetable processing is done in a different manner as per the requirement of the type of processed end products, in some processing pulping is the major unit operation for making processed product. There are different methods of pulping of fruits and vegetables, depending on its size shape and texture. Commercial production of processed product from fruits and vegetables requires different types of pulping machines, for increased capacity as well as hygienic production of the processed foods.

Equipment for Pulping

Pulping is process that performed by the extraction or pulper equipment which crush the food products and separate the pulp, seed and skin of fruits and vegetable. Pulper may be either mechanically or electrically operated to forces the feed in the machine.

A. Fruit crusher

Figure 1.6. Fruit Crusher

Powered machines that are used to crush pineapples or other hard fruits consist of a rotating screw inside a casing. The casing has a screen in the base. Juice/pulp drains from an outlet

Notes

in the base of the casing and skin is ejected from the end of the casing down a chute. The casing should be fitted with wing nuts to remove it easily.

In operation, pineapples are cut into large pieces and fed into the hopper. Routine maintenance consists of: weekly checks on the belt tension, weekly checks of electrical connections and monthly greasing of bearings. A spare drive belt and fuse should be kept.

B. Fruit presses

Figure 1.7. Food Presses

Manual fruit presses have a stainless-steel cage in which a press plate is raised and lowered by a screw. The screw should be made from a harder grade of steel than the bearing to prevent the more expensive screw from wearing down (the bearing can be replaced more cheaply than the screw). Layer plates made from stainless steel, nylon or painted mild steel may be needed in larger presses to promote efficient pressing. In operation a muslin or cotton bag is placed in the cage and pulp is poured in. The bag is closed and the press plate is lowered. After a few minutes, additional turns of the screw increase the pressure further. Juice is collected via a pipe. The screw is then raised and the bag is removed.

C. Twin pulper

Figure 1.8. Twin Pulper

Notes

A wide range of Fruit and Vegetable Pulper which can be used to extract pulps from fruits and vegetables. These pulpers are highly effective and also high on performance. These Fruit and Vegetable Pulpers are used various purposes like skin removal, destoning, pulping and finishing of pulps from fruits and vegetables like mangoes, litchi, tomatoes, carrot and pineapple.

D. Fruit mill

Figure 1.9. Fruit Mill

This is used for crushing hard seedless fruits for pulping or juice extraction. The machine is fed into a hopper which is then crushed by Stainless- Steel rotor against the Stainless -Steel blades driven by a powerful motor. All the parts of the fruit mill crusher should be made up of food grade stainless steel.

E. Motorized hydraulic fruit press

Figure 1.10. Motorized Hydraulic Fruit Press

Notes

A comprehensive range of Hydraulic Juice Press (Motorised) manufactured with high quality material. The Hydraulic Juice Press (Motorised) is used for the extraction of juice from crushed fruits like pineapple, grapes, orange, apple and so on. The product is also endowed with features like efficient durability and high tensile strength. The motorized Hydraulic Juice Press having stainless steel tray with proper depth which prevents the juice from spilling out from the filter cloth and wooden racks thereby retaining the nutrients left in the pulp from other juices.

F. Fruit juicer

Figure 1.11. Fruit Juicer

The Hand Operated Fruit Juicer is suitable for continuous operation and is easy to clean and maintain. These machines also easy to use, and do not require any power or electricity as it works on the similar principle of pressing the machine.

1.3.2 Clarification

Pectinization

If the juice is to be clarified further or concentrated after extraction, treatment with pectinase may be required. The juice is monitored for pectin content using a qualitative pectin check, consisting of combining one part juice with two parts ethanol. If a gel forms, pectin is still present and depectinization must continue. When depectinization is complete, a floc is typically formed by the aggregation of partially degraded pectin-protein aggregates.

Notes

Filtration

Filtration systems are varied in design, operation, and application. The most traditional system is diatomaceous earth filtration, in which diatomaceous earth is used to aggregate and collect suspended solids. The diatomaceous earth is collected on filter paper inside the pressure filter as the juice passes through the unit. The resulting juice is sparkling clear. Owing to concern over the cost of diatomaceous earth and its disposal, other filtration processes have been designed. The most successful is membrane filtration, in which hollow fibre, open tubular, or ceramic membranes are employed in juice filtration systems.

Physical Characteristics of Tomato Pulp

Colour : Red

Texture : Smooth texture and homogenized

Flavour & Taste : Natural flavour of Tomato and free from burned, cooked or any off-flavour taste

Appearance : Tomato Paste is processed without pips, seeds and peel

Physical Characteristics of Mango Pulp

Colour : Yellow to light golden yellow

Texture : Smooth texture and homogenized

Flavour & Taste : Natural flavour of Mango and free from burned, cooked or any of flavour taste

Appearance : Characteristic

Physical Characteristics of Guava Pulp

Colour : Creamy white

Texture : Smooth texture and homogenized

Flavour & Taste : Natural flavour of Guava and free from burned, cooked or any off flavour taste

Appearance : Guava Pulp is processed without pips, seeds and peel

Physical Characteristics of Papaya pulp

Colour : Red

Texture : Smooth Texture and homogenized

Flavour & Taste : Natural flavour of Papaya and free from burned, cooked or any off-flavour taste.

Appearance : Characteristic

Activity 4:

Prepare the pulp of Mango, Tomato and Guava and note the characteristics.

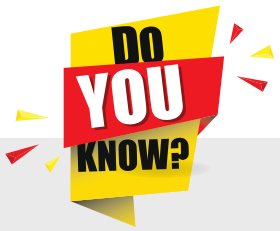
1.4. Preparation of Jam and Jelly

Preserving foods was a home-based operation until the nineteenth century. Even today, millions of people make fruit preserves in their own kitchens. Whether in the home kitchen or in a modern food processing plants, the procedure is essentially the same. Fruits are chopped and cooked with sugar and pectin until a gel is formed. The jam or jelly is then packed into sterilized jars.

1.4.1 Jam

Figure 1.13. Jam

Jam is a product made by boiling fruit pulp with sufficient sugar to a reasonably thick consistency, firm enough to hold the fruit tissues in position. Apple, pear, sapota (chikoo), apricot, loquat, peach, papaya, karonda, carrot, plum, straw- berry, raspberry, mango, tomato, grapes and muskmelon are used for preparation of jams. It can be prepared from one kind of fruit or from' two or more kinds. In its preparation about 45% of fruit pulp should be used for every 55% of sugar.The FPO specification of jam is 68.5% TSS, 45% of fruit pulp and 0.5-0.6% of acid (citric acid) per 100 gm of the prepared product. At home it can be prepared by using the combination as given in the table



Fruit Leathers

Figure 1.12. Fruit Leathers

Fruit leathers are dried sheets of fruit pulp which have a soft, rubbery texture and a sweet taste. They can be made from most fruits, although mango, apricot, banana and tamarind leathers are amongst the most popular. Leathers can also be made from a mixture of fruits.

Fruit leathers are eaten as snack foods instead of boiled sweets. They are also used as ingredients in the manufacture of cookies, cakes and ice cream. The preservation of fruit leathers depends on their low moisture content (15-25%), the natural acidity of the fruit and the high sugar content. When properly dried and packaged, fruit leathers have a shelf life of up to 9 months.

Notes

Table 1.1. Ratio for 1kg Pulp

Fruit/ Vegetable	Ingredient for one kg pulp		
	Sugar (kg)	Citric acid (gms)	Water (ml)
Aonla	0.75	-	150
Annie	0.75	2.0	100
Apricot	0.60	1.0	100
Carrot	0.75	2,5	200
Graces	0.70	1.0	50
Guava	0.75	2.5	150
Karonda	0.80	-	100
Loauat	0.75	1.0	100
Mango	0.75	1.5	50
Muskmelon	0.7	2.5	50
Plum	0,80	-	150
Peach	0.80	30	100
Pear	0.75	1.5	100

Procedure of Jam Preparation:

1. Select ripe fruits and after washing them thoroughly, cut the fruit into two halves and removes the seeds. Squeeze out the pulp and pass it through churner to make a homogeneous mass.

2. For every one kg of the pulp take ¾ to 1 kg of sugar and 10 gm of citric acid. Dissolve them in water and heat the mixture to nearly 60 °C and strain in through muslin cloth and mix it thoroughly with the pulp.

3. The fruit and sugar mixture is then boiled to concentrate the soluble solids to about 68.5 %. Remove the scum during cooking. Occasional stirring of the mass is essential till the temperature reaches 104 to 109 °C.

4. Soon after the end point is reached the jam is cooled in a cooling pan to about 200°F and filled into previously sterilized bottles and allow it to set over night.

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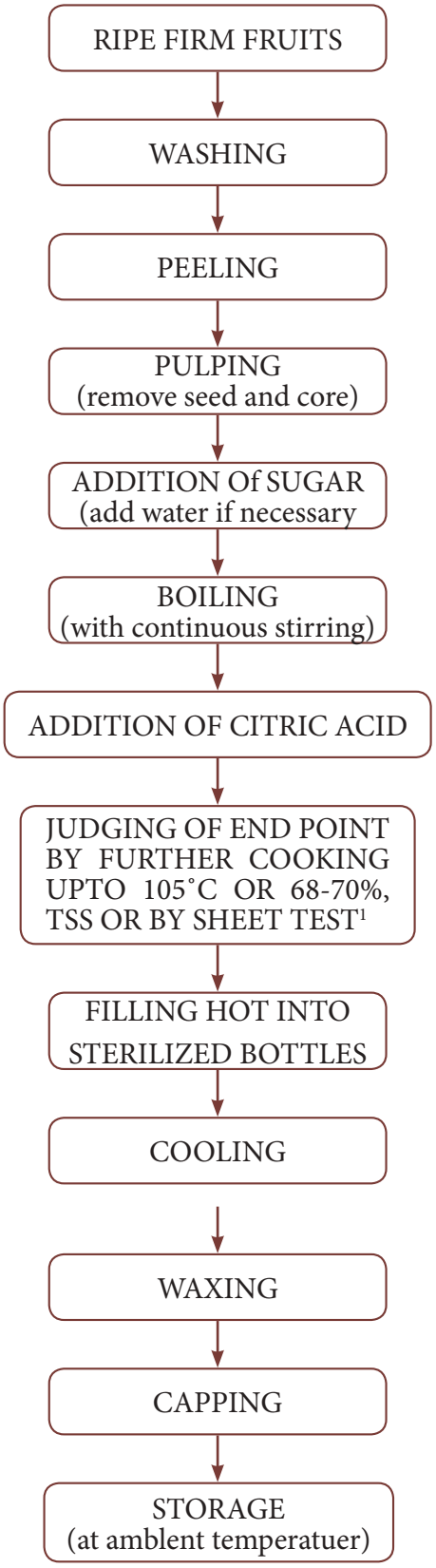
5. Next day pour a layer of melted paraffin wax on the surface of the jam and glass bottles are sealed and stored in a cool dry place.



Flowchart 1.1. Technical Flow-sheet for Processing of Jam

Notes

Determination of end point:

Temperature

Setting point for jam is 105°C (220 ° F) so a good way to test for setting point is to have a sugar thermometer clipped to the side of your saucepan, with the end dipped in the boiling jam mixture.

Wrinkle Test or Cold Plate Test

Figure 1.14. Wrinkle Test or Cold Plate Test

Before cooking the jam put 3 or 4 small heatproof plates in the freezer. Once the jam has boiled for several minutes, take the pan off the heat and carefully spoon a little jam onto one of the cold plates. Let it stand for a minute then push the blob of jam with the finger, if the surface of the jam wrinkles, then it has set. If it is still quite liquid then put the pan back on the heat and boil the jam for another 3 to 5 minutes before testing again.

Wooden Spoon– Flake Test

Figure 1.15. Wooden Spoon – Flake Test

Notes

Sheet (or) Flake Test A small portion of jam is taken out during boiling in a spoon or wooden laddle and cooled slightly. It is then allowed to drop. If the product falls off in the form of a sheet (or) flakes instead of flowing in a continuous stream (or) syrup, it means that the end point has been reached and the product is ready. Otherwise boiling is continued till the sheet test is positive.

Important Hints in Jam Preparation:

1. The process of Jam making should be done very rapidly and prolonged boiling should be avoided as it deteriorates the flavour and colour both.
2. To avoid excessive frothing during boiling, a little butter may be added to the jam.
3. While cooking, the ingredients should be stirred properly, otherwise it may char and may result in the spoilage of the whole product.
4. The final product should not contain less than 45 % of fruits and 68.5 % soluble solids when cold.
5. The finished product shall have a heavy consistency.
6. It shall have the flavour of the organism fruit and shall be free from burnt or other objectionable flavours, crystallization, mould growth and shall show no sign of fermentation.
7. Pectin present in fruits gives it a good set. If pectin is deficient in fruits, pectin from other fruits or solid pectin can be added.
8. Over ripe fruit should not be used as it produces a pasty product.

Problems in jam production

(i) Crystallization: The final product should contain 30 to 50 per cent invert sugar. If the percentage is less than 30, cane sugar may crystallize out on storage and if it is more than 50 the jam will become a honey-like mass due to the formation of small crystals of glucose. Corn syrup or glucose may be added along with cane sugar to avoid crystallization.

(ii) Sticky or gummy jam: Because of high percentage of total soluble solids, jams tend to become gummy or sticky. This problem can be solved by addition of pectin or citric acid, or both.

Notes

(iii) Premature setting: This is due to low total soluble solids and high pectin content in the jam and can be prevented by adding more sugar. If this cannot be done a small quantity of sodium bicarbonate is added to reduce the acidity and thus prevent precoagulation.

(iv) Surface graining and shrinkage: This is caused by evaporation of moisture during storage of jam. Storing in a cool place can reduce it.

(v) Microbial spoilage: Sometimes moulds may spoil the jam during storage but they are destroyed if exposed to less than 90 per cent humidity. Hence, jams should be stored at 80 per cent humidity. Mould growth can also be prevented by not sealing the filled jar and covering the surface of jam with a disc of waxed paper because mould does not grow under open conditions as rapidly as in a closed space. It is also advisable to add 40 ppm sulphur dioxide in the form of KMS. In the case of cans, sulphur dioxide should not be added to the jam as it causes blackening of the internal surface of the can. Yeasts are not a serious problem due to the high concentration of sugar.

1.4.2 Jelly

Figure 1.16. Jelly

A jelly is a semi-solid product prepared by boiling a clear, strained solution of pectin containing fruit extract, free from pulp, after the addition of sugar and acid. A perfect jelly should be transparent, well-set, but not too stiff, and should have the original flavour of the fruit. It should be of attractive colour and keep its shape when removed from the mould. It should be firm enough 'to retain a sharp edge but tender enough to quiver when pressed.

Notes

It should not be gummy, sticky or syrupy or have crystallized sugar. The product should be free from dullness, with little or no syneresis (weeping), and neither tough nor rubbery.

The FPO specification for jelly is the final product should have 65% solids, 45% fruit extract and 0.5-0.75% acid. Guava, sour apple, plum, karonda, wood apple, papaya and jack fruit are rich in pectin and generally used for preparation of jelly. Pineapple, strawberry grapes etc. can be used but only after addition of pectin powder, because these fruits have low pectin content. Preparation of jelly is similar to that of jam.

According to their pectin and acid contents:

1. Rich in pectin and acid: Sour and crab apple, grape, sour guavas, lemon, oranges (sour), plum (sour)
2. Rich in pectin but low in acid: Apple (low acid varieties), unripe banana, sour cherry, fig (unripe), pear, ripe guava, peel of orange and grapefruit.
3. Low in pectin but rich in acid: Apricot (sour), sweet cherry, sour peach, pineapple and strawberry.
4. Low in pectin and acid: Ripe apricot, peach (ripe), pomegranate, raspberry, strawberry and any other over-ripe fruit.

In the home it can be prepared by using following recipes:

Table 1.2. Combination of fruit and citric acid

Fruit	Inaredlents for one	
	Sugar(kg)	Citric acid (gms)
Guava	0.75	3.0
Sourle	0.75 -1.00	2.0
Gooseberry	0.80	-
Karonda	0.75	-
Jamun	0.75	1.0
Wood apple	1.00	-
Plum	0.75	2.5
Loquat	0.80	2.0
Papaya	0.75	3.0

Important considerations in jelly making

Pectin, acid, sugar (65%), and water are the four essential ingredients. Pectin test and determination of end-point of jelly formation are very important for the quality of the jelly.

Notes

(A) Pectin

Pectin substances present in the form of calcium pectate are responsible for the firmness of fruits. Pectin is the most important constituent of jelly. It is a commercial term for water soluble pectinic acid which under suitable conditions forms a gel with sugar and acid. In the early stage of development of fruits, the pectic substance is a water-insoluble protopectin which is converted into pectin by the enzyme protopectinase during ripening of fruit. In over-ripe fruits, due to the presence of pectic methyl esterase (PM E) enzyme, the pectin gets largely converted to pectic acid which is water-insoluble. This is one of the reasons that both immature and overripe fruits are not suitable for making jelly and only ripe fruits are used.

The setting of pectin is also dependent upon the pH and sugar concentration. Stiffness of the gel increases with increasing concentration of pectin up to a certain point beyond which the addition of more pectin has little effect. Too little pectin gives a soft syrup instead of gel. Pectin tends to keep the sugar from crystallizing by acting as a protective colloid, but is not effective when the concentration of sugar is 70 per cent or more. The jellying power of fruit pectin depends upon the amount of pectin used as well as its degree of polymerization and acetyl content.

The amount of pectin extracted varies with the method of extraction, the ripeness of the fruit, the quantity of water added for extracting the juice and the kind of fruit. Usually about 0.5-1. 0 per cent of pectin of good quality in the extract is sufficient to produce good jelly. If the pectin content is higher a firm and tough jelly is formed and if it is less the jelly may fail to set.

Determination of pectin content:

The pectin content of the strained extract is usually determined by one of the following two methods.

1. **Alcohol test:** This method, involving precipitation of pectin with alcohol, is outlined below:

One teaspoonful of strained extract is taken in a beaker and cooled, and 3 teaspoonfuls of methylated spirit are poured gently down the side of the beaker which is rotated for mixing and allowed to stand for a few minutes.

Notes

(a) If extract is rich in pectin, a single, transparent lump or clot will form. An equal amount of sugar is to be added to the extract for preparation of jelly.

(b) If extract contains a moderate amount of pectin, the clot will be less firm and fragmented. Three-fourths the amount of sugar is to be added.

(c) If extract is poor in pectin, numerous small granular clots will be seen. One-half the amount of sugar is added.

2. Jel meter test: The jel meter is held in the left hand with the thumb and forefinger. The bottom of the jel meter tube is closed with the little finger. The strained extract is poured into the jel meter with a spoon, held in the right hand, till it is filled to the brim. While still holding the jel meter, the little finger is removed from the bottom end and the extract is allowed to flow or drip for exactly one minute, at the end of which the finger is replaced. The reading of the level of extract in the jel meter is noted. This figure indicates how many parts of sugar are to be added to one part of juice. (8)

B. Acid

The jellying of extract depends on the amount of acid and pectin present in the fruit. Of the three acids citric, malic and tartaric found in fruits, tartaric acid gives the best results. The final jelly should contain at least 0.5 per cent (preferably 0.75%) but not more than 1 per cent total acids because a larger quantity of acid may cause syneresis.

pH of extract: Jelly strength increases with the increase in pH until optimum is reached. Further addition of acid decreases the jelly strength. The optimum pH for a jelly containing 1 per cent pectin is approximately 3.0, 3.2 and 3.4 for 60, 65 and 70 per cent TSS, respectively. The pH of the jelly can be controlled by

(i) adjusting pH of extract with acid/alkali, and

(ii) adding a suitable buffer.

Fruits also contain salts like sodium citrate, sodium potassium tartrate, etc., which have buffering action and help to control pH. In general, the optimum pH value for jelly is 3.2.

Notes

C. Sugar

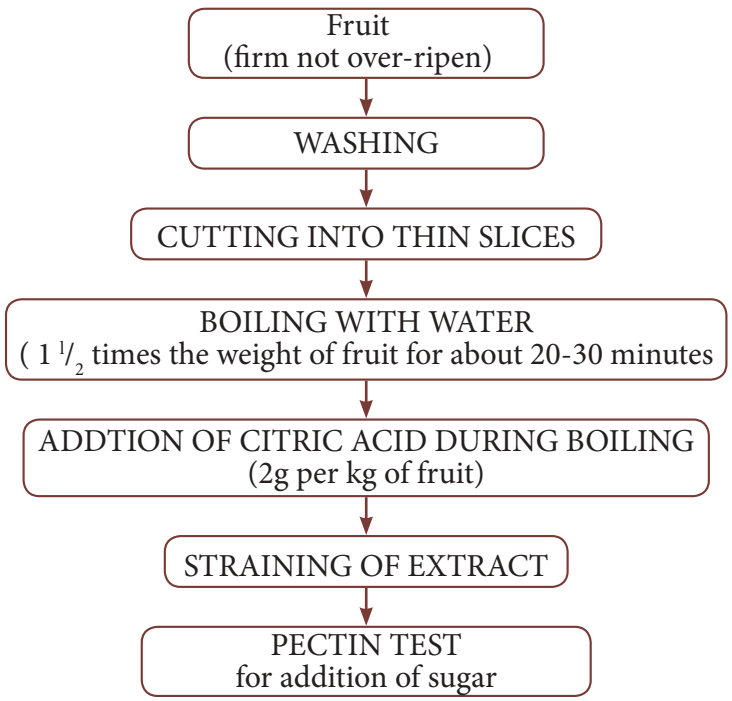
This essential constituent of jelly imparts to it sweetness as well as body. If the concentration of sugar is high, the jelly retains less water resulting in a stiff jelly, probably because of dehydration.

Inversion of sugar: When sugar (sucrose) is boiled with an acid, it is hydrolysed into dextrose and fructose, the degree of inversion depending on the pH and duration of boiling. Because of partial inversion of the sucrose, a mixture of sucrose, glucose and fructose are found in the jelly. This mixture is more soluble in water than sucrose alone and hence the jelly can hold more sugar in solution without crystallization.

D. Judging of end-point

Boiling of jelly should not be prolonged, because excessive boiling results in a greater inversion of sugar and destruction of pectin. The important point to remember is that it is the fruit extract which requires boiling and not the added sugar. If a jelly is cooked for a prolonged period, it may become gummy, sticky, syrupy and deteriorate in colour and flavour. The end-point of boiling can be judged in the following way:

1. Determination by jel meter
2. By carrying out the sheet or ladle test
3. By weighing the boiling mixture



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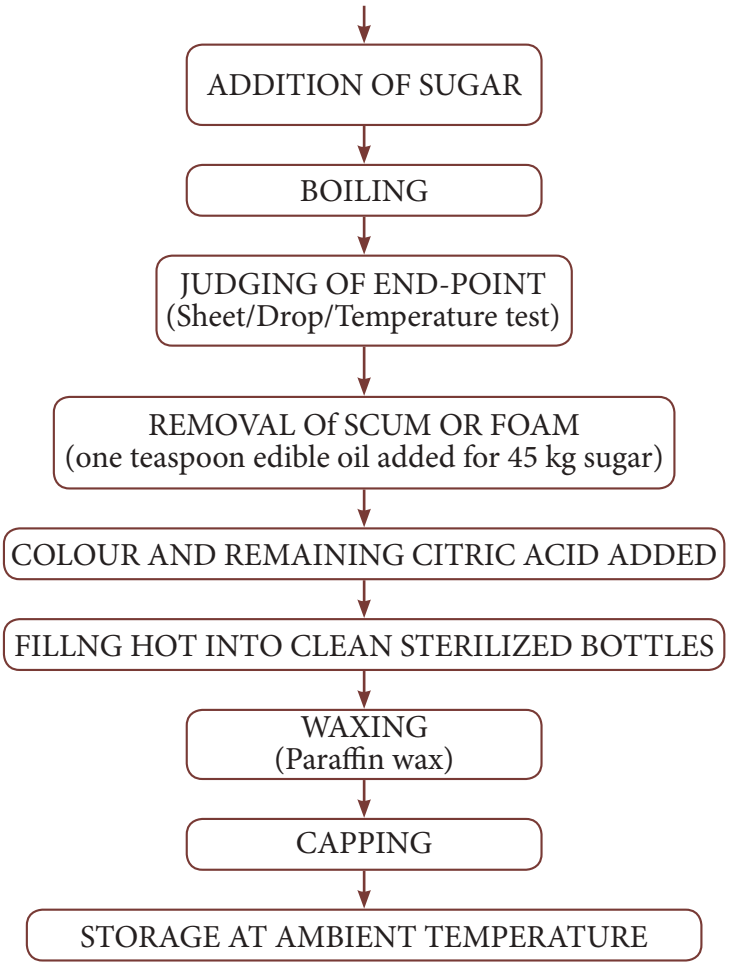


Flowchart 1.2. Technical Flow-Sheet for Processing of Jelly

Problems in jelly making

The most important difficulties that are experienced are as follows:

1. Failure to set: This may be due to:

- **Addition of too much sugar:** It results in a syrupy or highly soft jelly which can be corrected by addition of sufficient quantity of fresh, strained extract rich in pectin.
- **Lack of acid or pectin:** Lack of acid or pectin, or of both, in the fruit used or insufficient cooking of the fruit slices resulting in inadequate extraction of pectin and acid.
- **Cooking below the end-point:** If the cooking is stopped before the percentage of total soluble solids reaches 65, the jelly may remain syrupy and highly soft.

Notes

- **Cooking beyond the end-point:** Jelly becomes tough due to overconcentration. This usually happens when the juice is rich in both acid and pectin and enough sugar has not been added. If acid is in excess, the pectin breaks down resulting in formation of a ropy syrup or a jelly with waxy consistency.
- **Prolonged cooking:** In the presence of acid the coagulating property of pectin is destroyed if it is heated for a long time, hence prolonged heating should be avoided.

2. Cloudy or foggy jellies: It is due to the following reasons:

- Use of non-clarified juice or extract.
- **Use of immature fruits:** Green, immature fruits contain starch which is insoluble in the juice and therefore, gives it a cloudy appearance.
- **Over-cooking:** Such jellies are gummy or sticky on account of their high viscosity and do not become clear after pouring into containers.
- **Over-cooling:** If the jelly is cooled too much, it becomes viscous and sometimes, lumpy and is always almost cloudy.
- **Non-removal of scum:** The jelly becomes cloudy when the scum is not removed before pouring.
- **Faulty pouring:** When jelly is poured into containers from a great height, some air gets trapped in the form of bubbles and makes the jelly opaque. Hence the pouring vessel should not be held more than about 2.5 cm away from the top of the container.
- **Premature gelation:** Excess of pectin in the extract causes premature gelation with the result that air may get trapped in the jelly and thus make it opaque. It can be avoided by:

(a) Heating the solution to the boiling point and immediately pouring it into containers so as to reduce the time of contact between pectin, acid and boiling sugar;

(b) Using low concentration of sugar;

(c) Using a slow-setting pectin; and (d) Not using acid during cooking and instead putting a concentrated solution of acid in the container prior to pouring the cooked juice.

Notes

3. **Formation of crystals:** It is due to addition of excess sugar and also to overconcentration of jelly.

4. **Syneresis or weeping of jelly:** The phenomenon of spontaneous exudation of fluid from a gel is called syneresis or weeping and is caused by several factors:

- **Excess of acid:** It causes breakdown of the jelly structure by hydrolysis or decomposition of pectin. It occurs more in tender jellies and can be prevented by mixing either some quantity of juice low in acid or more of pectin, so that a larger quantity of sugar can be added which helps in reducing the acidity and increasing the volume of jelly.
- **Insufficient pectin**: This results in the formation of a pectin network which is not sufficiently dense and rigid to hold the sugar syrup.
- **Premature gelation:** This causes breaking of the pectin network during the pouring of jelly into containers and thus the jelly becomes weak and remains broken.
- **Fermentation:** Though a high percentage of sugar (65%) prevents ordinary fermentation, it can take place in jelly if syneresis occurs. Storage of jelly in a damp place, even if covered with a seal of paraffin wax, favours the growth of mould. The growth may be due to several reasons:

(a) not covering the jelly properly,

(b) not pouring sufficiently hot paraffin wax so as to kill the moulds and bacteria present on the surface of jelly, and

(c) breaking of paraffin wax seal. Hermetically sealable glass jars and cans are used to avoid this problem.

1.4.3 Differences between Jam and Jelly

S.No.	Jam	Jelly
1.	The fruit tissues are used in jam preparation	Clear fruit juices are used in jelly preparation
2.	It is opaque	It is transparent
3.	When cut at the edges, shape changes	It retains its shape when cut

Notes

4.	It is colloidal in nature	Jelly is too stiff
5.	When removed from the mould changes its shape	Keep its shape when removed from the mould
6.	It should not be cooled	It should be cooled
7.	Sugar is added according to the fruit pulp	Sugar is added according to the pectin content
8.	It can be prepared from any kind of fruit	Only pectin rich fruit can be used
9.	Preservatives are added	No preservative is added
10.	It is prepared by extracting fruit pulp	Jelly can also be prepared by adding jelly crystals artificially
11.	Fruits and vegetables can be used to prepare jam	Aqueous fruit is used for making jellies
12.	Equal amount of fruit pulp and sugar is added	Fruit extract and sugar is in the ratio of 1:0:5
13.	Jam is sticky	Jelly is non-sticky

Activity 5:

Collect recipes for preparing different Jams and Jellies.

1.5. PREPARATION OF SAUCES / KETCHUPS

There is no essential difference between sauce and ketchup. However, sauces are generally thinner and contain more total solids than ketchups. Tomato, apple, papaya, walnut, soybean etc. are used for making sauces. The FPO specifications of sauces are TSS – 25% and acidity – 1%. Sauces are of two kinds (i) thin sauces of low viscosity consistency mainly of vinegar extract of flavouring materials like herbs and spices and (ii) thick sauces that are highly viscous. Sauces / ketchups are prepared from more or less the same ingredients and in the same manner as chutney, except that the fruit or vegetable pulp or juice used in sieved after cooking to remove the skin, seeds and stalks of fruits. Vegetables and spices and to give a smooth consistency to the final product. However, cooking takes longer because fine pulp (or) juice is used. Some sauces develop a characteristic flavour and aroma

on storing in wooden barrels. Freshly prepared products often have a raw and harsh taste and have, therefore, to be matured by storage. High quality sauces, are prepared by maceration of spices herbs, fruits and vegetables in cold vinegar or by boiling them in vinegar. Thickening agents are also added to the sauce to prevent sedimentation of solid particles. Apple pulp is commonly used for this purpose in India but starch from potato, maize, arrow root (cassava) and sago are also used. A fruit sauce should be cooked to such a consistency that it can be freely poured without the fruit tissues separating out in the bottle. The colour of the sauce should be bright. Sauces usually thicken slightly on cooling. By using a funnel hot ketchup is filled in bottles leaving a 2 cm head space at the top and the bottles are sealed or corked at once. The necks of the bottles when cold, are dipped in paraffin wax for airtight sealing.

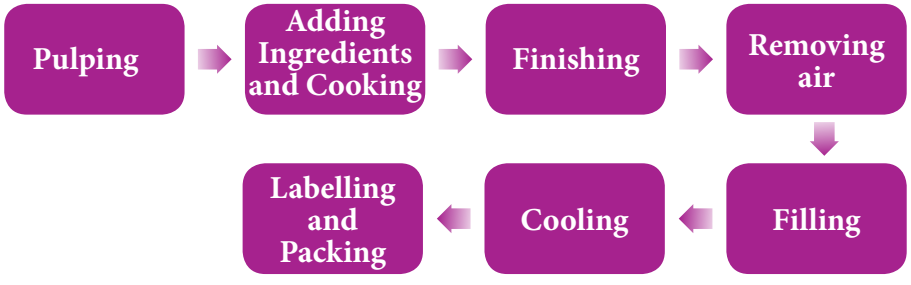
Tomato Ketchup

Ketchup is a table condiment or sauce. The unmodified term ("ketchup") now typically refers to tomato ketchup, although original recipes used egg whites, mushrooms, oysters, grapes, mussels, or walnuts, among other ingredients.

Tomato ketchup is a sweet and tangy condiment made from tomatoes, sugar, and vinegar, with seasonings and spices. The spices and flavours vary, but commonly include onions, allspice, coriander, cloves, cumin, garlic, and mustard, and sometimes include celery, cinnamon, or ginger.

1.5.1 Preparation of Tomato Ketchup

Tomato Ketchup is made of a whole lot of stuff going inside it from vegetables to tomatoes and spices to preservatives. Salt (Sodium Chloride), Sugar, Spices, Spice Extracts, Vinegar, Acetic Acid, Onions, Garlic, Chillies, Pectin and Alginates as Stabilizers.



Flowchart 1.3. Tomato Ketchup Production Flow Chart

Notes

1. Pulping

Figure 1.17. Pulping

The tomatoes are chopped and precooked, then pumped into Pulping Machines, or Cyclones, which separate seeds, skins, and stems from the pulp. This pulp is Filtered through Screens and processed further into ketchup, and some is stored in a form of paste to use later in the year.

2. Adding Ingredients and Cooking

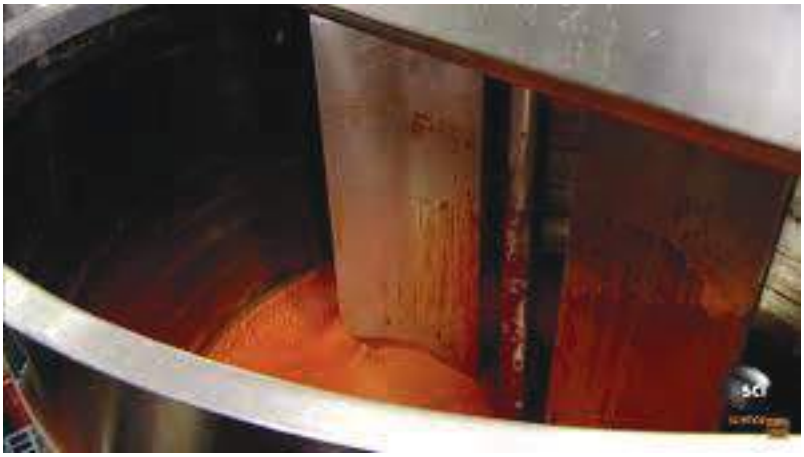


Figure 1.18. Cooking Tank

The pulp is pumped into Cooking Tanks or Kettles and heated to boiling and kept at Temperature above 80°C. Measured amounts of sweeteners, vinegar, salt, spices, and flavourings are added to the tomato pulp. To avoid evaporation of volatile oils they are not added early during the boiling with the spices, salt and sugar. Powders of onion or garlic are usually added which are procured from various firms which do the dehydration. The Mixture is Cooked for 30-45 minutes and is Circulated by Rotating Blades installed in the cookers or kettles. The temperature is

carefully regulated to insure absorption of the ingredients without overcooking.

Notes

3. Finishing

Figure 1.19. Finishing

Once the cooking is completed, the ketchup mixture passes through a Finishing Machine. Finishers are used to remove excess fibre and particles they do so by the help of screens, creating a smoother consistency. The ketchup is sometimes milled at higher temperatures and pressures to achieve a smoother consistency.

4. Removing air

Figure 1.20. Removing Air

The ketchup is De-aerated to Prevent Discoloration and Growth of Bacteria. Excess air may cause unattractive air pockets and impede the closure process.

5. Filling

To prevent contamination, the ketchup passes from the receiving tanks to the Filling Machines at a temperature Not Lower than 88°C.

Figure 1.21. Filling

The containers are filled with the ketchup and immediately sealed to retain the freshness of the product. Ketchup containers are available in various sizes and shapes.

6. Cooling

Figure 1.22. Cooling

The containers are cooled to prevent Flavour Loss through Stack Burning, which occurs when ketchup stays at high temperatures after cooking is complete. Containers of ketchup are cooled in cold air or cold water.

7. Labelling and Packing

Finally, the ketchup containers are labelled and coded with product information, including ingredients, date and location of manufacture, and shelf-life. The bottled ketchup may be inspected again before shipping. The entire process of ketchup manufacturing generally takes two to three hours.

Figure 1.23. Labelling

Figure 1.24. Packaging

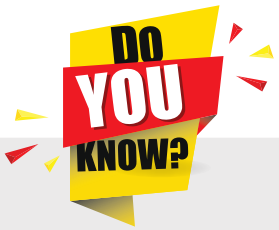
Note:

How much Sodium and Sugar in Ketchup?

Sodium chloride which is the major source of sodium is used commonly as a food-flavouring condiment and sometimes as a Food Preservative. In tomato ketchup it is used as taste enhancer. The Percentage of sodium chloride ranged from 1.84% to 2.58%. Similarly, for Sugars (Sucrose) gives a natural taste and uniform texture to the product, in addition to thick density. The addition of sugar in ketchup is for Balancing the taste of sourness of tomatoes. No limit or requirement has been set by the national standards. Sugar was found between 17.64% and 29.62%.

Viscosity of Ketchup

Being a Non-Newton ion Fluid, it's Viscosity is high and because of this only it's hard to pour out the bottle. Viscosity of ketchup ranges from 50,000-70,000 Centipoises.



Difference Between Puree, Paste, Sauces and Ketchup

Purees and Pastes are preserved generally only by **Physical Means** (eg: Heat), while **Sauces and Ketchups** are preserved by **Chemical Means** (eg: salt, sugar, seasonings) in addition to physical means.

Purees and Pastes generally do not contain seasonings, though nowadays, versions of both with seasonings are available. However, these have to be declared on the product label.

Purees and Pastes Differ Between themselves in their Thickness, measured by the total soluble solids (TSS). While **Purees** have a **TSS** ranging from **9 to 12%, Pastes have a TSS percentage of 25-44.**

The key **Difference** between **Tomato Sauce and Ketchup** too is the **Thickness or Consistency. Tomato Sauce has a TSS of 24–25%,** while **Ketchup** has a consistency of **28-30%.** This is because **Ketchup Contains more Spices and Seasonings than the Sauce.** Sauces and ketchups do not have to declare seasonings and spices, as these have been traditionally an inherent part of the product.

Chemical preservatives used in ketchup

Sodium benzoate is sometimes added to tomato ketchup to help preserve the products after the bottle has been opened. Some consumers do not like additives such as this, so prefer to buy products that do not contain them. Make sure that you do not add too much benzoate as it gives the product a bad taste. All countries have maximum permitted levels for preservatives. The recommended level for sodium benzoate is 0.2%.

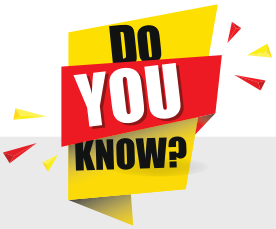
1.6. Fruit and Vegetable Waste

Fruit and vegetable waste has high environmental load and represents a company cost. Food processing industry around the world is making serious efforts to minimize by-products, compost organic waste, recycle processing and packaging materials, and save energy and water. Reduction, reuse, recycle and energy recovery strategies can be applied to fruit and vegetable waste.

Food processing industry around the world is making serious efforts to minimize by-products, compost organic waste, recycle processing and packaging materials, and save energy and water.

The three R's of waste management – Reduce, Reuse and Recycle – can help food manufacturers in reducing the amount of waste sent to landfill and reusing waste.

Figure 1.25. Food Recovery Hierarchy



Food Recovery Hierarchy is an excellent resource to follow for food processors and beverage producers as it provides the guidance to start a program that will provide the most benefits for the environment, society and the food manufacturer.

1.6.1 Waste management in Food Industry

Notably, landfill is the least favoured disposal option for waste generated in food and beverage producers worldwide. There are sustainable, effective and profitable waste management options including:

- making animal feed,
- composting to create nutrient-rich fertilizer,
- anaerobic digestion to produce energy-rich biogas,
- recycling/reusing waste for utilization by other industries,
- feeding surplus food to needy people

1.6.1.1 Waste Management Options

Food manufacturers has a unique problem – excess product usually has a relatively short shelf life while most of the waste is organic in nature. Food waste created during the production process can be turned into animal feed and sold to goat farms, chicken farms etc. As far as waste water treatment plant sludge is concerned, top food manufacturers are recycling/reusing it through land application, anaerobic digestion and composting alternatives.

Notes

Organic waste at any food processing plant can be composted in a modern in-vessel composting and the resultant fertilizer can be used for in-house landscaping or sold as organic fertilizer as attractive prices.

Another plausible way of managing organic waste at the food manufacturing plant is to biologically degrade it in an anaerobic digester leading to the formation of energy-rich biogas and digestate. Biogas can be used as a heating fuel in the plant itself or converted into electricity by using a Combined Heat and Power unit while digestate can be used as a soil conditioner. Biogas can also be converted into biomethane or bio-Compressed Natural Gas for its use as vehicle fuel. CHP unit while digestate can be used as a soil conditioner. Biogas can also be converted into Combined Heat and Power unit while digestate can be used as a soil conditioner. Biogas can also be converted into Combined Heat and Power unit while digestate can be used as a soil conditioner.

Items such as cardboard, clean plastic, metal and paper are all commodities that can be sold to recyclers Lots of cardboard boxes are used by food manufacturers for supplies which can be broken down into flat pieces and sold to recyclers.

Cardboard boxes can also be reused to temporarily store chip packages before putting them into retail distribution boxes. Packaging can be separated in-house and recovered using "jet shredder" waste technologies which separate film, carton and foodstuffs, all of which can then be recycled separately.

1.6.2 Fruit Waste Utilisation

Processing fruit produces two types of waste: a solid waste of peel/skin, seeds, stones, etc, and a liquid waste of juice and wash waters. In some fruits the discarded portion can be very high (e.g. mango 30-50%, banana 20%, pineapple 40-50% and orange 30-50%).

1.6.2.1 Use of Fruit Waste

The fruit and vegetable processing industries generated 10-60% waste or by-products in both solid and liquid form. Waste from fruits & vegetables can be used as such or after some treatments. They are rich in nutrients, therefore, have many health benefits. In addition to its use for livestock feed, Fruits and vegetable waste can be converted into value-added products like

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essential oils, edible oil, polyphenols, enzymes, pigments, anti-carcinogenic compounds, single cell proteins and bio-degradable films.

A large number of by-products are produced from food industries. These are the secondary products generated during manufacturing of primary products. This includes peels, seeds, leaves, residual pulp, stems, stones, and discarded pieces from a variety of sources. These by-products are the good source of bioactive compounds, nutraceuticals, and other functional foods. Therefore, there is a healthy trend towards by-product utilization and value addition.

Processing fruit produces two types of waste: a solid waste of peel/skin, seeds, stones, etc, and a liquid waste of juice and wash waters. In some fruits the discarded portion can be very high (e.g mango 30-50%, banana 20%, pineapple 40-50% and orange 30-50%). Therefore, there is often a serious waste disposal problem, which can lead to problems with flies and rats around the processing room, if not correctly dealt with. If there are no plans to use the waste it should be buried or fed to animals well away from the processing site.

Solid wastes

There are a number of possibilities for use of some types of solid fruit wastes but there is as yet no evidence that any of these are economic. It is stressed that a full financial evaluation should be done before attempting to introduce any of the ideas below.

One of the main problems in using fruit wastes is to ensure that the waste has a reasonable microbiological quality. Only waste produced during the same day should therefore be used - it is not advisable to store-up wastes to use for example at the end of a week's production. Even with this precaution the waste is still likely to contain mouldy fruit, discarded during processing, insects, leaves, stems, soils etc which will contaminate any products made from it.

Therefore, it is necessary to ensure that some preliminary separation takes place during processing (e.g peel and waste pulp into one bin, mouldy parts, leaves, soil etc to another which is discarded, stones, seeds etc into a third bin).

Notes

Possible products

The six main products that can be considered are as follows:

- Candied peel
- Oils
- Pectin
- Reformed fruit pieces
- Enzymes
- Wine/vinegar

1. Candied Peel

Peel from citrus fruits (orange, lemon, grapefruit) can be candied for use either in baked goods or as a snack food. In addition, shreds of peel are used in marmalades and the process to make these is similar to candying. In summary, the process involves boiling the slices or shreds of peel in 20% sugar syrup for 15-20 minutes and then progressively increasing the sugar concentration in the syrup to 65-70°Brix (% sugar by refractometer) as the food is soaked for 4-5 days. It is then removed, rinsed and given a final drying in the sun or a hot air drier. This can therefore form a second product for a fruit juice or jam processor especially if larger food companies are available and willing to buy the candied peel as an ingredient for their foods. In one application, candied melon skin has been used to substitute for sultanas in baked goods and in another, candied root vegetables have found a similar market.

2. Oils

The stones of some fruits (e.g mango, apricot, peach) contain appreciable quantities of oil or fat, some of which have specialised markets for culinary or perfumery/toiletry applications. Palm kernel oil is well established as both a cooking and industrial oil. In addition, some seeds. In addition, some seeds (e.g grape, papaya and passion fruit) contain oil which has a very specialised market. The main problems are to identify the import/export agents who would buy such products, producing the oil in sufficient quantities for them, meeting their very stringent quality standards and finally, obtaining the equipment needed to produce the oils at low cost.

The process in summary involves grinding the seeds/nuts to release the oil without a significant rise in temperature which

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(with the exception of palm kernel oil) would spoil their delicate flavours. Generally, a powered hammer mill is needed for nut/ kernels. A press is needed to extract the oil but, to our knowledge, the existing manual presses have not been tried in this application and a certain amount of experimentation is needed to establish oil yields and suitability of the equipment. Solvent extraction is not recommended for small-scale applications. However, steam distillation of citrus peel oils is well established at a small-scale.

The crude oil may be sold for refining elsewhere, but it is likely that at least preliminary (or part) refining would need to be carried out by the producer. At present, we know of no detailed publications on the special refining requirements for these oils. It would seem necessary to contact the end-user to determine the quality required.

It is also possible that the sale of seeds or stones to larger oil processors could generate additional income for small-scale fruit processors. This should be explored.

3. Pectin

This is a gelling-agent used in jams and some sweets found to a greater or lesser extent in most fruits. Commercially, pectin is extracted from citrus peel and apple pomace (the residue left after apple juice has been removed). Some other tropical fruits contain high levels of pectin, passion fruit being a notable example. The utilisation of the 'shells' remaining after pulp removal offers possibilities for pectin extraction.

In most developing countries, pectin is imported from Europe or USA and superficially at least there would seem to be a good market for supplying local fruit processors with pectin to substitute for imports. However, there are major problems:

- In countries where this has been tried, it has not been possible to produce pectin at a cost which is lower than the imported products.
- It is difficult to produce pectin powder on a small-scale although liquid pectin is possible.
- There is not one type of pectin but many types - each of which has specific properties that make it suitable for its intended application (eg jam that is to be used in baked goods requires a different type of pectin to normal jam sold in jars).

Notes

A detailed knowledge of pectin and its properties is needed to ensure that a producer is supplying the right product.

However, in essence the process of pectin extraction is not too complex. The shredded fruit peel or de-juiced pulp is soaked in hot water (60-70°C), or the hot water is recirculated through the material, and the pectin is extracted into the water (along with sugars and other fruit components). This is continued, often passing the same water through several batches of material, until the pectin concentration increases to around 5% (in larger industries the concentration may be increased by vacuum evaporation).

The pectin is then precipitated as a gel from solution by adding one of a number of chemicals. The most common are hexane or spirit alcohol which are then recovered by distillation and reused (the % recovery and cost of this step are often the most critical in determining profitability). It is also possible to use ammonium sulphate (a component of fertiliser) but this cannot be recovered and the higher cost therefore prevents its use commercially in large-scale operations.

The pectin gel is then washed and redissolved in water to produce a concentrated pectin solution. It is at this stage that it is standardised or modified to give the specific properties required. On a large-scale, it is usually dried to a powder, but on a small-scale it is possible to add sodium benzoate preservative and sell the concentrated liquid in bottles.

4. Reformed fruit pieces

Fruit pulp can be recovered and formed into synthetic fruit pieces. It is a relatively simple process but the demand for this product is not likely to be high and a thorough evaluation of the potential market is strongly recommended before any work is undertaken.

In summary, the process involves boiling the fruit pulp to concentrate and sterilise it. Sugar may also be added. A gelling agent, sodium alginate is then mixed with the cooled pulp this is then mixed with a strong solution of calcium chloride. All ingredients are safe to eat and are permitted food additives in most countries. The calcium and the alginate combine to form a solid gel structure and the pulp can therefore be re-formed into fruit pieces. The most common way is to pour the mixture into fruit-

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shaped moulds and allow it to set. It is also possible to allow drops of the fruit/alginate mixture to fall into a bath of calcium chloride solution where they form small grains of reformed fruit which can be used in baked goods. Commercially, the most common product of this type is glacé cherries.

5. Enzymes

Commercially, the three most important enzymes from fruit are papain (from papaya), bromelain (from pineapple) and ficin (from figs). Each is a protein-degrading enzyme used in such applications as meat tenderisers, washing powders, leather tanning and beer brewing. However, it is unlikely to be economic to obtain these from waste fruit. Even the more efficient collection from fresh whole fruit is no longer economic and changes in both large-scale production (higher quality standards and use of biotechnology to produce 'synthetic' enzymes) mean that small-scale producers will be unlikely to compete effectively. In addition, there are moves to phase out the use of these enzymes in food products in Europe and USA and their market is therefore declining. In summary, these are not recommended as a means of income from waste utilisation.

6. Wine / vinegar

Although these products should be produced from fresh, high quality fruit juices in order to obtain high quality products, it is technically feasible to produce them from both solid and liquid fruit wastes. Solid wastes should be shredded and then boiled for 20-30 minutes to extract the sugars from the fruit and to sterilise the liquid. Several batches of waste may be boiled in the same liquid to increase the sugar concentration. This is then filtered through boiled cloth to remove the solids and cooled ready for inoculation with yeast.

Liquid wastes should be separated during production to ensure that fruit juice is kept separate from wash water (e.g the juice could be drained from a peeling/slicing table into a separate drum). The juice is then boiled for 10-15 minutes and treated as above.

The liquid is then inoculated with a wine yeast (not a bread or a beer yeast) and fermented in the normal way for wine production. This can then undergo the normal second fermentation to produce fruit vinegar.

Notes

Examples of some fruit waste

1. Orange waste

By-products obtained from orange pulp and peel after juice extraction is the cheap and abundant source of dietary fibre. Dietary fibre powder can be prepared from this. After proper washing, it is dried at a temperature below 650C for 12 hrs. Care should be taken that functional properties and polyphenols, tannins, anthocyanin like compounds remain unchanged. After drying it is ground to a particle size of 500-600µm. This powder can be used for value addition in various food products.

2. Apple pomace

The residue left after the extraction of apple juice is called pomace. In apple juice industry near about 25% is the by-product which is pomace. Generally, it is thrown away and causes environmental pollution. But it can be converted into edible products as pomace is a rich source of pectin, carbohydrates, fibres, and minerals. Dried apple pomace can be used as energy source in a broiler. Food products like apple pomace jam, sauce, papad can be prepared and also have application in confectionery industries.

3. Banana fruit waste

Banana waste includes peels, rhizomes, leaves, damaged bananas, young stalks, and pseudo stems. They are most commonly used to feed livestock but the value-added products can be prepared. The pith of pseudo stem, peels can be low cost and a good source of starch, pectin, cellulose which can be used as thickening agent, stabilizers etc. banana inflorescence bracts can be used for natural bio-colorant and flavour purposes.

4. Citrus fruit waste

Most of all citrus by-products are generally used as animal fodder. Citroflavonoids, carotenoids, aromatic compounds, dietary fibre can be obtained from citrus peels. Citrus waste can be used as a clouding agent in citrus beverages. Cellulose can be extracted from citrus waste and utilized as a thickening agent. It possesses high antioxidant activity also.

5. Mango fruit waste

By-products from mango are peel and kernel. Mango seed kernel has low protein content but it is high in essential amino

acids. Furthermore, it is also a good source of polyphenols, phytosterols, and tocopherols. Mango seed could be used as natural antioxidants, antimicrobial compounds as a functional ingredient. The oil from mango seed kernel is very useful; it contains 44-48% saturated fatty acids and 52-56% unsaturated. Mango stone can be used as an adsorbent.

6. Grapes fruit waste

Different types of waste like stem, seeds, lees, pomace generated during winemaking process from grapes. Grape pomace is fibrous material and because of its carbohydrate content, it is used in different fermentation processes. Lees can be used as a substrate for microbial activities. Grape stem extract prepared in acetone have a high level of antioxidant and polyphenols.

In summary, each of the above uses for fruit waste requires:

- a good knowledge of the potential market for products and of the quality standards required
- a careful assessment of the economics of production
- a certain amount of additional production knowledge
- a certain amount of additional capital investment in equipment
- a fairly large amount of waste to make utilisation worthwhile

At very small-scales of operation, where pollution or waste disposal is more important than process economics, the most likely solution is to use wastes as animal feeds.

Activity 6:

Tabulate the use of different food wastes from your kitchen.

Glossary

Pip	:	A small hard seed in a fruit
Condiment	:	A substance such as salt, mustard, or pickle that is used to add flavour to food
Tart	:	An open pastry case containing a sweet or savoury filling
Homogenous	:	Consisting of parts all of the same kind

Notes

Scum : A layer of dirt or froth on the surface of a liquid

Viscous : Having a thick, sticky consistency between solid and liquid

Evaluation

I. Choose the best answer (1 mark)

1. …… are generally low in both acid and pectin.

   a) Strawberries b) Peaches c) Apples d) Apricots

2. …….. are the most popular and versatile fruit for jams and jellies.

   a) Strawberries b) Bananas c) Pineapples d) Pomegranate

3. …… is a high acid food.

   a) Peach b) Raspberry c) Melon d) Pineapple

4. …… is the separation of raw materials and/or food slurries into categories on the basis of shape, size, weight, image and colour.

   a) Sorting b) Washing c) Cutting d) Blanching

5. The objective of …….. is to remove unwanted or inedible material from vegetable raw materials.

   a) Washing b) Sorting c) Blanching d) Peeling

6. Setting point for jam is ……

   a) 105 degree C b)106 degree C

   c)107 degree C d) 108 degree C

7. …….. is rich in pectin and acid.

   a) Banana b) Pomegranate c) Cherry d) Sour Guava

8. The optimum pH value for jelly is……..

   a) 3.4 b) 5.4 c) 3.2 d) 4.6

9. …….. is a table condiment or sauce.

   a) Ketchup b) Pulp c) Jam d) Marmalade

Notes

10. ……. can be candied for use either in baked goods or as a snack food.

a) Peel from citrus fruits b) Stone of fruits

c) Pectin d) Pomace

II. Very Short Answer (2 Marks)

1. Define Jam.
2. What are types of marmalades?
3. Group fruits according to pectin content.
4. Mention the types of fruit and vegetable washing machines.
5. Explain destoning.
6. Differentiate fruit pulp and fruit puree.
7. How will you determine the end point in jam preparation?
8. Mention the methods of determining pectin content.
9. What are the profitable waste management methods?
10. How can you use fruit waste?

III. Short Answer (3 Marks)

1. How do you sort fruits and vegetables?
2. What are the techniques of peeling?
3. Explain the different pulping equipment.
4. Write the procedure for Jam preparation.
5. What are the problems in jam preparation?
6. Enumerate the problems in jelly making.
7. Differentiate Jam and Jelly.
8. Explain - preparation of tomato ketchup.
9. What are the waste management options in a food processing industry?
10. Draw and explain food recovery hierarchy.

Notes

Linkages

https://youtu.be/ZozA1gHNoDA

https://youtu.be/nji6VDpv_80

https://youtu.be/qzdvO3RK5Rc

https://youtu.be/jTg74ZT_5Vo

https://youtu.be/2I8Tjb4Fy-Q

PRACTICAL EXERCISE

1.1 Physical parameters to test quality of fruits and vegetables

Aim: To gain knowledge on how to select fruits and vegetables for jam, jelly and ketchup

Apparatus: Tomato, Strawberry, Grapes, Guava, Peach, Banana.

Procedure: Selection process

Tomato

Careful selection of tomato for the manufacture of tomato ketchup is very crucial step as it may affect the quality as well as shelf-life of the finished product. The criteria for selection include maturity, freedom from blemishes and defects. Ripe deep red coloured tomatoes with higher TSS and pulp provide better quality product. Pectin content and pigmentation are two important parameters determined the finished product quality.

All green and yellow-coloured portions should be removed. Chlorophyll and Xanthophyll present in immature fruits, upon heating form brown coloured compound pheophytin that may adversely affect the acceptability of the product. Flavour of the product also gets affected, if green tomatoes are used.

Strawberry

Look for fresh green leaves. After the berries are picked, the green leaves will start to dry and wilt. The longer the berries have been picked, the more "wilt" the leaves will look. Fresh green leaves mean that the berries are fresh, too. Look for plump berries. If the

Notes

berries are starting to look "dry" or shrivelled, they are getting old. Size doesn't matter. Different varieties of strawberries grow to different sizes. Weather and growing conditions can also affect the size of strawberries. Smaller berries are often sweeter, but bigger berries are delicious.

Grapes

Examine the grape texture. Ripe, healthy grapes should be firm and plump on all sides. If a grape is shrivelled where the stem meets the fruit or if there are any signs of moldiness, the grapes are not in good condition.

Look at the skin on the grapes. The best grapes will have a healthy shade to the skin. Ripe red grapes should have a dark purple hue, as any signs of green indicate that red grapes are not yet ripe. Ripe black grapes should have a full, rich shade of bluish-black, and green grapes should have a yellowish hue.

- In addition to skin tone, healthy grapes should also have a light silver-coloured dusting on the skin called bloom.
- Bloom is commonly mistaken for dirt, but it's actually the plant's way of protecting the fruit from drying out or rotting.

Select a very sweet or tart grape for making jam. When choosing grapes to make jam with, opt for a grape that's sweeter than the one used for table eating. For this reason, many jam makers prefer muscadine grapes for a sweeter jam, though others do prefer a tart grape for a more balanced jam profile.

Beta grapes and Chambourcin grapes make a good tart jam, while something more saccharin like Van Buren grapes would be ideal for a sweeter jam.

Guava

The softer a guava is, the sweeter and more delicious it will be. Keep in mind that because guavas are best when extremely soft, they are also extremely perishable. Select guavas that are blemish-free. Blemishes or bruises can mean the fruit is bad or will not taste good. A perfectly ripe guava is one that you can smell without even putting it to your nose. It should smell sweet and slightly musky. Ripe guavas are those that have gone from bright green to a softer yellowish-green colour.

Peach

Look for firm peaches with a pleasant aroma. Pick full-coloured peaches. A great peach will have a vibrant yellow or orange background colour that is partially or fully covered by a deep red blush. Bigger can be better when it comes to peaches. Choose tree-ripened fruits.

Check the parameters for the fruits that will be used to prepare jam, jelly and ketchup

Fruit	Freshness	Free from Blemishes	Colour	Ripeness	Free from Bruises	Free from infestation
Tomato						
Guava						
Grapes						
Strawberry						
Peach						
Banana						

Result and Discussion:

1.2 Demonstration of Sorting and Washing

Aim: To obtain the skill of sorting, washing and deseeding.

Apparatus: Fruits, fruit sorter, water, bowl

Procedure:

The following methods are demonstrated by the teacher

Sorting

Sorting is the separation of fruits and vegetables according to size, colour, image, shape and weight. Sorting also allows the separation at first sight of some (undesirable) additional material (e.g.leaves, stones) or inappropriate raw material (immature or rotted berries), and aims at ensuring that only good quality fruit is preserved and passed through for further processing.

Notes

For size sorting, various types of screens and sieves, with fixed or variable apertures, can be used. The screens may be stationary, rotating or vibrating.

Shape sorting can be accomplished manually or mechanically with, for example, a belt- or roller-sorter. Weight sorting is a very accurate method and is therefore used for more valuable foods (tropical fruits, certain vegetables). Image processing is used to sort foods on the basis of length, diameter, and appearance, i.e. surface defects and orientation of food on a conveyor. Colour sorting can be applied at high rates using microprocessor controlled colour sorters.

Washing

Harvested fruit is washed to remove soil, microorganisms and pesticide residues. Fruit washing is a mandatory processing step; it would be wise to eliminate spoiled fruit before washing in order to avoid the pollution of washing tools and/or equipment and the contamination of fruit during washing. Washing efficiency can be gauged by the total number of microorganisms present on fruit surface before and after washing - best result are when there is a sixfold reduction.

The water from the final wash should be free from moulds and yeast; a small quantity of bacteria is acceptable. Fruit washing can be carried out by immersion, by spray/ showers or by combination of these two processes which is generally the best solution: pre-washing and washing.

Some usual practices in fruit washing are:

- Addition of detergents or 1.5% HCl solution in washing water to remove traces of insect-fungicides;
- Use of warm water (about 50°C) in the pre-washing phase;
- Higher water pressure in spray/shower washers. Washing must be done before the fruit is cut in order to avoid losing high nutritive value soluble substances (vitamins, minerals, sugars, etc.).
- Firm produce. Fruits with firmer skins like apples, lemons, and pears can benefit from being brushed with a clean, soft bristle to better remove residues from their pores.

Notes

- Delicate produce. Berries, mushrooms, and other types of produce that are more likely to fall apart can be cleaned with a steady stream of water and gentle friction using your fingers to remove grit.

Result and Discussion:

5.3 Demonstration of Peeling and Deseeding

Aim: To obtain the skill of peeling and deseeding

Apparatus: Peeler, Strainer, Fruits

Procedure:

The following methods are demonstrated by the teacher

Peeling

This processing step aims at removing the parts of the fruit which are either not edible or difficult to digest especially the skin.

Up to now the industrial peeling of fruit and vegetables was performed by three procedures:

- Mechanically
- By using steam
- Chemically; this method consists in treating fruit and vegetables by dipping them in a caustic soda solution at a temperature of 90 to 100° C; the concentration of this solution as well as the dipping or immersion time varying according to each specific case.

Orange – Skin is peeled by hand

Apple – Peeler should be used

Pineapple – Knife is used to peel

Deseeding

- Strawberries are crushed between rollers; raspberries are steamed, crushed and passed through sieves to remove the hard cores.
- Plums, peach and apricots are heated with a small quantity of water until they become soft and are then passed through a wide mesh sieve to separate the stones.

Notes

- There are three ways to de-seed tomatoes, depending on how perfect the remaining tomato needs to look.

If making a sauce, cut the tomatoes in half horizontally and squeeze out the seeds.

If making a dish that requires the tomato flesh to be chopped later, cut the tomatoes in half horizontally and scoop out the seeds using a teaspoon.

If making a dish where the de-seeded tomatoes will be on display, cut the tomatoes in half vertically, cut them in half again (into quarters), then carefully cut out the seeds and core using a sharp knife.

- Mangoes are peeled and stones separated.

Result and Discussion:

5.4. Demonstration of Pulper and Juicer

Aim: To gain the skill of using a pulper and juicer

Apparatus: Pulper, Juicer, Fruits

Procedure:

Pulper

Fruit pulping machines are of various sizes for extraction the pulp of most fruits such as tomatoes, mangoes, raspberry, strawberry, papaya, rock melon, jamoon, guava, peach, grapes and bananas.

Figure 1.26. Pulper

The fruit pulper unit consists of two brushes and two beater which give a combined beating and brushing action. The pulper unit can also be supplied with four beater or four brushes depending upon the fruits to be handled. The gap between the sieve and beater/brushes can be adjusted to suit different type of size and qualities of products to be pulped. The sieve is available and perforations of different sizes and is easily removable for cleaning. Food regulation screw ensures correct feeding of products for better performance. All metal contact parts are stainless steel. They are also providing a structure for pulper using mild steel fabricated heavy duty "L" section. All parts can be easily dismantled and reassembled for facility of inspection, proper washing, cleaning, and periodic maintenance.

Juicer

Figure 1.27. Juicer

The following fruits can be made into a juice using a juicer

- Apples
- Berries (small juice content but big flavour)
- Citrus (lemons, limes, oranges, etc.)
- Grapes
- Kiwis
- Melons (Honeydew, watermelon, cantaloupe)
- Pears
- Pineapple
- Tomatoes

Notes

Method

- Peel the skin of the fruits. Chop them.
- For fruits, especially citrus, that means peeling away tough outer skins, peels and pith. They can add bitter and unpleasant flavours to the juice.
- Remove any seeds and hard pits, too, especially those in stone fruits. Not only can damage the juicer and create a bitter taste in the juice, but most contain toxic chemicals. For example, apricot, cherry, peach and plum pits have cyanogenic compounds, which if crushed and ingested, will turn into cyanide in the body.
- Juicers tend to be centrifugal machines. These appliances spin sharp blades at high speeds. Juice is then pushed (and strained) through a mesh sieve underneath that.
- Line the pulp collection bin of your juicer with plastic wrap first. After juicing your items, just pull the wrap out and throw it, pulp and all, into the trash.

Result and Discussion:

5.5 Best Quality Fruit Pulp and Juice

Aim: to gain the skill of assessing the quality of Fruit juice

Apparatus

- Refractometer with degrees Brix scale and

Fruit pulp and juice should adhere to GMP and HACCP standards. A selected variety of fully matured fruits, which are free from any genetic modification are harvested and swiftly transported to the processing units. They are then inspected, washed, blanched, pulped, deseeded and processed. They are hygienically processed to produce a natural fruit pulp and juice that has a wholesome characteristic flavour of the fruit.

In a food processing unit fruit pulp is used to prepare jam, jelly, nectar, dairy beverages, baby products and puddings.

Procedure

1. Bring single-strength or reconstituted juice samples to ambient temperature and mix thoroughly.

Notes

2. Measure sample temperature if refractometer has no automatic temperature compensation.

3. Clean the prisms of the refractometer before each reading with distilled water and soft tissue or nonabrasive materials.

4. Apply an aliquot of sample (~3 drops) to the refractometer prism, avoiding bubbles and large pulp particles.

5. If sample temperature differs from the refractometer's, allow time for adjustment.

6. Cover the sample with the fogged glass and position the light beam to shine through the fogged glass.

7. Adjust the shadow to the cross hairs.

8. Read the °Brix.

V. Calculations

Total soluble solids of citrus juice is expressed in degrees Brix, in equivalent of sucrose solution at 20°C (68°F), after acid correction (Table 1) and temperature correction (Table 2). Acid correction and temperature correction can also be calculated from the %Acid and temperature of juice (see Chapter III, 2).

- For refractometer with ATC:

°Brix C = Refractometer °Brix + Acid Correction

- For refractometer without ATC:

°Brix C = Refractometer °Brix + Acid Correction + Temperature Correction

The weight of the soluble solids in juice is calculated using the following formula:

Soluble Solids (kg) = Juice Weight (kg) x Brix/100

Result and Discussion:

5.6 Preparation of Jam and Jelly

Aim:

To obtain the skill of preparing Jam and Jelly

Apparatus:

Vessels, stove, fruits, sugar, preservatives.

Notes

Procedure:

Jam: Jam is prepared by boiling the fruit pulp with a sufficient quantity of sugar to a thick consistency, firm enough to hold fruit tissues in position. The method for preparation of jam and jelly is the same except that pulp and pieces of fruit are used in jam while, for jelly making clear fruit extract is used. According to FPO specifications, minimum soluble solids in the final product shall not be less than 68 percent.

Procedure for jam preparation

Fruit preparation: The fruit is washed thoroughly to remove any adhering dust and dirt. The fruit is then subjected to preliminary treatment which varies with the type of fruit.

- Strawberries are crushed between rollers; raspberries are steamed, crushed and passed through sieves to remove the hard cores.
- Plums, peach and apricots are heated with a small quantity of water until they become soft and are then passed through a wide mesh sieve to separate the stones.
- Fruit after softening by boiling with small quantity of water can be passed through the pulper to extract the pulp.
- Pears are peeled, cored and cut into small pieces.
- Mangoes are peeled, stones separated and then the slices are passed through a pulper.
- Pineapples are peeled, sliced and the cores punched. The slices are then cut into smaller pieces and passed through a screw type crusher to get a fairly coarse pulp suitable for making the jam.
- When two or more fruits or fruit pulps are mixed in appropriate proportion for preparation of jam, the jam is called as mixed fruit jam.

Addition of sugar: Generally, 55 parts of cane sugar (sucrose) is used for every 45 parts of fruit for preparation of jam. The prepared jam should contain 30 to 50 percent invert sugar to avoid crystallization of sugar in the jam during storage. If the percentage of invert sugar (reducing sugar) is less than 30, then jam develops crystallization and if it is more than 50%, the jam will develop into a honey like mass due to the formation of

Notes

small crystals of glucose. Sugar should not be added in excess as jam with higher total soluble solids becomes gummy and sticky.

Addition of acid, colour and flavour: Citric, tartaric or malic acid are used to supplement the acidity of the fruit for jam making. Addition of acids to fruits which are deficient in acid is required to get appropriate combination of pectin, sugar and acid for proper setting of jam. The pH of the mixture of fruit juice and pectin should be 3.1 before sugar is added. Only permitted edible food colours should be used and these should be added towards the end of the boiling process. Flavours are added at the end of cooking process and just before packing.

Boiling: The fruit is placed in the boiling pan along with a small quantity of water to facilitate pulping. It is then cooked sufficiently to liberate the pectin. After addition of sugar, the mixture is boiled to concentrate the soluble solids to about 68.5 percent and also to allow the necessary degree of inversion of the sugar. Boiling can be performed in steam jacketed kettle or stainless steel or aluminium boiling pan. Boiling in a vacuum pan using reduced pressure is used to prepare jam at lower temperature (65-750C) to minimize undesirable changes and for retention of vitamin.

Storage: The jam is packed in sterilized glass jars. It should be noticed that unless the jars are stored in a fairly cool place, moisture will evaporate from the jam resulting in shrinkage of the jam. If jam is prepared from fresh, it is advisable to add about 40ppm of sulphur dioxide in the form of potassium meta-bi-sulphite to the jam, which is permitted by law. A layer of molten paraffin wax can be put on the top surface of the cooled jam in the glass jar, which on cooling sets. This acts as a safeguard against any possible moulding on the surface of the jam.

2. Jelly: Jelly is prepared by boiling the fruit with or without addition of water, straining the extract and mixing the clear extract with sugar and boiling the mixture to a stage at which it will set to a clear gel. The jelly should be transparent, well set, but not too stiff and having original flavour of the fruit. It should be of attractive colour and should keep its shape with

Notes

a clean cut surface. In the preparation of jellies, pectin is the most essential constituent. Pectin is present in the cell wall of fruits. In order to get a good quality jelly fruits rich in pectin, but deficient in acid should be preferred.

Procedure for jelly preparation

Selection of fruits: The fruits should be sufficiently ripe, but not over ripe and they should have good flavour. Slightly under-ripe fruit yields more pectin than over-ripe fruit; as during ripening the pectin present is decomposed into pectic acid, which does not form a jelly with acid and sugar. The amount of pectin extracted from a fruit depends on the degree of disintegration of protection during the heating process.

Pectin requirement: Usually 0.5 to 1 percent of pectin in the extract is sufficient to produce a good jelly. If the pectin content is in excess, a firm and tough jelly is formed and if it is less, the jelly may fail to set. Pectin, sugar, acid and water are the four essential constituents of a jelly and must be present approximately in the following proportions:

Pectin	- 1 percent
Sugar	- 60 to 65 percent
Fruit acid	- 1 percent
Water	- 33 to 38 percent

However, the exact proportion of the sugar depends on the pectin grade.

Pectin grades: Grades of pectin means the weight of sugar required to set one gram of pectin under suitable conditions to form a satisfactory jelly. e.g. 100 grade pectin means 100g of sugar is required for setting of 1 g pectin.

Mixed Fruit Jam

Ingredients

Papaya	– 4 nos.
Sapota	– 6 nos.
Apple	– 12 nos.
Banana	– 12 nos.

Pineapple	– 1 no.
Black grapes	– ½ kg
Sugar	– 6 kg
Citric acid	– 30 gms
Sodium benzoate	– 6 gms

Figure 1.27. Mixed Fruit Jam

Method:

- Take pulp from all the fruits.
- Pass it through the strainer and then cook.
- To the cooked pulp add equal quantity of sugar and cook on fire till the required consistency is got.
- Dissolve 6 tsp. of citric acid and cook for 10 minutes before removing from the fire and test for doneness. Add raspberry red colour, strawberry essence / pineapple essence and sodium benzoate.
- Mix and bottle it immediately.

Notes

Yield: 12 bottles of 200g each.

Precautions:

- To get uniform consistency the pulp should be passed through a strainer.
- Citric acid should not be added in the beginning, otherwise inversion of sugar may take place.
- The jam bottles should be placed on a wooden plank while filling.
- No head space should be left on top of the bottle.
- Close the bottles after the jam cools.
- Overripe fruits should not be used as it produces a pasty product

Theory of Jelly Formation:

Jelly formation is due to the precipitation of pectin rather than its swelling. Only when the pectin, acid, sugar and water are in definite equilibrium range, the precipitation of pectin takes place.

The Rate of Precipitation:

It is influenced by the following factors

1. Concentration of pectin in the solution
2. Constitution of pectin
3. Hydrogen ion concentration (pH) of the pectin solution (for good jelly preparation pH value should be 3.2)
4. Concentration of sugar in solution
5. Temperature of the mixture

Cooking of jelly: Cooking promotes cohesion of jelly components and also brings them to a setting state. The mixture should be concentrated as rapidly as possible to avoid destruction of pectin. To achieve this, only that quantity of juice should be handled which can be boiled down to the desired consistency in about 20 mintues. If jelly is cooked for prolonged periods it may become gummy and sticky and may deteriorate in colour and flavour.

Notes

Jelly Preparation: Guava Jelly

Figure 1.28. Guava Jelly

Ingredients Needed:

Fruit juice - 1 litre

Sugar - 500 g

Essence - ¼ tsp.

Citric acid - ¼ tsp.

Preservative - ¼ tsp.

Preparation:

- Guava is rich in pectin content
- Ripe guavas with plenty of pulp are used. Wash the fruits and cut into thin slices
- Add water to cover the surface then boil
- Do not stir the contents when it is boiling because Jelly formation will be delayed
- Strain the fruit juice
- Then add sugar and citric acid and boil again
- Add essence and preservatives when it is fully boiled and test for an end point
- Cool it after putting in jelly moulds
- Finished jelly is stored in sterilized containers

Result and Discussion:

Notes

5.7 Determination of End point in Jam and Jelly

Aim: To know the tests for end point in jam and Jelly preparation.

Equipment needed: Plates, fork, sauce pan, cutting board, knife, vessels.

Determination of End Point for Jam: In order to make a product of uniform quality, a definite quantity of fruit and sugar should always be used. Cooking should be done properly. Doneness of jam is determined by the following tests.

1. Cold Plate Test: Keep a plate in the freezer for some time. Place a drop of the boiling jam on the plate and tilt it slightly. The jam should come down as a whole mass forming U shape. Water should not separate out.

2. Fork Test: Dip the fork into jam or jelly. Jam of correct consistency forms a sheet between the needles of the fork.

3. Sheet Test: The mixture is allowed to drip from a large cool spoon or wooden ladle, cooled slightly and then allowed to drop off. If the syrup forms a sheet instead of two separate drops, the jam is done.

4. Bubble Test: When the end point reaches, big bubbles can be seen throughout the jam mass.

5. Jel meter test: Generally, fruits which are fairly rich in pectin, the weight of the finished jam is one and a half times (11/2 times) the weight of sugar used. Jam containing 68.5 percent of soluble solids boils at 105°C at sea level. It should yield a definite quantity of the finished jam.

Determination of End point for Jelly: The end-point in jelly can be judged by using following methods:

1. Cold plate test: A drop of the boiling liquid from the pan is taken and placed on a plate and allowed to cool quickly. If the jelly is about to set, the mixture on the plate will crinkle when pushed with a finger. The main drawback in this method is that while the drop on the plate is cooling, the jelly mixture continues to boil in the pan and there is a risk of over-cooking the product or of missing the correct setting point.

2. Sheet or flake test: This test is more reliable than the plate test. A small portion of jelly is taken with a large spoon or wooden

Notes

ladle, cooled slightly and then allowed to drop off. If the jelly drops like syrup, it requires further concentration. Falling of the drop in the form of flakes or sheet indicates the end point.

Result and Discussion:

5.8 Preparation of Tomato Ketchup

Aim: To know about the preparation of tomato sauce.

Equipment needed: Sauce pan, mixie, spatula, ladles, cutting board, knives.

Importance of Tomato Ketchup:

- Fresh tomatoes are highly refreshing and appetizing. They are good source of vitamins, particularly Vitamin 'C'.
- Large quantities of tomato sauces and ketchups are popular and are manufactured mostly in small units.
- Since tomatoes are available practically throughout the year in our country, there is scope for setting up a large-scale tomato processing industry.
- Tomato products are judged by their colour, which in turn, depending on the degree of redness of tomatoes. Use only plant ripened red tomatoes.

Tomato Ketchup

Figure 1.29. Tomato Ketchup

Notes

Ingredients

Tomato	– 1kg
Garlic	– 5g
Onions	– 10g
Red chillies	– 5g
Salt	– to taste
Citric acid	– 2g
Cloves	– 3g
Cinnamon	– 3g
Black pepper	– 5g
Cumin seeds	– 3 g
Sodium Benzoate	– 1g
Sugar	– 40g

Method:

- Wash, cut and boil tomatoes.
- Add cut onion and garlic. Boil till tender.
- Strain and extract thick juice. Grind all the spices and tie in a loose bag.
- Drop this in the juice and boil.
- Add sugar and salt gradually.
- Press the spice bag regularly to extract the flavours.
- Cook till end point is reached.
- Remove from fire and add preservatives and citric acid.
- Bottle when still hot.
- Store in a cool and dry place.

Result and Discussion:

Table1: Acid corrections (AC) to be added to temperature-compensated Brix readings from refractometer

%Acid	AC	%Acid	AC	%Acid	AC	%Acid	AC
00	0.00	6.0	1.15	12.0	2.27	18.0	3.35
0.2	0.04	6.2	1.19	12.2	2.31	18.2	3.38
0.4	0.08	6.4	1.23	12.4	2.36	18.4	3.42
0.6	0.12	6.6	1.27	12.6	2.39	18.6	3.45
0.8	0.16	6.8	1.30	12.8	2.42	18.8	3.49
1.0	0.20	7.0	1.34	13.0	2.46	19.0	3.52
1.2	0.24	7.2	1.38	13.2	2.50	19.2	3.56
1.4	0.28	7.4	1.42	13.4	2.54	19.4	3.59
1.6	0.32	7.6	1.46	13.6	2.57	19.6	3.63
1.8	0.36	7.8	1.50	13.8	2.61	19.8	3.68
2.0	0.39	8.0	1.54	14.0	2.64	20.0	3.70
2.2	0.43	8.2	1.58	14.2	2.69	20.2	3.73
2.4	0.47	8.4	1.62	14.4	2.72	20.4	3.77
2.6	0.51	8.6	1.66	14.6	2.75	20.6	3.80
2.8	0.54	8.8	1.69	14.8	2.78	20.8	3.84
3.0	0.58	9.0	1.72	15.0	2.81	21.0	3.88
3.2	0.62	9.2	1.76	15.2	2.85	21.2	3.91
3.4	0.66	9.4	1.80	15.4	2.89	21.4	3.95
3.6	0.70	9.6	1.83	15.6	2.93	21.6	3.99
3.8	0.72	9.8	1.87	15.8	2.97	21.8	4.02
4.0	0.78	10.0	1.91	16.0	3.00	22.0	4.05
4.2	0.81	10.2	1.95	16.2	3.03	22.2	4.09
4.4	0.85	10.4	1.99	16.4	3.06	22.4	4.13
4.6	0.89	10.6	2.03	16.6	3.09	22.6	4.17
4.8	0.93	10.8	20.6	16.8	3.13	22.8	4.20
5.0	0.97	11.0	2.10	17.0	3.17	23.0	4.24
5.2	1.01	11.2	2.14	17.2	3.21	23.2	4.27
5.4	1.04	11.4	2.18	17.4	3.24	23.4	4.30
5.6	1.07	11.6	2.21	17.6	3.27	23.6	4.34
5.8	1.11	11.8	2.24	17.8	3.13	23.8	4.38

* Bassed on citric acid content of citrus juices or other acid-containing sugar solutions.

** For % Aeid values between the list numbers, use the average of the nearest lower and higher corredtion values.

Table 2: Temperature corrections for °Brix readings of percent sucrose in sugar solutions by either Abbe or immersion refractometer at temperature other than 20°C (68°F)

Temp.		Pcroent Sucrose													
°C	°F	0	5	10	15	20	25	30	35	40	45	50	55	60	65
Subtract from Percent Sucrose															
10	50.0	.50	.54	.58	.61	.64	.66	.68	.70	.72	.73	.74	.75	.76	.78
11	51.8	.46	.49	.53	.55	.58	.60	.62	.64	.65	.66	.67	68	.69	.70
12	53.6	.42	.45	.48	.50	.52	.54	.56	.57	.58	.59	.60	.61	.61	.63
13	55.4	.37	.40	.42	.44	.46	.48	.49	.50	.51	.52	.53	54	.54	.55
14	57.2	.33	.35	.37	.39	.40	.41	.42	.43	.44	.45	.45	.46	.46	.47
15	59.0	.27	.29	.31	.33	.34	.34	.35	.36	.37	.37	.38	.39	.39	.40
16	60.8	.22	.24	.25	.27	.27	.28	.28	.29	.30	.30	.3	.31	.31	.32
17	62.6	.17	.18	.19	.20	.21	.21	.21	.22	.22	.23	.23	.23	.23	.24
18	64.4	.12	13	.13	.14	.14	.14	.14	.15	.15	.15	.15	.16	.16	.16
19	66.2	.06	.06	.06	.10	.07	.07	.07	.08	.08	.08	.08	.08	.08	.08
Add to Percent Sucrose															
21	69.8	.06	.07	.07	.07	.07	.08	.08	.08	.08	.08	.08	.08	.08	.08
22	71.6	.13	.13	.14	.14	.15	.15	.15	.15	.15	.16	.16	.16	.16	.16
23	73.4	.19	.20	.21	.22	22	.23	.23	.23	.23	.24	24	.24	.24	.24
24	75.2	.26	.27	.28	.29	.30	.30	.31	.31	.31	.31	.31	32	.32	.32
25	77.0	.33	.35	.35	.37	.38	.38	.39	.40	.40	.40	.40	.40	.40	.40
26	78.8	.40	.42	.43	.44	.45	.46	.48	.48	.48	.48	.48	.48	.48	.48
27	80.6	.48	.50	.52	.53	.54	.5l	.55	.56	.56	.56	.56	.56	.56	.56
28	82.4	.56	.57	.60	.61	.62	.63	.63	.64	.64	.64	.64	64	.64	.64
29	84.2	.64	.66	.68	.69	.71	.72	.72	.73	.73	.73	.73	.73	.73	.73
30	86.0	.72	.74	.77	.78	.79	.80	.80	.81	.81	.81	.81	.81	.81	.81

Project

- Visit a jam making unit and find out about the large-scale process
- Visit a tomato ketchup preparation unit and learn the process

Notes

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M. Shadaksharaswamy Formerly, Professor of Biochemistry, Head of the Department of Chemistry, Dean Faculty of Science Bangalore University

Bangalore (Karnataka)

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY (STUDY MATERIAL)

Course Title: Fruit and Vegetable Processing by Sri S.Chenna Kesava Reddy

Part-Time Teacher, CFST, Pulivendula & Mrs.R.Preethi Sagar Part-Time Teacher, CFST, Bapatla.

Check the reference format

Ingredients quantity in gms not in teaspoon..

Unit 2

UNDERSTAND PACKAGING

Learning Outcomes

- Understanding the term packaging
- Acquire knowledge about suitable packaging materials for jam, jellies and ketchup
- Gaining knowledge on deaeration, sterilization and aseptic packaging
- Learning the types and importance of packaging materials used for fruits and vegetable products.

2.1.0 Introduction

Fruits and vegetables play a vital role in healthy nutrition and are primarily important on the list of consumer priorities. However, the major obstacle in purchasing ready-to-eat fresh-cut fruits and vegetables is their short shelf life, leading to quick degeneration and decomposition of the product, undesirable look and negative palatability. Processing and packaging are the two important phases of operations in the food industry and the final phase is the

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packaging stage. The correct packaging allows processors to pack fresh, fresh-cut fruits and vegetables and this extends their shelf life. Packaging is the science, art, and technology of enclosing or protecting products for distribution, storage, sale, and use.

History

Figure 2.1. Packaging Materials

The history of packaging originated in the year 1035, when a Persian traveler, visited markets in Cairo, he observed that vegetables, spices and hardware were wrapped in paper for the customers when they were sold or purchased. In the due course of time, the basket of reeds, wooden boxes, pottery vases, woven bags etc., were used for wrapping things. However, in the 19th century, the use of cardboards, paperboards and cartons were traced.

Michigan State University was the first to offer a degree course in "Packaging Engineering", since then there has been no looking back. Eventually, the packaging industry has boomed as more than before. Packaging plays an important role in marketing and "packaging" drew the attention of the buyer.

Figure 2.2. Bakelite Closures

There was a revolution in the field of "packaging" in the early 20th century due to several modes of packaging. Different types of packaging were designed such as Bakelite closures on bottles, transparent cellophane over-wraps and panels on cartons increased processing efficiencies and ensured food safety. Additionally, materials such as aluminum foils and several types of plastic were developed and they were incorporated into packages to improve performance and functionality.

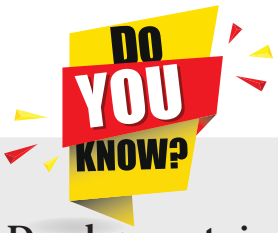
2.1.1. Definition

Figure 2.3. Bottling of Products

Packaging is defined as a socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in the best condition intended for their use. The word 'package' means the physical entity that contains the product. Packaging can also be defined as a coordinated system of preparing goods for transport, warehousing, logistics, sale, and end use. Packaging conclusively contains, protects, preserves, transports, informs and sells.

The terms packing and packaging are synonymously used but their meaning varies. Packaging is a process of covering the product itself so that it is protected from damage, leakage, dust, pollution and contamination. Examples of packaging are Chocolates packaged in a thin sheet, milk packaged in sachets etc.

Figure 2.4. Packaging Chest



Developments in packaging

7000 BC: The adoption of pottery and glass which saw industrialization around 1500 BC

1800: Nicolas Appert in response to extending shelf life of food for the French Army employed the use of glass bottles in thermal food treatment which was later replaced by metal cans.

1870: The use of paper board was launched and corrugated materials patented.

1880s: First cereal packaged in a folding box by Quaker Oats.

1890s: Crown cap for glass bottles was patented by William Painter.

1940s: Aerosol was first used by the marines during the World War II in pesticides application.

1960s: Development of the two-piece drawn and wall-ironed metal cans in the USA, the ring- pull opener and the Tetra Brik Aseptic carton package.

1970s: 1970 Barcode system was introduced in the retail and manufacturing industry. PET plastic blow-mold bottle technology widely used in the beverage industry was introduced.

1990s: The application of digital printing on food packages became widely adopted.

Packaging refers to the process of wrapping or bottling of products to make them safe from damages during transportation and storage. It keeps a product safe and marketable and enables in identifying, describing, and promoting the product.

Packing can be defined as the enclosing of an individual item or items in a package or container. Packing means putting all the packages in a huge box, container, chest, crate etc. for the purposes of storage, transportation and handling. Henceforth the functions of packing and packaging, in the present context have gone beyond the basic expectations of protection of the product.

2.1.2 Objectives of packaging

- To provide Physical Protection
- To enable Marketing
- To convey a Message
- To provide Convenience
- To provide Containment or Agglomeration
- To provide Portion Control
- To allow Product Identification
- To enhance Profits
- To enable Self-Service Sales
- To magnify Brand Image

2.1.3 Important Features of packaging

In developing the marketing plan for a product in International market, packaging is an important element. Packaging should be viewed from its promotional and protection characteristics.

(a) Promotional Aspect of Packaging

Figure 2.5. Promotional Aspect of Packaging

Packaging of a product plays an inevitable role in promotion of a product in the international markets. With the emergence of self-service in super markets, the package of a product serves as a 'silent sales man'.

(b) Protection Aspect of Packaging

The second important aspect of packaging is its protection feature which it provides to

the product, consumer packaging aims to offer better convenience to consumers in use and in storage.

It protects the product from:

Figure 2.6. Protection Packaging

- Pilferage and adulteration
- Product loss
- Contamination by dirt or dust
- Moisture gain or loss
- Chemical change
- Insect attack

(c) Transport Packaging Protection during Transit:

The basic function of transport packaging in International marketing is to assure that the goods would reach safely in the hands of consumers. The materials used in packaging should shield the goods from the ill-effects of moisture, gas, light, air, etc. so that the goods may not lose its attributes, shape, weight, stability, fragility, rigidity, surface finish and durability etc. Therefore packaging plays an important role in the process storage, preservation, protection and distribution.

(d) Legal Provisions:

The mandatory provisions as to packaging of the goods imported also have important bearing on the packaging of goods.

1) A utensil or container should be made of the following materials or metals, when used in the preparation, packaging and storing of food and deemed to render it unfit for human consumption:—

- containers which are rusty

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- enameled containers which have become chipped and rusty;
- copper or brass containers which are not properly tinned
- containers made of aluminium not conforming in chemical composition to IS:20
- Specification for Cast Aluminium and Aluminium Alloy for utensils or IS:21 specification for Wrought Aluminium and Aluminium Alloy for utensils.

2) Containers made of plastic materials should conform to the following Indian Standards Specification, used as appliances or receptacles for packing or storing whether partly or wholly, food articles namely :—

- IS : 10146 (Specification for Polyethylene in contact with foodstuffs);
- IS : 10142 (Specification for Styrene Polymers in contact with foodstuffs);
- IS : 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs);
- IS : 10910 (Specification for Polypropylene in contact with foodstuffs);
- IS : 11434 (Specification for Ionomer Resins in contact with foodstuffs);
- IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer.
- IS: 12252 - Specification for Polyalkylene Terephathalates (PET).
- IS: 12247 - Specification for Nylon 6 Polymer;
- IS: 13601 - Ethylene Vinyl Acetate (EVA);
- IS: 13576 - Ethylene Metha Acrylic Acid (EMAA);
- Tin and plastic containers once used, shall not be re-used for packaging of edible oils and fats; Provided that utensils or containers made of copper though not properly tinned, may be used for the preparation of sugar confectionery or essential

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oils and mere use of such utensils or containers shall not be deemed to render sugar confectionery or essential oils unfit for human consumption.

3) General packaging requirements for canned products,

- All containers should be securely packed and sealed.
- The exterior of the cans should be free from major dents, rust, perforations and seam distortions.
- Cans should be free from leaks

2.1.4 Qualities of Good Packaging

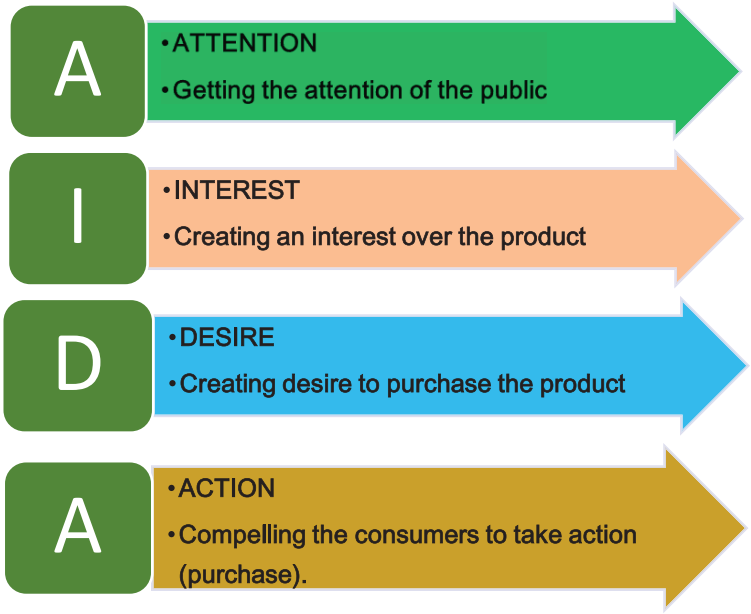
- Attractive appearance
- Convenient for storage and display
- Safety of goods
- Product description shown on package.
- Recognizable
- Eye-appealing package.
- Transport economies
- Uniformity and consistency.
- Convenience in transport handling
- Capable of withstanding hazards of transport
- Amenable to quick examination of contents; for example in case of export and import by customs and authorities.
- Easy to dispose it after opening of goods.
- Proper and adequate marking.
- Proper instructions like –'This side up', 'Fragile' and, 'Handle with Care'

2.1.5 Points to be considered while Packaging:

- Cost of packaging
- Appearance
- Kinds of designs
- Convenience
- Reuse

(a) AIDA Formula for Packaging:

This formula represents four basic requirements.



Flowchart 2.1. AIDA Formula for Packaging

(b) Packaging cost

The most important aspect of packaging is the packaging cost. In spite of its various advantages, packaging has been subjected to criticisms. One among them is its cost. It is true that packaging expenses definitely increase the cost. But the benefits derived are sufficient to compensate the increase in the cost.

Packaging cost includes the following

1. Material cost –cost of the pack and quality control cost.
2. Storage and handling cost of empty packages –handling cost of bulky packages, heavy materials of construction, drums, etc.
3. Packaging operation cost –the cost involved in operations like cleaning the package, product filling, closing, labeling, unitizing, stenciling, handling cylindrical drums, etc.
4. Storage of filled packages –the cost incurred to shift the goods from one form of packaging to another.
5. Transportation cost of filled packages –the transportation cost by sea, air and road.

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6. Loss and damage cost –loss and damage during operation, transportation, delivery.
7. Insurance cost – It varies depending on the vulnerability of package.
8. Effect of packages on sales – The package that influences the sales.
9. Obsolescence cost - when changes in the packaging materials, packages and labels happen.
10. Package developmental cost –the evaluation cost, pilot test cost, field testing cost, consumer research cost, feedback cost, final trial cost, etc.

Packaging is important because it aids food distribution, and rapid and reliable distribution helps remove local food surpluses, allows consumers more choice in the foods available and helps to reduce malnutrition. Packaging also reduces post harvest losses, which together with giving access to larger markets, allow producers to increase their incomes.

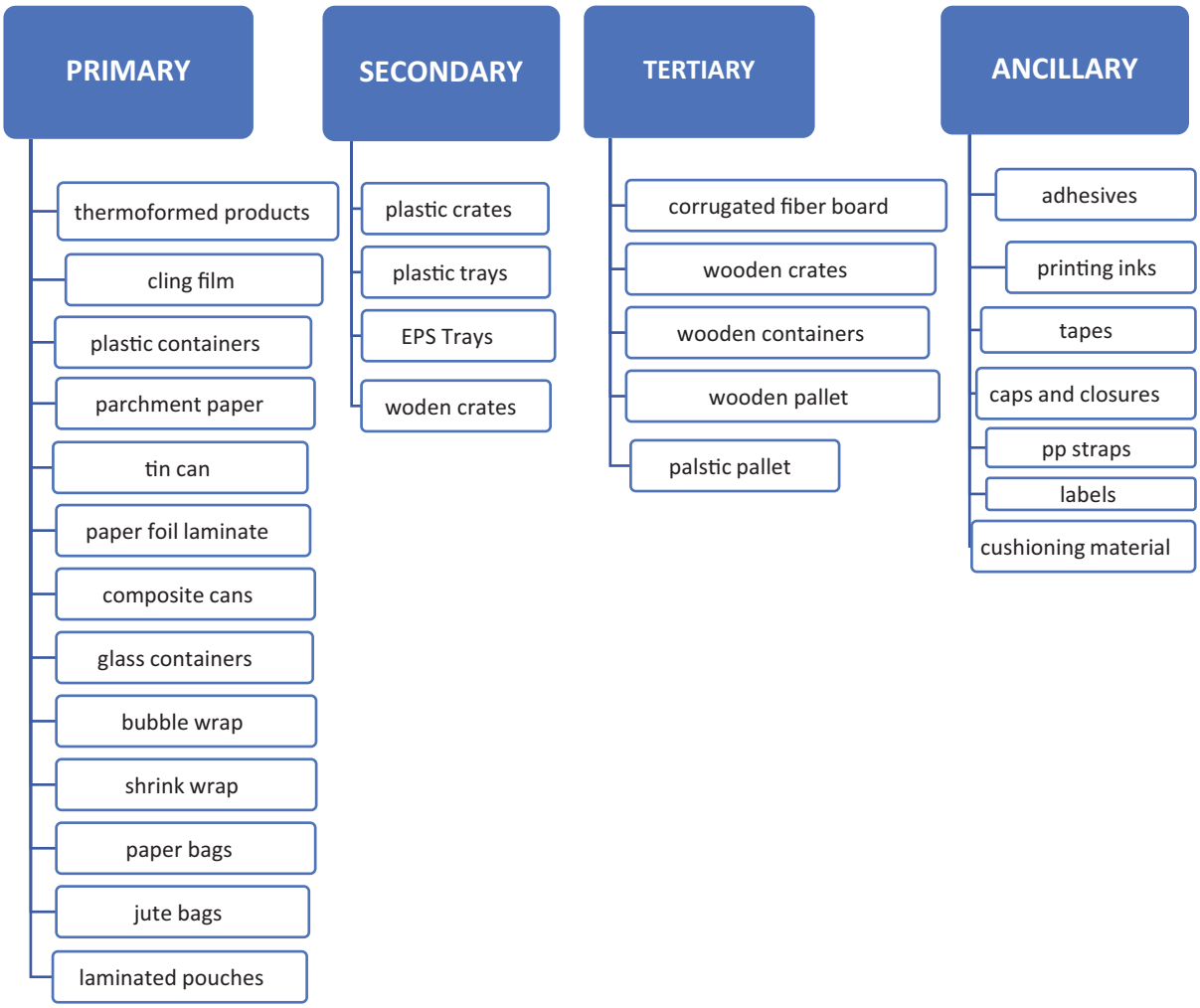
Activity 1:

List some packaging materials used in your daily life and find their qualities.

2.2.0 Types of Packaging Material for Used Fruits and Vegetable Products

Packaging fresh fruits and vegetables is one of the most important steps in the long and complicated journey from grower to consumer. Bags, crates, hampers, baskets, cartons, bulk bins, and palletized containers are convenient for handling, transporting and marketing fresh produce. Packing and packaging materials contribute a significant cost to the production industry; therefore it is important that packers, shippers, buyers, and consumers have a clear understanding about the wide range of packaging options that are available.

2.2.1 Types of packaging materials



Flowchart 2.2. Types of Packaging Materials

2.2.2 Kinds of Materials used for Packaging

Figure 2.7. Earthenware

Packaging for foodstuffs comes in many different forms, based on technical requirements throughout the supply chain, as well as marketing needs (like brand identity or consumer information) and other criteria. Materials that have traditionally

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been used in food packaging include glass, metals (aluminum, foils and laminates, tinplate, and tin-free steel), paper and paperboards, and plastics. Moreover, a wider variety of plastics have been introduced in both rigid and flexible forms. Today's food packages often combine several materials to exploit each material's functional or aesthetic properties.

Figure2.8. China Jars

1. **Earthenware –** It is a traditional and an old method of preserving products of liquid nature.
2. **Wooden boxes –** They prevent breakage due to rough handling.
3. **Cardboard containers –** These are mostly used in specialist goods which are not bulky.
4. **China jars –** They are used where protection is required against light and corrosive action.
5. **Straw baskets –** These are meant for storing vegetables.
6. **Gunny bags –** Gunny bags are popular for packing goods like rice, grains, sugar, cement, white and colour washing materials, etc. Gunny bags cannot give protection to the goods.
7. **Glass –** Glass is used to pack liquid products. It affords protection against the action of chemicals.

Figure 2.9. Cushion Materials

8. **Tin containers –** Tin containers are used to pack liquid and solid products. They are light and strong.

9. **Plastic containers –** Plastic containers are gaining extreme popularity. Plastic containers are used to pack liquid and solid products. It involves low cost, good appearance, convenience and ability for reuse.

10. **Paper bags –** Paper bags are used to pack products which are in solid form. They are commendable. But their limitations are that the freshness of the product cannot be preserved.

11. **Cellophane paper –** Cellophane is a good substitute for paper as a packing material. It protects the contents from moisture, but it cannot protect the products against harmful effects of light.

12. **Cushion materials:** Cushioning is a part of packaging, which protects the article from damage due to shock and vibration.

Activity 2

Find out some commonly used cushion materials for packaging food products .

2.2.3 List of suggestive packaging materials for Fruit and Vegetable products

- Glass bottle with metal caps or plastic (polypropylene (PP) or High-density polyethylene (HDPE) caps.
- Aluminum can with the easy open end.
- Tinplate container.
- Aseptic and flexible packaging material (Paper board or Aluminium foil or polyethylene) based multi-layered structure.
- Plastic rigid container (jar) made of either High-density polyethylene (HDPE) or Co-extruded structure with Plastic (polypropylene (PP) or High-density polyethylene (HDPE) caps.
- Stand up Pouch made up of Plastic based structure with the plastic spout.
- Flexible Plastic pouch made of either polyethylene (PE) or Laminated structure.
- Thermoformed Plastic container (Blister Pack) with aluminum foil or polyethylene (PE) based lid.

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- Plastic jar (Co-extruded) with metal caps.
- Plastic trays with overwrap.
- Polyethylene terephthalate (PET) or polypropylene (PP) or Poly Vinyl Chloride (PVC) Punnets

2.2.4 Packaging Requirements

The layer that is in direct contact with the food or beverage is called "food contact material". For some types of food packaging the food contact material determines the name

- In plastic bottles the materials in contact with the foodstuff are plastic
- In glass jars the materials in contact with the foodstuff are glass and coated metal from the closure.
- In beverage cartons the direct food contact layer is not carton, it is a laminated plastic.
- In aluminium cans a coating is in direct contact with the beverage.

The term food contact material applies to food and beverage packaging, but also to any other materials that come into contact with food, either during storage, processing and filling, or consumption like cooking utensils.

(a) Qualities of good packaging material

- They must be non-toxic and compatible with specific foods.
- Resistance to impact
- Transparency
- Tamper proofness
- Ease of opening
- Pouring features
- Reseal features
- Ease of disposal
- Size, Shape, Weight limitations
- Appearance, Printability
- Low cost

(b) Functions of Food Containers

- Sanitary protection
- Moisture protection
- Gas and odour protection
- Light protection

(c) Factors for selecting a packaging material for food storage

Flowchart 2.3. Factors for Selecting a Packaging Material for Food Storage

2.2.5 Generally used packaging materials

(a) Wood

(b) Paper

(c) Plastic

(d) Metals

(e) Glass

(f) Films and foils

(a) Wood

Figure 2.10. Pallets

Wood is widely used for packaging fresh products; its use is limited when dealing with processed foods. The most common applications are:

- Barrels for wines, beers, spirits, salted fish and vegetables in brine.
- Wooden crates, particularly for bottles that are returnable.
- Small fancy boxes for foods aimed at a tourist or gift market, to construct pallets.

1. **Pallets** literally form the base on which most fresh produce is delivered to the consumer. Pallets were first used during World War II as an efficient way to move goods.

2. **Pallet Bins** Substantial wooden pallet bins of a milled lumber or plywood are primarily used to move products from the field or orchard to the packing house.

Figure 2.11. Pallet Bins

3. **Wire-Bound Crates.** Although alternatives are available, wooden wire-bound crates are used extensively for snap beans, sweet corn and several other commodities that require hydro cooling.

4. **Wooden Baskets and Hampers.** Wire-reinforced wood veneer baskets and hampers of different sizes were once used for a wide variety of crops from strawberries to sweet potatoes

(b) Paper and paperboard

Paperboard is the general name given to a variety of different types of materials that are used to make boxes, cartons and trays to package foods. They can be used as shipping (outer) containers or as consumer packs, but only a few types of materials can be used directly in contact with foods.

Figure 2.12. Paperboards

Paper and paperboard are sheet materials made from an interlaced network of cellulose fibers derived from wood by using sulfate and sulfite. The fibers are then pulped and/or bleached and treated with chemicals such as slimicides and strengthening agents to produce the paper product. Paper and paperboards are commonly used in corrugated boxes, milk cartons, folding cartons, bags and sacks, wrapping paper, Tissue paper, paper plates, and cups.

Paper, cardboard Paper and boards are made from wood pulp and additives are mixed into the pulp to give particular properties to the packaging, the additives are

- Fillers such as china clay, to increase the brightness of paper and improve surface smoothness and printability.

- Binders, including starches, vegetable gums, and synthetic resins to improve the strength.
- Resin or waxing agents to reduce penetration by water or printing inks.
- Pigments to colour the paper and other chemicals to assist in the manufacturing process

1) Different types of paper used for wrapping foods are:

Figure 2.13. Sulphate Paper

- **'Sulphate'paper** is strong and used for single-or multi-walled paper sacks for flour, sugar, fruits and vegetables

Figure 2.14.Sulphite Paper

- **'Sulphite' paper** is lighter and weaker and is used for grocery bags and sweet wrappers, as an inner liner for plastic biscuit wrappers and laminated with plastic films.
- **Tissue paper** is a soft paper used for example to protect fruits against dust and bruising.
- **Paper and Mesh Bags** are used for consumer packs of potatoes and onions.

Figure 2.15. Grease Proof Paper

- **Grease proof paper** is sulphite paper made resistant to oils and fats, and used to wrap meat and dairy products.

- **Wax is laminated between layers of paper and/or polyethylene is** used for bread wrappers and inner liners for cereal cartons.

'Paperboard' is a term that includes boxboard, chipboard and corrugated or solid fiber boards. Paperboard has the following structure:

- A top layer of white material to give surface strength and printability.
- Middle layers of grey/brown lower grade material.
- An under-layer of white material to stop the colour of the middle layer showing through.
- A back layer if strength or printability is required. All layers are glued together with adhesive.

2. Uses of Different types of paperboards:

Figure 2.16. White Board

- **White board** is suitable for contact with foods and is often coated with wax or laminated with plastic to make it heat sealable. It is used for ice cream, chocolate and frozen food cartons.
- **Chipboard** is made from recycled paper and is used for example as the outer cartons for tea or cereals but not in contact with foods.

Figure 2.17. Chipboard

- **Molded paperboard** trays for eggs, fruit, meat or fish or for egg cartons.

- **Small paperboard tubs** or cans are used for snack foods, confectionery, nuts, salt, cocoa powder and spices
- **Larger drums** are used as a cheaper alternative to metal drums for powders and dry foods, when lined with polyethylene, used for cooking fats, fruit and vegetable products, peanut butter and sauces.
- **Pulp Containers are** Containers made from recycled paper pulp and a starch binder is mainly used for small consumer packages of fresh products.

Figure 2.18. Pulp Containers

- Corrugated board used for shipping containers
- Corrugated cartons are used as shipping containers for bottled, canned or plastic-packaged foods.
- Corrugated board with polyethylene or a laminate of wax-coated greaseproof paper used for chilled bulk meat, dairy products and frozen foods.

Paper and card packaging are lightweight and low cost in comparison to metal and glass. It is also a widely recyclable and compostable material. However, the barrier integrity of paper based packaging is compromised when in contact with moisture and humidity, making it easier to tear or damage.

Activity 3

Find out the type of paperboard used for packaging the following foods

1. Trays for eggs

2. Peanut butter and sauces

3. Chocolate and frozen food cartons

4. Chilled bulk meat

5. Canned or plastic-packaged foods

(c) Plastics

Figure 2.19. Shrink Wrap

Food Grade Plastic – Food grade plastic packaging is one of the best materials for the food safety and quality of a product. Plastic has good barrier qualities, meaning it protects the food once wrapped from potential contaminants. The barrier qualities of packaging will also impact the shelf life of a product and prevent it from spoilage or reducing in quality which, in turn, reduces food waste going to landfill. Some food grade plastics are also recyclable. Plastic can be made into sheets, shapes, and structures, offering considerable design flexibility. Because they are chemically resistant, plastics are inexpensive and lightweight with a wide range of physical and optical properties. In fact, many plastics are heat sealable, easy to print, and can be integrated into production processes where the package is formed, filled, and sealed in the same production line.

1. Different types of plastics used for packaging foods are:

- **Plastic Bags.** Plastic bags (polyethylene film) are the predominant material for fruit and vegetable consumer packaging.
- **Shrink Wrap.** One of the newest trends in product packaging is the shrink wrapping of individual product items. Shrink wrapping has been used successfully to package potatoes, sweet potatoes, apples, onions, sweet corn, cucumbers and a variety of tropical fruits.
- **Rigid and semi-rigid plastic containers.** Packages with a top and bottom and a one-piece container formed from one or two pieces of plastic is known as clamshell. Clamshells are gaining in popularity because they are inexpensive, versatile, provide excellent protection to the produce, and present a very pleasing consumer package. Clamshells are most often used with consumer packs of high value produce items like

small fruit, berries, mushrooms, etc., or items that are easily damaged by crushing.

Figure 2.20. Clamshell

d. Plastic sheets

- Cellophane paper can be used for packing dried products, mainly for dry fruits.
- Polyethylene sheets are a good packing material for primary protection of dehydrated products. If a good protection is needed to prevent flavour and gas losses, it will be necessary to combine polyethylene with other materials.

(d) Metal

Metal containers commonly used in the food industry include steel drums, tins with push-on or screw-on closures, sanitary cans (the 'tin' can), composite cans (usually a combination of paper board and steel), aerosols, aluminium cans and aluminium foil made into dishes, etc. Cans are used for packaging and preserving food. Fruit juices, fruit in syrup, tomatoes, vegetables, meats, fish and dried goods can be canned.

(1) Aluminium

Figure 2.21. Aluminium Cans

Aluminium is commonly used to make cans, foil, and laminated paper or plastic packaging; aluminium is a lightweight, silvery white metal.

(2) Tin can/ tinplate

Figure 2.22. Tin Can

The "tin can" is a container made of tinplate. Tinplate is a rigid and impervious material and consists of a thin sheet of low carbon steel coated on both sides with a very thin layer of tin. In addition to its excellent barrier properties to gases, water vapor, light, and odors, tinplate can be heat-treated and sealed hermetically, making it suitable for sterile products. Tin is not completely resistant to corrosion but its rate of reaction with many food materials is considerably slower than that of steel.

(e) Glass

Figure 2.23. Glass Bottles

Glass has an extremely long history in food packaging. It is impermeable to gases and vapours, so it maintains product freshness for a long period of time without impairing taste or flavour. As far as food packaging is concerned, glass is chemically inert, although the usual problems of corrosion and reactivity of metal closures will of course apply. The principal limitation of glass is its susceptibility to breakage, which may be from internal pressure, impact, or thermal shock, all of which can be greatly minimized by proper matching of the container to its intended use and intelligent handling practices.

(e) Films and foils

Figure 2.24. Aluminium Foil

Films and foils have different values for moisture and gas permeability, strength, elasticity, inflammability and resistance to insect penetration and many of these characteristics depend upon the film's thickness.

(1) Aluminium foil Aluminium foil is made by rolling pure aluminium metal into very thin sheets, followed by annealing to achieve dead-folding properties (a crease or fold made in the film will stay in place), which allows it to be folded tightly.

(2) Flexible plastic films

Figure 2.25. Flexible Plastic Films

There is a very wide choice of plastic films made from different types of plastic polymer. Each can have ranges of mechanical, optical, thermal and moisture/gas barrier properties. These are produced by variations in film thickness and the amount and type of additives that are used in their production. e.g., polyester, polyethylene, polypropylene

Different types of flexible plastic films

- Cellulose - Plain cellulose is a glossy transparent film that is odourless, tasteless and biodegradable (within approximately 100 days).It is tough and puncture resistant, although it tears

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easily. It has dead-folding properties that make it suitable for twist-wrapping (e.g. sugar confectionery). It is used for foods that do not require a complete moisture or gas barrier, including fresh bread and some types of sugar confectionery.

- Cellulose acetate is a clear, glossy transparent, sparkling film that is permeable to water vapour, odours and gases and is mainly used as a window material for paperboard cartons.
- Polyethylene (or polythene)
  - Low-density polyethylene (LDPE) is heat sealable, inert, odour free and shrinks when heated. It is a good moisture barrier but is relatively permeable to oxygen and is a poor odour barrier. It is less expensive than most films and is therefore widely used for bags, for coating papers or boards and as a component in laminates.
  - High-density polyethylene (HDPE) is stronger, thicker, less flexible and more brittle than LDPE and a better barrier to gases and moisture. Sacks made from HDPE have high tear and puncture resistance and have good seal strength.
- Polypropylene is a clear glossy film with a high strength and puncture resistance. It has a moderate barrier to moisture, gases and odours, which is not affected by changes in humidity. It is used for bags, for coating papers or boards and as a component in laminates.
- Oriented polypropylene is a clear glossy film with good optical properties and a high tensile strength and puncture resistance. It has moderate permeability to gases and odours and a higher barrier to water vapour, which is not affected by changes in humidity. It is widely used to pack biscuits, snack foods and dried foods.
- Polyvinylidene chloride is very strong and is therefore used in thin films. It has a high barrier to gas and water vapour and is heat shrinkable and heat sealable.
- Polyamides (or Nylons) are clear, strong films over a wide temperature range (from –60 to 200°C) that have low permeability to gases and are greaseproof. They are used with other polymers to make them heat sealable at lower temperatures and to improve the barrier properties, and are used to pack meats and cheeses.
- Coated films are coated with other polymers or aluminium to improve their barrier properties or to impart heat sealability. They are used for packaging meats before smoking and cooking.

Notes

Properties of packaging films:

Material	Properties
Paper	Strength; rigidity; opacity; printability.
Aluminium foil	Negligible permeability to water-vapour, gases and odors; grease proof, opacity and brilliant appearance; dimensional stability; dead folding characteristics.
Cellulose film (coated)	Strength; attractive appearance; low permeability to water vapour (depending on the type of coating used), gases, odors and greases; printability.
Polythene	Durability; heat-seal-ability; low permeability to water-vapour; good chemical resistance; good low-temperature performance.
Rubber hydrochloride	Heat-seal-ability; low permeability to water vapour, gases, odors and greases; chemical resistance.
Cellulose acetate	Strength; rigidity; glossy appearance; printability; dimensional stability.
Vinylidene chloride	Low permeability to water vapour, gases, copolymer odor and greases; chemical resistance; heat-seal-ability.
Polyvinyl chloride	Resistance to chemicals, oils and greases; heat-seal-ability;
Polyethylene terephtalate	Strength; durability; dimensional stability; low permeability to gases, odorous and greases.

(3) Laminates

Figure 2.26. Laminates

Lamination of packaging involves the binding of aluminum foil to paper or plastic film to improve barrier properties. Various flexible materials such as papers, plastic films, and thin metal foils have different properties with respect to water vapour transmission, oxygen permeability, light transmission, burst strength, pin holes and crease hole sensitivity, etc. and so multi-layers or laminates of these materials which combine the best features of each are used.

Applications of Laminated films:

Laminated film	Typical food applications
Polyvinylidene chloride coated polypropylene (2 layers)	Crisps, snack foods, confectionery, ice cream, biscuits, chocolate
Polyvinylidene chloride coated polypropylene-polyethylene	Bakery products, cheeses, confectionery, dried fruit, frozen vegetables
Cellulose-polyethylene-cellulose	Pies, crusty bread, bacon, coffee, cooked meats, cheeses
Cellulose acetate-paper-foil-polyethylene	Dried soups
Metallised polyester-polyethylene	Coffee, dried milk
Polyethylene-aluminium-paper	Dried soup, dried vegetables, chocolate

(4) Co extruded films

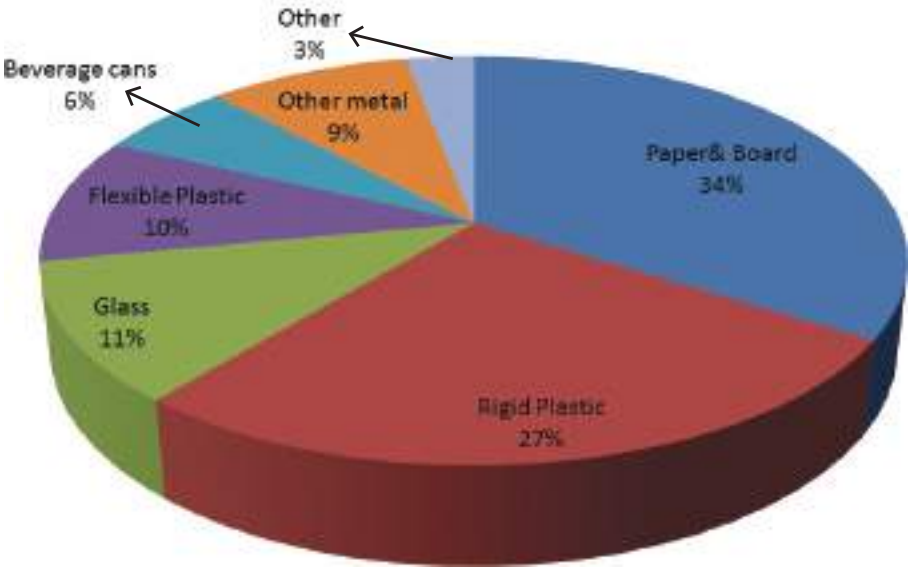
Co extrusion is the simultaneous extrusion of two or more layers of different polymers to make a film. They are used, for confectionery, snack foods, cereals and dried foods. A three-layer co extrusion has an outside layer that has a high gloss and printability, a middle bulk layer which provides stiffness and strength, and an inner layer which is suitable for heat sealing

There is a wide range of plastic bottles, pots, jars, trays and tubs made from single or coextruded plastics that are increasingly used for processed foods.

Applications of coextruded plastic films:

Coextruded film	Typical food applications
polyvinyl chloride	Trays for meat products and chocolates, tubs for margarine or jams. Cups or tubs for margarine, processed meats, cheese, spread, yoghurt, peanut butter, dried foods or ice cream and desserts.
High impact polystyrene-PET	Margarine, butter tubs
Polystyrene-polystyrene-PvDC-polystyrene	Juice and milk bottles
Polystyrene-polystyrene-PvDC-polyethylene	Tubs for butter, cheese, margarine, bottles for coffee, mayonnaise, sauces
HDPE, polyvinyl chloride	Bottles and jars for fruit juices, squashes and juice concentrates, vinegar, cooking oil, milk, wine, syrup and, and as drums for salt and bulk fruit juices
polyethylene terephthalate (PET)	Bottles for carbonated drinks
polypropylene coextruded with ethylene vinyl alcohol	Squeezable bottles and pots for mustard, mayonnaise, jams, tomato ketchup and other sauces

2.2.6 Market share of packaging material



Package design and construction plays a significant role in determining the shelf life of a food product. The right selection of packaging materials and technologies maintains product quality and freshness during distribution and storage.

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2.3.0 Define De-aeration, Sterilization and Aseptic Packaging

2.3.1 Deaeration

Deaeration is the process of removing oxygen from the container to extend the shelf life of foods with flexible package forms, to reduce the volume of the contents and package. By reducing the oxygen residual contents, the growth of aerobic bacteria is limited and thus the shelf life can be extended. Additionally, it prevents evaporation of volatile components, protects the flavor and texture, and reduces freezer burn by protecting the food from the dry cold air.

(a) Deaerator

Figure 2.27. Deaerator

A deaerator is a device that removes oxygen and other dissolved gases from liquids. Deaerators are used to remove dissolved gases from products such as food, personal care products, cosmetic products, chemicals, and pharmaceuticals to increase the dosing accuracy in the filling process, to increase product shelf stability, to prevent oxidative effects, for e.g. discolouration, changes in smell or taste, rancidity, to alter pH, and to reduce packaging volume.

(b) Need for Deaeration

Some products contain lots of air as soon as they arrive from production process. If these products are packed without removing the air, the bags will be practically impossible to stack. If the bag is laid flat, the air moves to the top of the product in the bag with a sort of balloon effect at the top. These types of bags obviously results in an unstable stack when stacked on a pallet. Air in the bag also has its consequences for the shelf life of various products, to prevent this air- and moisture-sealing and storage can be done using deaeration process .The 'deaerated' packaging process has an impact on stacking, storage and shelf life of the product which are to be packaged.

(c) Deaeration Process

Deaeration relies on the principle that the solubility of a gas in water decreases as the water temperature increases and approaches its boiling point. A Deaerator is a device that is widely used for the removal of oxygen and other dissolved gases from the feed water to steam-generating boilers. In particular, dissolved oxygen in boiler feed water which will cause serious corrosion damage in steam systems by attaching itself to the walls of metal piping and other metallic equipment and forms oxides (rust).Dissolved carbon dioxide combines with water to form carbonic acid that causes further corrosion. Most deaerators are designed to remove oxygenate, reduce its levels to 7 ppb by weight (0.005cm^3/L) or less essentially by eliminating carbon dioxide.

(d) Deaeration in Food Preservation

- When manufacturing shelf-stable fruit juices, the reduction of the dissolved oxygen level is desirable. In order to minimize the chemical oxidation process that develops in the fruit juice during the subsequent storage period, makes it unfit for human consumption.
- To prevent fruits from maturing, they are stored in cooling chambers under so-called controlled atmosphere conditions, after having been exhausted the cooling chamber is filled with inert gas. Alternatively, the inert gas is carefully compressed into the packaging.
- Fruits, vegetables and their subsequent products, such as mash and purée, are preserved through cooking. This involves heating a small amount of water to generate steam which removes the air. To obtain a high product quality and energy efficiency, the preservation process is carried out under vacuum.
- Certain liquid foods such as raw milk contain appreciable quantities of ascorbic acid known as vitamin C, which is easily destroyed through the effects of dissolved oxygen in the milk. This oxygen is also responsible for the development of the off or oxidized flavor in the milk. This deterioration of the milk is accelerated by the copper dissolved from the milk plant equipment, by the action of sunlight and by irradiation the milk is treated to the action of artificial ultra-violet rays. Deaeration of the milk preserves its vitamin C, and prevents development of the oxidized flavor in spite of copper contamination or the action of ultra-violet rays.

The deaerator system works according to the principle of two laws. They are as follows:

Henry's Law: In conformity to Henry, the pressure available inside the equipment is directly proportional to the solubility of gases. Whenever the pressure present inside is decreased consequently the solubility of gases also gets reduced. Hence, the pressure is reduced by the introduction of steam inside the deaerator.

Inverse solubility Law: In conformity to Inverse solubility Law, the temperature inside the equipment is inversely proportional to the solubility of gases. Whenever the temperature is increased the number of dissolved gases inside will be consequently reduced. Thus, the temperature is increased by the introduction of steam inside the deaerator. Therefore, this is the basic principle of how does a deaerator system work by removing the dissolved gases from the feed water before supplying it to the boiler. They are removed either by decreasing pressure or by increasing temperature but both will be practiced by the introduction of steam.

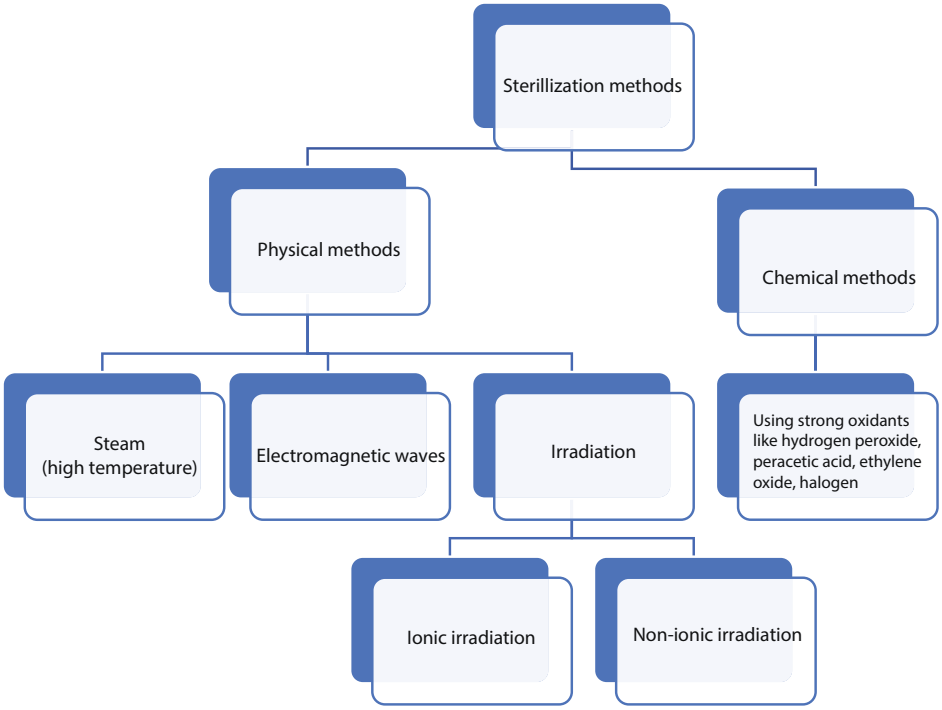
- Vacuum deaeration is used in the food industry to remove encapsulated air from products such as pasta, tomato paste, fish paste, ketchup, mayonnaise, mustard and jam. The process is normally carried out immediately before packaging, and may be integrated into a mixer, tumbler, extruder or evaporator production line.
- Vacuum deaeration extends storage life by removing oxygen from the finished product. It also improves product structure and consistency, especially in the case of pasta. The process is rapid, energy-efficient and requires minimal maintenance.

2.3.2 Sterilization

Figure 2.28. Sterilization

Sterilization is one of the key technologies in food aseptic packaging, especially for the retort packaging. The scope of sterilization includes food, packaging materials (containers), working environment, and equipment.

(a) Sterilization methods



Flowchart 2.4. Sterilization Methods

The use of chemical sterilization produces a certain amount of residual contamination of containers and packaging materials as well as equipment. Strict measures must be taken to control the residues to ensure the safety of the final product.

(b) The Sterilization Techniques in Food Aseptic Packaging are mainly as follows.

Method	Sterilization agent	Action	Area of usage	Merits/ Demerits
1. Thermal sterilization technology (a) Low temperature sterilization	61^0C to 63^0C for 30 minutes, or 72^0C to 75^0C for15 minutes to 20 minutes	Kills pathogenic bacteria, but prevents growth of yeast, mold and *lactobacilli*	Sterilization of jams, canned syrup, beer, pickles, canned vegetables,	Needs long time, should not be used for heat-sensitive foods. Limited action on non-pathogenic bacteria and their spores
(b) High temperature short-time sterilization (HTST)	85^0C to 90^0C for 3 minutes to 5 minutes, or 95^0C for 12 minutes	Kills yeast, mold, lactic acid and bacteria	Sterilization of canned food, low acid juices, alcohol, dairy and beverages	Results in a higher retention in quality characteristics, such as vitamins, odour , flavour, and texture
(c) Ultra-high temperature instantaneous sterilization (UHT)	140^0C to 160^0C in a few seconds	Close to the requirement of complete sterilization	Sterilization of milk, soymilk, juice and various beverages	Sterilization time is short, nutrient destruction is less and food quality is almost unchanged
2. Superheated steam sterilization technology or dry heat sterilization	Superheated steam with a temperature of 130°C to 160°C.	Kills all the heat-resistant bacteria	Sterilization of food packaging containers (metal, glass etc.)	Highly sterile, Quality of the product is safe and reliable.
3. Resistance heating sterilization technology or Ohmic sterilization	It uses electrodes for sterilization	Inactivate microorganisms through thermal and non-thermal cellular damage.	Sterilization of acidic and low-acid foods and granular foods.	Some non-ionized foods such as fat, sugar, oil, and treated water without added salt are unsuitable for this technology.
4. Irradiation sterilization technology	Uses krypton, beta, gamma rays or accelerated electron rays	Kills pathogenic bacteria, microorganisms and parasitic insects in food	Used for irradiation packaging	It can maintain the original color, aroma, taste and nutrients in food.

5. Microwave sterilization technology	2450MHz microwave frequency is used	Kills microorganisms	Sterilization of meat, fish, soy products, milk, fruits and beer.	Easy control, uniform heating, nutrients, color, aroma and taste of food remain close to the natural quality of food.
6. Far infrared sterilization technology	Use of infrared light of 3 μm to 10 μm	Direct sterilization of fungi	Sterilization of powdery and blocky foods, coffee beans, peanuts and grains	Does not require media, and heat it directly penetrates from the surface of the object.
7. UV sterilization technology	Ultraviolet irradiation	Kills bacteria on the surface	Sterilization of food surfaces, food packaging materials, food processing equipments and environments.	Has no drug residue, highly efficient and high speed.
8. Magnetic sterilization technology	Sterilized in a magnetic field and under the action of the set magnetic field strength	Has a broad-spectrum and sterilization effect	Applicable to various beverages, liquid foods and seasonings.	The flavour and quality of the processed food are not affected
9. High voltage electric field pulse sterilization technology	Using high-voltage electric field	Destroys the cell membrane of bacteria and changes its permeability.	Suitable for heat-sensitive foods.	Processed food has little change in physical properties, chemical properties and nutrients
10. Pulsed light sterilization	Using intense flashing white light	Strong lethal effect on *Bacillus subtilis* and yeast	Extends the shelf life of fresh foods packaged in transparent materials	Has minimal effect on the flavour and nutrients of the food

11. Excited state ultraviolet pulse sterilization	Ultraviolet light under high frequency and high pressure, and its intensity can reach 200mw/cm3 or more	Breaks the C-H bond, C-N bond and O-H bond in the DNA structure of the cell, causing the DNA structure to be lethal	Provides powerful microbial barrier system for aseptic packaging equipment	Different from the conventional physical sterilization method.
12. Ultra-high pressure sterilization technology	Ultra-high pressure	Kills the common yeast, *E. coli* and *Cocci*	Sterilization of foods such as juice, jam and meat.	It can maintain the original flavor, composition, and has little loss of nutrients (vitamin c).
13. High hydrostatic sterilization technology	Utilizes the liquid as a pressure transmitting medium	Inactivation of vegetative pathogenic microorganisms in dairy and meat products, *Salmonella* in eggs and *E.coli* in fruit.	Sterilization of liquid foods, and packaging containers.	The operating temperature is low, and damage to the food is small, and the treated product is suitable for aseptic filling.
14. Ultrasonic sterilization technology	Ultrasound is a sound wave with a frequency greater than 10 kHz	Destroys microorganisms in a very short time	Used for sterilization of soy sauce.	It produce various effects such as homogenization, aging, and cleavage of macromolecular substances
15. Membrane filtration sterilization technology	Ultra filtration Membrane pore size is from 0.0001 microns to 10 microns	Bacterial particles are trapped by the membrane.	Used in food, juices, dairy products, water and air.	Low energy consumption, operation at normal temperature, and suitable for heat sensitive materials,
16. Ozone sterilization technology	Utilizes O_3/H_2O	O_3 enters the cell, it destroys the enzyme and genetic material, thereby it kills microorganism	Used in food processing, production of tap water and purified water	Highly efficient, fast, safe, and inexpensive.
17. Hydrogen peroxide (hydrogen peroxide -H_2O_2) sterilization technology.	Concentration of H_2O_2 is controlled to 25% to 30%, and the temperature is 60 to 65°C.	Broad-spectrum sterilization effect on microorganisms.	Sterilization of packaging containers and auxiliary devices	Hydrogen peroxide is rarely used alone, and it is often used in combination with other sterilization techniques

Notes

Activity 4

Identify the sterilization method used for following foods

Jams

Production of tap water

Soy sauce

Fresh foods packaged in transparent materials

Heat-sensitive foods

Coffee beans, peanuts

Acidic and low-acid foods

Milk, soymilk

2.3.3 Aseptic Packaging

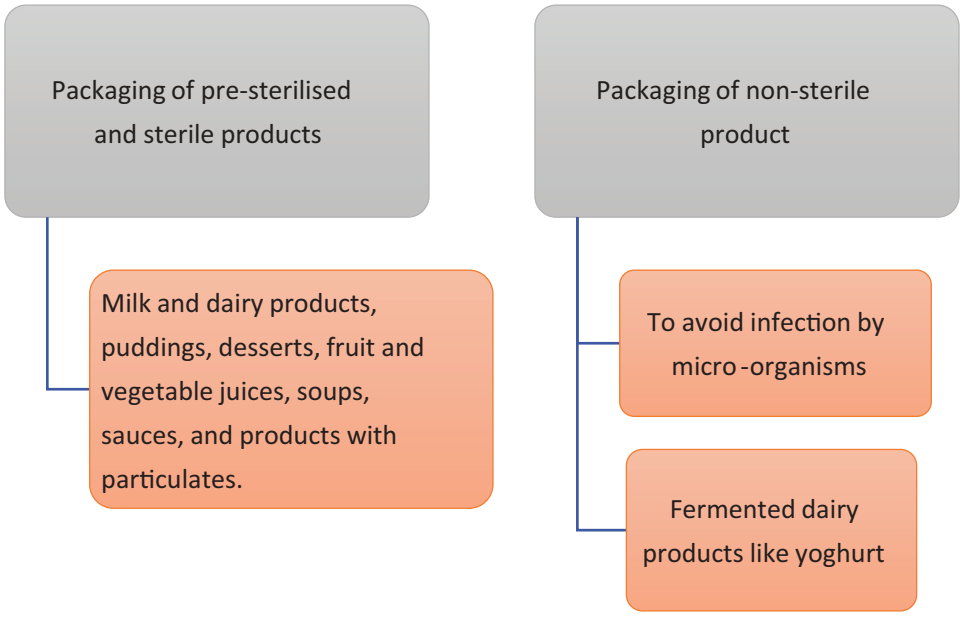
Figure 2.29.Aseptic Packaging

In order to meet the huge demand of processed food with longer shelf life, various new methods of packaging are being used in the food processing industry. Aseptic packaging is one of them. Aseptic packaging involves the filling and sealing of microbiologically stable (i.e. commercially sterile) product into sterilized containers under conditions that prevent microbial recontamination of the product, the containers, and their closures (i.e. under aseptic condition).

(a) Definition

Aseptic packaging can be defined as the filling of a commercially sterile product into asterile container under aseptic conditions and hermetically sealing the containers so that re-infection is prevented. This results in a product, which is shelf-stable at ambient conditions. The term "aseptic" is derived from the Greek word "septicos" which means the absence of putrefactive micro-organisms.

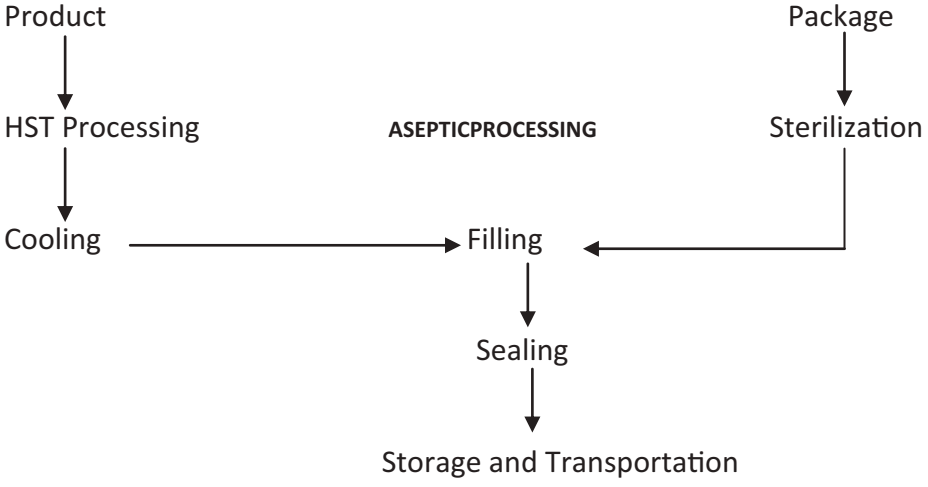
(b) Application of aseptic packaging technology:



Flowchart 2.5. Application of Aseptic Packaging Technology

(c) Aseptic Processing – Methodology

Aseptic packaging of foods can be defined as a process where a pre-sterilized food product is filled and hermetically sealed in sterile packaging materials under an aseptic environment without reheating for sterilization.



Flowchart 2.6. Aseptic Processing

In aseptic packaging systems, packaging materials are sterilized by various methods in order to kill microorganisms contained in the packages during forming and transport through the machine prior to filling. Experimental data as well as theoretical results from several years of research in the area of sterilization methods for effective inactivation of microorganisms on surfaces

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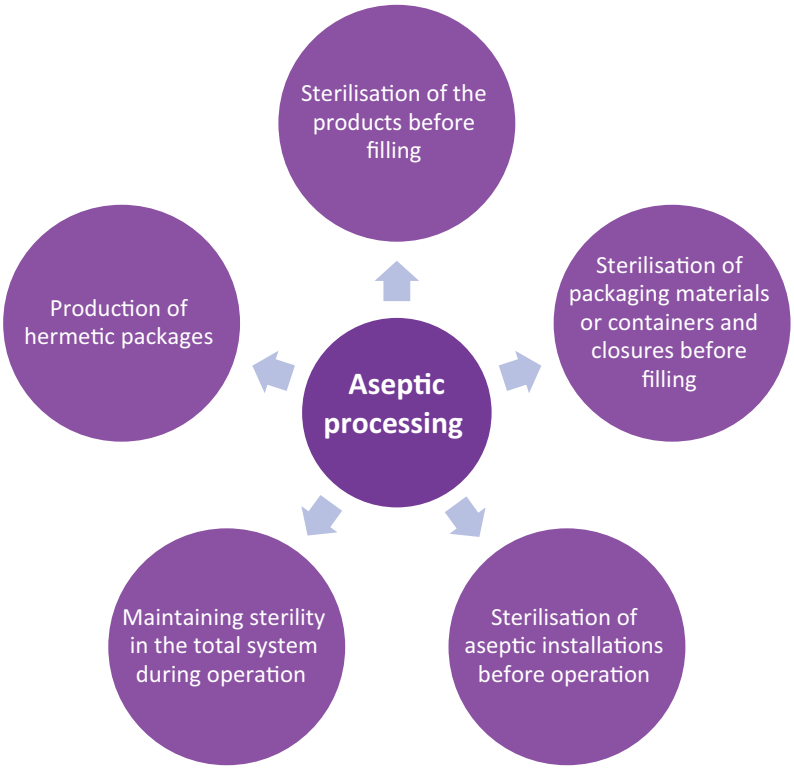
of aseptic packaging materials are compiled and presented in order to choose the right method of sterilization by the food processing industry for a successful operation. Hydrogen peroxide, with concentrations up to 30%, temperatures of up to 80°C and contact times up to 15 seconds, with or without wetting agent, has been found to be successful for in-line aseptic packaging. The final product must not contain greater than 0.5 ppm H_2O_2. Economic considerations and non-uniform dose delivery to pre-formed containers inhibit commercial adoption of ionizing radiation sterilization in-line with aseptic packaging systems.

Aseptic processing requires as per Buchner, 1993:



Flowchart 2.6. Aseptic Processing

(d) Types of Aseptic Packs

- Carton Boxes
- Bags and Pouches
- Cups and Trays
- Bottles and Jars
- Metal Cans
- Plastic Cans
- Composite Cans

(e) Aseptic Packaging Materials must meet following factors:

- The packaging material must be compatible with the product intended to be packed and must comply with applicable material migration requirements.
- Physical integrity of the package is necessary to assume containment of the product and maintenance of sterility.
- The package material must be able to withstand sterilization and be compatible with the methods of sterilization.
- The package must protect the product from oxygen; also package must retain the aroma of the product.

(f) Plastics in Aseptic Packaging

Packaging for aseptics particularly demands the long shelf-life, high seal integrity and consumer appeal. Plastic material is so important to aseptic packaging.

Some special properties demanded for plastics by aseptic process are

- Chemical resistance and wettability
- Thermal stability
- Low levels of contaminating microorganisms
- Resistance to ionizing radiations

(g) Advantages of Aseptic Packaging Technology

- Packaging materials, which are not suitable for in-package sterilization, can be used. Therefore, light weight materials consuming less space offering convenient features and with low cost such as paper, flexible and semi-rigid plastic materials can be used gainfully.
- Sterilization process of high-temperature-short time (HTST) for aseptic packaging is thermally efficient and generally gives rise to products of high quality and nutritive value compared to those processed at lower temperatures for longer time.
- Extension of shelf-life of products at normal temperatures by packing them aseptically.
- Utilizes less energy, as part of the process-heat is recovered through the heat exchangers and the aseptic process is a modern continuous flow process needing fewer operators.

Notes

Aseptic packaging is a state of the art technology for production of high-quality liquid food products with extended shelf life, ensuring the standards of food safety. It does not only include the packaging itself, but is a complete process, ranging from the product sterilization to package sealing.

2.4.0 Suitable Packing Materials for Jam, Jelly and Ketchup

Effective packaging of product is critical to protect product quality during transport and in store aisles. The type of packaging chosen depends on the product type and what will work best to enclose the product and provide the best means of handling. Packaging must be designed to effectively withstand various conditions in the supply chain: rough handling during loading and unloading, compression from weight that may bear down from other containers (if double-stacked), impact and shifting during transportation, and the high humidity that can occur during pre-cooling, transit and storage. Having a good understanding of all areas of packaging is the key in selecting the appropriate kind for the product being shipped and for effective handling during transit.

2.4.1 Packaging Requirements for Fruit and Vegetable Products

1. Every container in which any fruit product is packed should be sealed so that it cannot be opened without destroying the licensing number. The special identification mark of the manufacture must be displayed on the top or neck of the bottle.
2. Sanitary top cans made up of suitable kind of tin plates can be used for canned fruits, juices and vegetables.
3. Only bottles/ jars capable of giving hermetic seal must be used for bottled fruits, juices and vegetables.
4. Juices, squashes, crush, cordials, syrups, barley waters and other beverages should be packed in clean bottles which are securely sealed. These products when frozen and sold in the form of ice should be packed in suitable cartons. Juices and pulps may be packed in wooden barrels when sulphited.
5. New cans, clean jars, new canisters, bottles, chinaware jars and aluminum containers may be used for packing preserves, jams, jellies, and marmalades and it should be securely sealed.

6. Clean bottles, jars, wooden casks, tin containers covered from inside with polythene lining of 250 gauges or suitable lacquered cans should be used for pickles.
7. Clean bottles should be used for tomato ketchups and sauces. If acidity does not exceed 0.5 percent of acetic acid, open top sanitary cans can also be used.
8. Candied fruits and peels and dried fruits and vegetables can be packed in paper bags, cardboard or wooden boxes, new tins, bottles, jars, aluminum and other suitable approved containers.
9. Fruits and vegetable products can also be packed in aseptic and flexible packaging material having good grade quality must meet the standards laid down by BIS.

2.4.2 Generally used packaging materials for fruits and vegetables products

Packaging materials such as glass and plastic bottles and jars, cans, pottery, wood, boxes, drums, tins, plastic pots and tubes are commonly used. They all are used in varying degrees, which gives physical protection to the food inside that is not provided by flexible packaging. Most rigid containers are strong, they are, because of the amount of material used in their production and more expensive compared to flexible packaging.

(a) Glass

Figure 2.30. Jam packed in Glass bottles

Glass is a good material for long shelf life foods as it is moisture and heat resistant. This allows you to heat treat the product after filling and it will not let air in providing the seal remains intact. Glass will not react with the food and can be made transparent to view the food inside the packaging. Glass can also be coloured, for example, a brown beer bottle to prevent light from affecting the product quality. Glass is widely recycled and is perceived as a sustainable material. However, glass packaging will break if dropped or damaged and it is bulky and heavy to transport.

Notes

Glass used for receptacles in fruit and vegetable processing is a carefully controlled mixture of sand, soda ash, limestone and other materials made molten by heating to about 1500° C (2800° F). The molten glass is blown into moulds, in two stages, to make bottles and jars which are then cooled under carefully controlled conditions to prevent weaknesses and breakage.

Figure 2.31. Glass jars with Mechanical Closure

Main classes of glass receptacles are:

1. **Jars** which are resistant to heat treatments,
2. **Jars, glasses,** for products not subjected to heat treatment (marmalades, acidified vegetables.)
3. **Glass bottles** for pasteurized products (tomato juice, fruit juices, etc.) or not pasteurized (syrups) and
4. **Receptacles** with higher capacity (flasks.)

1. Jars for sterilised/pasteurized, canned products

Figure 2.32. Glass jars with Pneumatic Closure

These receptacles may replace metal cans. Receptacles in this category must assure a perfect hermeticity after their pasteurization/ sterilization and cooling and this has to be achieved by the use of metallic (or glass) caps and specific materials for tightness. Taking into account the receptacles' closure method glass jars falls into two categories, namely

- glass jars with mechanical closure
- glass jars with pneumatic closure

2. Jars for products without heat treatment:

For marmalades, jellies and jams glass jars with non hermetic closures made of metal, glass or rigid plastic caps are used.

3. Glass bottles for finished products which need pasteurization are closed hermetically with metallic caps, provided with special materials for tightness. Glass bottles for those which are preserved as such are closed by various corks, and aluminium caps with tightness materials.

4. Glass receptacles with high capacity

Figure 2.33. SKO metal caps

In this glass flasks with 3 to10 litre capacity which can be hermetically closed by a SKO caps system and are resistant to product pasteurization (e.g. tomato juice).

Advantages of Glass as a packaging material

- Chemically inert (no reaction with any food)
- Strong, can resist internal pressure and weight
- Can be re-used and re-cycled
- Impermeable to gases, aromas and moisture
- Can give protection against light
- Barrier to micro-organisms, insects etc
- Can be heat-sterilized
- Good product display in clear glass
- Long shelf-life possible
- High customer appeal and acceptability
- Resistance to thermal shocks

Disadvantages

- Breaks with rapid temperature change
- Fragile, poor shock resistance
- It is heavy
- In-plant breakage carries danger of splinters in food
- High demand of water needed in production process, particularly for cooling
- Noise generated during filling operations
- High transportation cost

Food packaged in glass containers can have a very long shelf life provided that the food has been properly processed before packaging, no contamination occurs at the filling stage and that the container is properly closed with a lid or seal. It should be remembered that the pack is only as good as the closure. Recommended shelf-lives vary but are usually 6 to 12 months, not because the product actually deteriorates, but because over time there is a gradual loss of colour and flavour.

(b) Metal containers

Figure 2.34. Aluminium based Packaging Materials

Metal packaging is usually made from stainless steel, aluminium and tinplate. The properties of food safe metal make the packaging heat resistant, durable and the material is often widely recycled. Metal cans containing acidic foods may result in corrosion causing changes to the quality of the food, loss of barrier integrity and in turn its shelf life.

DO YOU KNOW?

The shape of the bottle and their strength

The shape of the bottle or jar is also important as some shapes are weaker than others and so they need greater protection. A round bottle is about 4 times as strong as a square one with rounded corners and 10 times as strong as a square one with sharp corners. The use of simple round bottles is thus recommended to reduce breakage and shipping container costs.

1. Aluminium

Aluminium is widely used in food contact material. Aluminium alloys used for food contact may contain elements such as magnesium, silicon, iron, manganese, copper and zinc .Aluminium and its various alloys are highly resistant to corrosion. When exposed to air, the metal develops a thin film of aluminium oxide (Al2O3). The film is colourless, tough and non-flaking and few chemicals are able to dissolve it.

2. Tin & Can

Figure 2.35. Tin Cans

Tin is applied as a thin layer on steel used for metal packaging. It is applied electrolytically during the manufacture of ETP (electrolytic tinplate). The tin layer provides corrosion resistance and in some cases it is not coated, as tin can act as an efficient oxygen scavenger. However, using uncoated tin is limited by the various possible interactions between the metal surface and the foodstuff and is therefore mainly used for, e.g. light fruits in brine or tomato-based products.

Can is the most common rigid container used for packaging and preserving food. While almost any food, including dried goods, can be canned. The most common applications are to fruit juices, fruit in syrup, tomatoes, meats, fish and vegetables.

The can has distinct advantages over glass they are

- Good heat transmission,
- Not subjected to thermal shock, rapid heating and cooling are possible.
- Lighter in weight,
- Not subjected to breaking,
- Little or no interaction between the food if correct type of can is chosen

- Resistant to physical damage.
- They are also totally impervious to light and air.
- The main Disadvantage is contents cannot be seen by the purchaser.

3. Steel drums

Figure 2.36. Steel Drums

Drums are large cylindrical metal containers with capacities between 10 and 240 liters, the most common size being 210 liters or 55 Gallons.

Uses

- For bulk safe
- For bulk storage of ingredients
- For safe storage of finished goods, particularly dried foods.

Drums are made of sheet steel 0.4 to 1.5 mm thick which may be galvanised and coated internally. They are strong and provide excellent protection against light, moisture and rodents. As many drums are made for use in the chemical industry it is important to check that any internal coating is of 'food grade' quality.

(c) Plastics

Figure 2.37. Plastic based Packaging Materials

Largely for cost reasons rigid plastic bottles, jars, tubes, cups and trays are increasingly replacing glass and tin cans for food

packaging. The range of plastics and co-polymers used to make rigid plastic food containers is wide.

1. Advantages

- Lower cost
- Lightness
- Resistance to impact damage
- Availability ,both clear and colored
- Squeezability, which are useful for spreads and honey.

2. Disadvantages

- Gives less protection against light and air.
- Not as strong, in terms of weight bearing and crushing.
- Easily punctured by sharp objects.
- They cannot be easily re-used or re-cycled.

3. Common uses for plastic containers

Container	Application
Plastic bottles	non alcoholic beverages, cooking oils, ketchups, sauces
Plastic jars	honey, spreads, peanut, butter, dry foods
Trays and tubs	butter, fats, spreads, ice cream, jams, condiments
Cups	drinks, yoghurt
Tubes	honey, spreads

Packaging manufactures and shipper/growers are like matchmakers in the production industry: they find the right container for the specific fruit or vegetable, based on the characteristics, tendencies, and behaviors of that particular product. The job takes a lot of hard work. The more that everyone in the supply chain (shippers, drivers, and receivers) understands the particulars of the match, the more products will successfully hit the shelves and reach consumers.

2.4.3 Labelling

Food Labelling serves as a primary link of communication between the manufacturer and the packer of food on the one hand and the distributor, seller, and the user or consumer on the other hand.

Notes

As per Food Laws, every packaged food article is mandatorily labeled and also it has to be labeled in accordance with the law which is applicable in the country of the user. Every packaged food article for the domestic use is required to be labeled in accordance to the related Indian Food Law i.e. Food Safety and Standards (Packaging and Labeling) Regulations, 2011, which is notified by Food Safety and Standards Authority of India (FSSAI).

"FSSAI Guidelines on Labeling of Food Products".

- **Name of the food:** The name of the food product should be in clear format on the packaged product in clear font.
- **List of Ingredients:** List of Ingredients means the elements which have been utilized for making the final product. It is very necessary that the manufacturer mentions all the ingredients fairly and do not cheat the end-consumer.
- **Nutritional Information:** Nutritional Information means the calories which gets from fats, saturated fat, trans fat, cholesterol, sodium, carbohydrates, dietary fiber, sugars, protein, vitamin A, vitamin C, calcium, and iron present in the product. The calories are mentioned on all the products labels.
- **Declaration regarding Vegetarian or Non-Vegetarian:** The manufacturer on the label should mention whether the product is vegetarian or non-vegetarian. Green colour of small sign present on the corner of the label indicates the product being vegetarian and red colour indicates that the product is non-vegetarian.
- **Declaration regarding Food Additives:** Food additives are substances which are added to food in order to preserve flavor or enhance its taste and appearance. Hence, it is very necessary to give a declaration regarding the additives added on the label or the package.
- **Name and Address of the Manufacturer:** The manufacturer has to give complete address of his factory which includes street address, city, state, and zip code. Without mentioning any of these, products can be considered fake in the market.
- **Net Quantity:** Net Quantity here refers to the weight of the product. The weight of the product and the packaging weight are usually combined together and then mentioned in the Net Quantity.

- **Code No./Lot No./Batch No:** A batch number or code number or lot number is a mark of recognition through which the food can be found in the manufacture and even recognized in the distribution. Therefore, the Code No./Lot No./Batch No should be definitely mentioned by the manufacturer.
- **Date of Manufacture and Best Before & Use By Date:** The date of manufacture is when the product has been manufactured and Best Before & Use By Date means by what date and month should the product be consumed. If the product is consumed after expiry date, it usually can harm the health of the human.
- **Country of Origin for Imported Food:** The country of origin of goods means the nationality of imported goods and even refers to the area where such goods have grown up or have been produced, manufactured or processed.
- **Instructions for Use:** the Instructions for Use should be mandatorily mentioned. It usually instructing or guiding the consumer on how to utilize the product.

The primary objective of packaging is to protect the food contents from microbiological, chemical, physical and atmospheric contamination and preserve the food and thereby protect consumer's health. Good packaging also ensures that there is no change in sensory properties or composition of food when packed. Packaging is essential and critical for promoting **food safety**, extended shelf-life and thereby enhancing food security.

Glossary

Agglomeration	:	A mass or collection of things
Alloy	:	A metal made by combining two or more metallic elements, especially to give greater strength or resistance to corrosion.
Chipped	:	Damaged by having a small piece broken off at the edge or on the surface
Clamshell	:	A hinged container, case, or cover that opens like the shell of a clam
Co extrusion	:	It is an extrusion process used to obtain a product that combines two textures

Notes

Crate	:	A slatted wooden case used for transporting goods
Deterioration	:	A process of becoming progressively worse
Encapsulated	:	Enclose in or as if in a capsule
Galvanized	:	Coat with a protective layer of zinc
Hampers	:	A basket with a carrying handle and a hinged lid contains food for a special occasion
Ionomer	:	Any class of tough thermoplastics with ionic bonding between the polymer chains
Obsolescence	:	Outdated and no longer used
Perforations	:	A small hole or row of holes made by piercing
Pilferage	:	The action of stealing things of little value
Polycondensation	:	Formation of polymers as a result of reactions involving condensation of organic materials in which small molecules are split out
Polymerization	:	A chemical reaction in which two or more molecules combine to form larger molecules that contain repeating structural units.
Receptacles	:	A container used for storing or putting objects in
Resins	:	A solid or liquid synthetic organic polymer used as the basis of plastics, adhesives or other products
Stacked	:	A pile of things arranged one on top of another
SKO Metal Caps	:	Disposable metal closures made of Tinplate. A rubber gasket ensures a hermetic sealing.

Notes

Evaluation

I. Choose the best answer (1 mark)

1. The history of packaging originated in the year…….

   a) 1035 b) 1036 c) 1037 d) 1034

2. In glass jars the materials in contact with the foodstuff are ……

   a) Glass

   b) Aluminium lining

   c) Tin coating

   d) Glass and coated metal from the closure

3. Match the following

   1) Climatic hazards - i) Customer appeal

   2) Biological hazards - ii) Atmospheric humidity

   3) Mechanical hazards - iii) Insects

   4) Other factors - iv) Stacking

   a)1-(ii), 2-(iii), 3-(iv),4-(i) b) 1-(i), 2-(ii), 3-(iii), 4-(iv)

   c) 1-(iv), 2-(iii), 3-(ii), 4-(i) d) 1-(iii), 2-(iv), 3-(i), 4-(ii)

4. ……were first used during World War II as an efficient way to move goods.

   a) Pellet bins b) Cardboards

   c) Pallets d) Paperboards

5. The packaging material used to prepare trays for eggs, meat or fish or for egg cartons are……

   a) Pulp Containers

   b) Molded paperboard

   c) Corrugated board

   d) White board

6. Packages with a top and bottom and a one-piece container formed from one or two pieces of plastic is known as …….

   a) Pulp Containers b) Joint plates

   c) Chipboard d) Clamshell

Notes

7. The temperature used in High temperature short-time (HTST) sterilization is……

   a) 85^0C to 90^0C b) 61^0C to 63^0C

   c) 72^0C to 75^0C d) 140^0C to 160^0C

8. In Membrane filtration sterilization technology pore size of the Membrane is from……

   a) 0.0001 to 10 microns b) 0.001 to 20 microns

   c) 0.002 to 20 microns d) 0.0001to 30 microns

9. The term "aseptic" is derived from the Greek word "septicos" which means…….

   a) Killing of microorganisms

   b) Absence of putrefactive micro-organisms

   c) Inactivating microorganisms

   d) removing microorganisms.

10. Glass jars with non hermetic closures made of metal, glass or rigid plastic caps are used for……..

    a) Jellies and jams b) tomatoes

    c) meats d) fish

II. Very Short Answer (2 Marks)

1. Define packaging

2. What are the four Important Features of packaging?

3. List some generally used packaging materials.

4. Give the AIDA formula for packaging.

5. Write the additives mixed into the wood pulp to get particular properties to the packaging material.

6. Write a short note on shrink wrap.

7. Why Tin can / tinplate is suitable for sterile products. give reasons.

8. List the Different types of flexible plastic films

9. Define Deaeration.

10. Write the Sterilization methods in short.

Notes

III. Short Answer (3 Marks)

1. What are the Objectives of packaging?
2. Write the Qualities of Good Packaging?
3. What are the Qualities of good packaging material?
4. List different types of paperboards and their Uses.
5. Give the applications of laminated films.
6. Write a note on deaeration in Food Preservation.
7. What are the advantages of aseptic packaging technology?`
8. Give the role of plastics used as a packaging material.
9. What are the common uses for plastic containers?
10. The can has distinct advantages over glass. Give reasons

PRACTICAL EXERCISE

Enlist and discuss on basic quality standard for packaging materials.

Aim:

To know about quality standards for packaging materials

Procedure:

Food packaging considerations may include:

- Use of hazard analysis and critical control points,
- Verification and validation protocols,
- Good manufacturing practices,
- Use of an effective quality management system,
- Track and trace systems, and
- Requirements for label content.

Packaging and package labeling have several objectives:

- **Physical protection -** The food enclosed in the package may require protection from shock, vibration, compression, temperature, bacteria, etc.

Notes

- **Barrier protection** - A barrier from oxygen, water vapour, dust, etc., is often required. Keeping the contents clean, fresh, and safe for the intended shelf life is a primary function. Modified atmospheres or controlled atmospheres are also maintained in some food packages. Some packages contain desiccants, oxygen absorbers or ethylene absorbers to help extend shelf life.
- **Containment or agglomeration** - Small items are typically grouped together in one package to allow efficient handling. Liquids, powders, and granular materials need containment.
- **Information transmission** - Packages and labels communicate how to use, transport, recycle, or dispose of the package or product. Some types of information are required by governments.
- **Marketing** - The packaging and labels can be used by marketers to encourage potential buyers to purchase the product. Aesthetically pleasing and eye-appealing food presentations can encourage people to consider the contents. Marketing communications and graphic design are applied to the surface of the package and the point of sale display. The colour of the package plays a significant role in evoking emotions that persuade the consumer to make the purchase.
- **Security** - Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering. Packages can be engineered to help reduce the risks of package pilferage; some package constructions are more resistant to pilferage and some have pilfer-indicating seals. Packages may include authentication seals to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices, such as dye packs, RFID tags, or electronic article surveillance tags, that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of retail loss prevention.
- **Convenience** - Packages can have features which add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, and reuse.
- **Portion control** - Single-serving packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable

size for individual households. It also aids the control of inventory: selling sealed one-litre bottles of milk, rather than having people bring their own bottles to fill themselves.

An ideal packaging material should have following qualities:

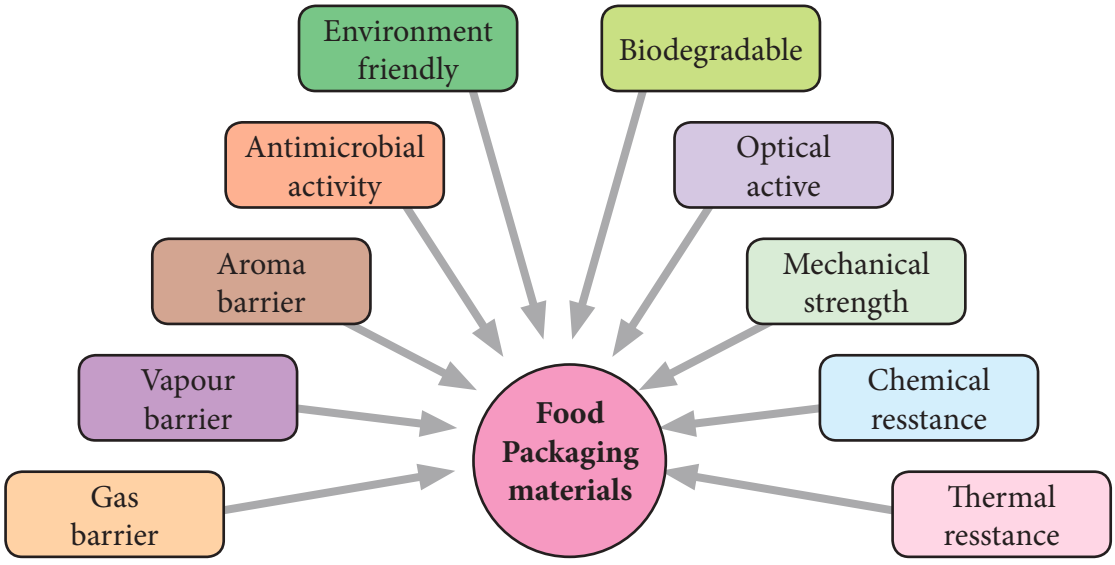


Figure 2.38. Qualities of packaging materials

- It should contain the content within it
- It should not affect the flavour of the product packaged it
- Stable performance over large range of temperature.
- Adequate compulsive strength and sufficient impact and puncture strength.
- Sufficient thickness of cushioning materials with sufficient ventilation, space for rapid cooling of product.
- Protect the product from oxygen, moisture and light.
- Protection of the content form adulterations.
- Closure characteristics such as opening, sealing, resealing and pouring.
- Low cost and availability.
- It should non-toxic in nature.
- Proper labeling, storing, marketing appeal to sale, etc.

Result and discussion:

2.1 Identification of Packaging Materials

Aim: To identify the packaging materials in the market

Packaging Product	Name	Biodegradable / Non-biodegradable	Material used	Cost per unit
	Aluminium sachet			
				
				
				
				
				
				
				
				
				

Result and Discussion:

Notes

Project

1. Visit to a food packaging in industry and write a report
   a. Name of the unit with address
   b. Products packed
   c. Types of packaging (primary, secondary, tertiary)
   d. Packaging materials used
2. Visit a departmental store or grocery shop; find out the various packaging materials used for fruit and vegetable products.
3. Collect the pictures of different packaging materials and create an album.

Linkages

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Unit 3

Documentation and Record Keeping

- Keeping record of raw materials
- Maintaining record of production schedule and process
- Maintaining record of finished product

Learning Outcomes

Introduction

Documentation is a set of documents provided on paper or online or a digital media. An approved instruction either in paper or electronic form which guides about how an activity shall be executed.

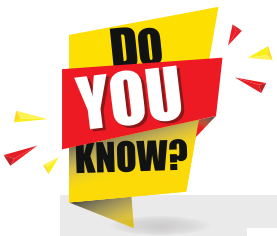
Record keeping is an activity of organizing and storing all the documents like files, invoices, relating company's or organisation's activities.

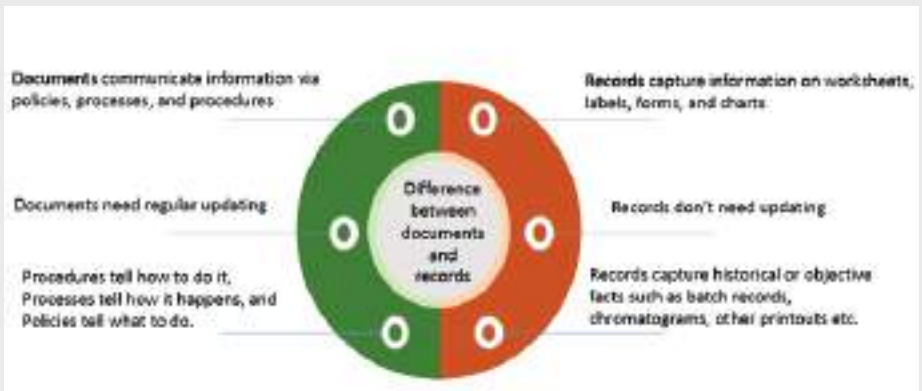
A **document** can be a procedure, specification, drawing, work instruction and the **record** is often considered as a document that it provides evidence of compliance with the established requirements and effectiveness of the operation. They always document the past.

The **documentation** and **record keeping** are critical elements of the food safety management system. They will help control processes and ensure that they are done in a consistent and approved manner.

Figure 3.1. Documents

Food firms maintain records relating to the manufacturing, processing, packing, distributing, receiving, holding or importing of food products. The purpose is to assist in determining whether anything has happened to the food or been done to the food that would render it unsafe (i.e., adulterated). Accordingly, firms must maintain records and government authorities may access the records.





3.1.0. Keep Record of Raw Material

What are raw materials?

Raw materials are materials or substances used in the primary production or manufacturing of goods. Raw materials are the resources used by a company to produce its finished goods and products.

Raw materials are the basic ingredients to create food products. The raw materials used are generally of vegetable or animal origin and produce of agriculture, farming, breeding and fishing.

Table 3.1. The Food Industries, their Raw Materials and Processes

Industry	Materials processed	Storage requirements	Processing techniques	Preserving techniques	Packaging of finished products
Meat processing and preserving	Beef, lamb, pork, poultry	Cold stores	Slaughtering, cutting up, boning, comminuting, cooking	Salting, smoking, refrigeration, deep-freezing, sterilization	Loose or in cans, cardboard
Fish processing	All types of fish	Cold stores or salted loose or in barrels	Heading, gutting, filleting, cooking	Deep-freezing, drying, smoking, sterilization	Loose in refrigerated containers or in cans
Fruit and vegetable preserving	Fresh fruit and vegetables	Processed immediately; fruits may be stabilized with sulphur dioxide	Blanching or cooking, grinding, vacuum-concentration of juices	Sterilization, pasteurization, drying, dehydration, lyophilization (freeze drying)	Bags, cans or glass or plastic bottles
Milling	Grains	Silos may be fumigated in storage	Sifting, milling, rolling	Drying, cooking or baking	Silos, sacks or bags to other processes, or boxed for retail trade
Baking	Flour and other dry goods, water, oils	Silos, super sacks and bags	Kneading, fermentation, laminating, surface treatments of seasoning	Baking, cutting, surface treatments and packaging	Packaged for wholesale trades, restaurants and retail markets

Biscuit making	Flour, cream, butter, sugar, fruit and seasoning	Silos, super sacks and bags	Mixing, kneading, laminating, moulding	Baking, cutting surface treatments and packaging	Bags, boxes for institutional and retail trades
Pasta manufacture	Flour, eggs	Silos	Kneading, grinding, cutting, extrusion or moulding	Drying	Bags, packets
Sugar processing and refining	Sugar beet, sugar cane	Silos	Crushing, maceration, vacuum concentration, centrifuging, drying	Vacuum cooking	Bags, packets
Chocolate making and confectionery	Cocoa bean, sugar, fats	Silos, sacks, conditioned chambers	Roasting, grinding, mixing, conching, moulding	-	Packets
Brewing	Barley, hops	Silos, tanks, conditioned cellars	Grain milling, malting, brewing, filter pressing, fermentation	Pasteurization	Bottles, cans, barrels
Distilling and manufacture of other beverages	Fruit, grain, carbonated water	Silos, tanks, vats	Distillation, blending, aeration	Pasteurization	Barrels, bottles, cans
Milk and milk products processing	Milk, sugar, other constituents	Immediate processing; subsequently in ripening vats, conditioned vats, cold store	Skimming, churning (butter), coagulation (cheese), ripening	Pasteurization, sterilization or concentration, desiccation	Bottles, plastic wrapping, boxes (cheese) or unpacked
Processing of oils and fats	Groundnuts, olives, dates, other fruit and grain, animal or vegetable fats	Silos, tanks, cold stores	Milling, solvent or steam extraction, filter pressing	Pasteurization where necessary	Bottles, packets, cans

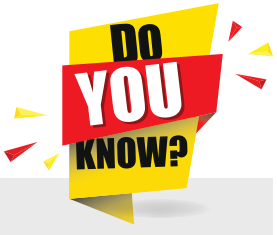
3.1.1. Importance of record keeping

1. Detailed knowledge about the operation of the business
2. Identification of trends
3. Accurate control over finances and product quality
4. Identification of individual costs to allow changes to a product or process to optimize profits
5. Keeping track of money owed to the business
6. Evidence for tax authorities (may be a legal requirement)
7. Factual basis for product pricing or salary levels
8. Knowledge and avoidance of theft
9. Promotes better communication and dissemination of information between members of the multi-professional team
10. Helps to address complaints or legal processes

3.1.2.Assess the details to be documented at raw material collection stages

Material control is the main component of the process of material management. Control over materials is of utmost importance for smooth and uninterrupted functioning of an organization.

Material control refers to the various measures adopted to reduce the amount of loss of materials at the time of receiving, storing and issuing the raw materials. Material control in practice is exercised through periodical records and reports relating to purchase, receipt, inspection, storage and issue direct and indirect materials.



What is the most common document format?

PDF. The PDF document file is a Portable Document Format by Adobe that has become the most prevalent file format used on the web today. PDF is optimal for printing documents onto paper because it upholds the original intended layout of the file.

Notes

Flowchart 3.1. Material Control Cycle

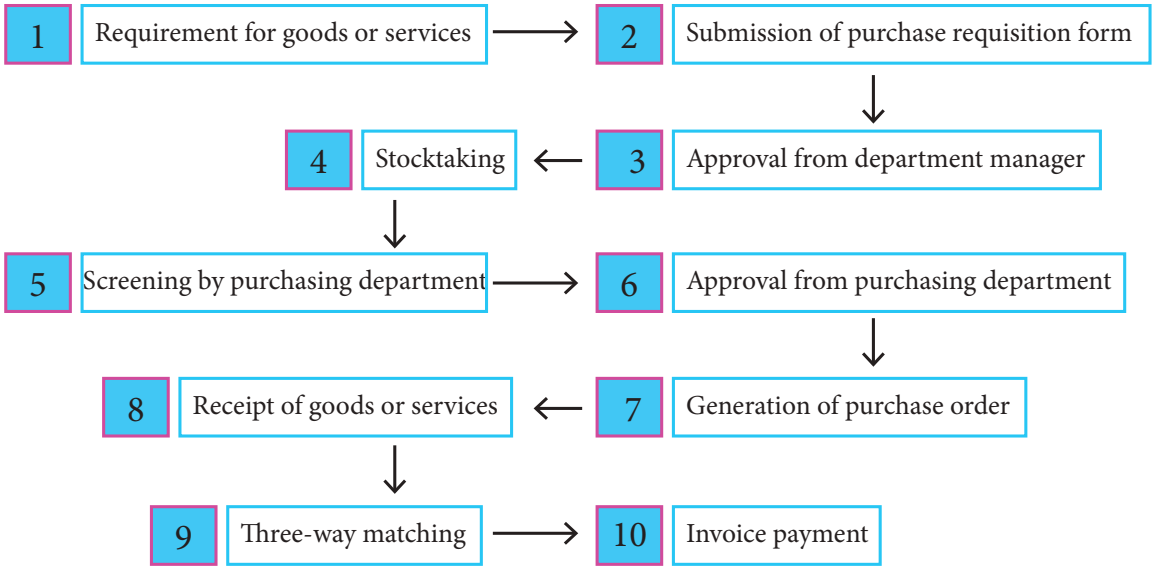
Necessity and importance of material control:

1. Material control is significant only by keeping the stock of raw materials within limits in the stores i.e., to avoid overstocking and understocking of raw materials, materials control is significant.
2. It ensures proper storage of materials. Adequate storage facilities are to be provided for the proper preservation and safety of materials. With the help of proper storing of materials, quantity of materials as and when required can be issued to various jobs.
3. Control over materials is indispensable for knowing proper cost of production.
4. Certain techniques and methods are developed under the system of materials control thereby ensuring optimum utilization of materials.
5. In order to undertake continuous checking of materials, the necessity of a proper system of material control cannot be ignored.
6. A well-managed system of materials control ensures the availability of different kinds of materials without delay.

At each stage of material control cycle, there should be documents or other procedures that allow control to be exercised.

In that, raw material collection stages and details to be documented at raw material collection stages are as follows:

Raw material collection stages



Flowchart 3.2. Raw Material Collection Stages

Details to be documented at raw material collection stages

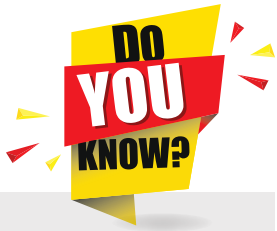
1. Purchase requisition form
2. Purchase order
3. Goods delivery note
4. Goods received note/ Receipt of goods
5. Invoice
6. Stock record

1. Purchase requisition form

A purchase requisition form is an internal document used by an employee to purchase goods or services on behalf of their firm. The purchase requisition form is submitted to the purchase department for approval.

Contents of a purchase requisition form

- Name and department of the requestor
- The date of request
- The products or services requested



Three-way matching

Three-way match is used to match the details of purchase order, Goods Receipt and the Invoice document received from vendor. In Three way match the Quantity & Price is matched between PO, GR & IR.

- Item description, quantity, and price
- Reason for purchase
- Legal name of the supplier

Purchase Requisition Form

The Owners' Corporation of XXX Building

No. _____

Delivery: on or before _____

QUANTITY	DESCRIPTION	LAST PURCHASE PRICE	
		Unit Price (HK$)	Total (HK$)
		TOTAL	

Purpose:

Budgeted Expenditure - Yes / No* Funds Available - Yes / No* (* Delete as appropriate)

Quotations / Tenders Received					
Supplier / Service Provider	Approved Supplier / Service Provider Yes / No)	Date	Contact Person & Tel. (Verbal quotation)	Price Offered HK$	Special Conditions / Remarks

Recommended Supplier / Service Provider: _____ PO No.: _____

Reason(s) if not the lowest offer: _____

Proposed by: _____ Signature: _____ Date: _____

Approved by: _____ Signature: _____ Date: _____

Approved by: _____ Signature: _____ Date: _____

Figure 3.2. Purchase Requisition Form

Sometimes, despite the supplier being entered on the purchase requisition, the purchasing department might ask several suppliers for quotations.

2. Purchase order

A purchase order is a source document used by the purchasing department to place an order with a vendor or supplier. In other

words, this is the contract that a buyer drafts to purchase goods from a seller.

Once the purchase requisition is approved by the relevant department, a purchase order is issued to the vendor of the requested goods or services.

Contents of a purchase order form

- Name of the buyer and seller
- Purchase order number
- Date of the order
- Shipping date
- Discount terms
- Supplier's name and address
- Details of goods required: product codes, description, unit price and total price
- Authorization

The order will have at least two copies: one for the supplier, one for the stores to inform them that a delivery is expected.

Activity 1:

Prepare a sample purchase order form for purchasing raw materials for a jam manufacturing industry.

3. Goods delivery note

A delivery note is a document that accompanies a shipment of goods, and provides a list of the products and quantity of the goods included in the delivery. A delivery note can also be known as a 'dispatch note' or a 'goods received note'. Although they are normally printed, delivery notes can also be sent by email. It can be used as a checklist by customer to ensure that everything is there.

Every item contained in a delivery note has to be in the accompanying shipment. Goods should not be accepted before checking to a copy of the purchase order. One copy of the delivery note is signed and kept by the supplier. A copy of the delivery note is signed by the recipient and then returned to the seller or consignor as proof of delivery. This is then known as 'recorded delivery' or 'signed for delivery'.

Notes

Delivery notes should be marked unchecked and received in accordance with our terms and conditions if the delivery has not been inspected or matched against the original Purchase Order.

Contents of Goods delivery note

- The name and contact details of the seller
- Name and contact details of the customer
- Date of issue
- Date of delivery of the goods
- A description of the goods contained in the order
- The quantity of each type of goods.

4. Goods Received Note (GRN) / Receipt of goods

Goods Received Note (GRN) is a document that represents the receipt of goods by customers. It is the record of goods received by the store manager. Usually a store manager of the buyer will create a Goods received note from the delivery note. This document is for internal usage. After receiving the goods, inventory ledger is updated mentioning the GRN number along with the date. This document is used to confirm whether all goods mentioned in the purchase order have been received.

The receiving department will prepare the "Goods Received Note" in" Five Copies". Original copy to be retained, the others are to be sent to the purchasing department, the accounts department, the storekeeper and the department making the purchase requisition.

On the other hand, Goods received note confirm to suppliers that their goods have been delivered and received by the buyer. However, Goods received note is the most important documents both for suppliers and customers.

Steps Involved in Goods Receipt

- A purchase order is issued with a request for goods receipt.
- When goods are received, the person receiving the goods inspects them for any likely damage.
- If the packaging is good, the recipient forwards the goods to the department that ordered them.

- If the department that ordered the goods is satisfied as to its suitability and condition, it raises a goods receipt with reference to the purchase order.

Contents of Goods Received Note

- The name of the supplier
- Different products delivered
- Products details such as name, type and size
- Delivery time and date
- Quantities of each product
- Name and signature of supplier's representative
- Name and signature of the store's manager or representative
- Purchase order number

Activity 2:

Formulate a checklist to be used while receiving the perishable foods from the market.

5. Invoices

An invoice is a document sent to a buyer that specifies the amount and cost of products or services that have been provided by a seller. The most important document in determining if the goods received are the goods ordered is the invoice.

An invoice is an itemized list of the goods or products delivered to a food preparation premise. An invoice shows the quantity, quality, price per kilogram or unit. Only the careful comparison and checking can ensure that the information on the invoice tallies with the products received. This comparison may require that items be weighed and/or counted.

Once the supplier sends an invoice, the accounts department will use the goods received note to verify the invoice before making any payment.

Contents of an Invoice

Usually, an invoice will include the following points of information in order to be considered legal invoices:

- The word 'Invoice'

- A unique reference number: the invoice number
- The date the product was sent or delivered (or the date the service was rendered)
- The date the invoice was sent
- The contact information and name of the seller
- The name and contact details of the buyer
- The terms of payment (that explain the means of payment, when the sum should be received, any cash discount details for early payment, late payment fees, etc.)
- A line detailing the product/service
- The cost per unit of the product (if this applies)
- The total amount that is owed

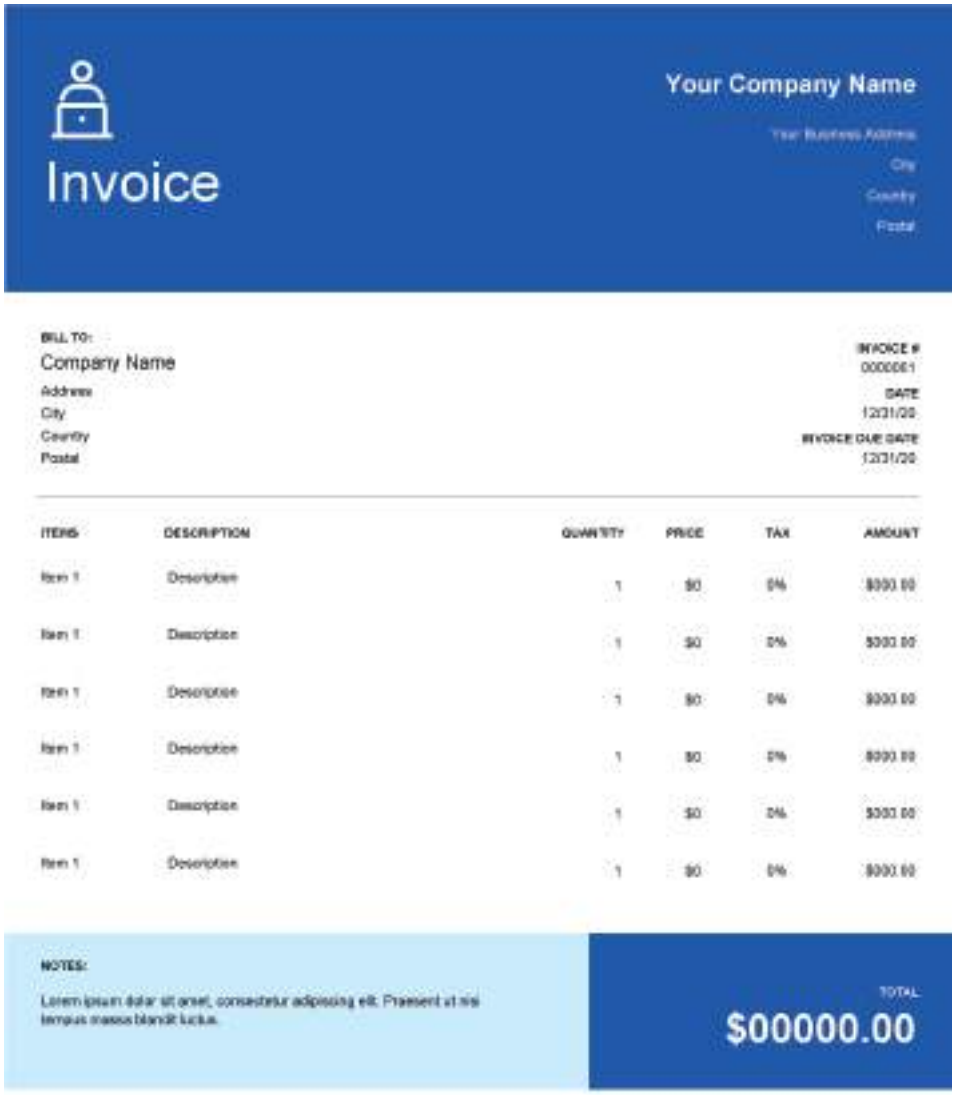


Figure 3.3. Invoice

6. Stock record

Purchase of raw materials is an integral part of any business, i.e. manufacturing organization or service organization. Purpose of raw material is to be converted into finished goods for selling, but after purchase and before selling, they need to keep in safety and good care. The timeframe of storage can be short period or longer depending upon nature and requirement of materials.

Any damage or theft to the materials is going to increase cost to the organization. So it becomes important for organization to have a robust and effective warehouse as well as material's management.

Finally, the goods will be stored in the warehouse and stock records on bin cards will be updated from the goods received note. A bin card is a document used to keep track of the number of items held in a warehouse or stock room. It contains details relating to the number of items, their description and relevant notes.

Company Name
Bin Card

Material Nam: Maximum Stock level
Material Code: Minimum Stock Level
Location Reorder Level

Date	Receipt		Issue		Balance	Name
	GRN #	Qty	Request #	Qty		

Figure 3.4. Bin Card

Notes

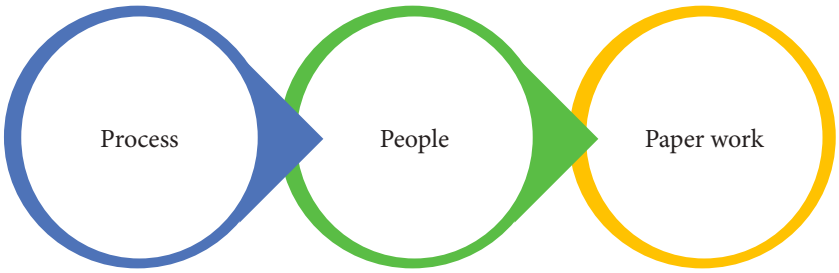
There are two types of stock records namely, physical inventory and perpetual inventory.

(i) Physical inventory document: It is an actual count of all stock or equipment or both in a stores.

(ii) Perpetual inventory document: The perpetual inventory is a running record of the balance on hand for each item of goods in the store room. This is also called as stock book or stock register.

3.1.3. Understanding loading process of raw material details in Enterprise resource planning

Every procurement management process consists of 3 P's namely Process, People, and Paper work.



Flowchart 3.3. Procurement Process

1. Process

The list of rules that need to be followed while reviewing, ordering, obtaining, and paying for goods/services. Check points/ steps increase with the complexity of the purchase.

2. People

These are stakeholders and their specific responsibility in the procurement cycle. They take care of initiating or authorizing every stage of the process. The number of stakeholders involved is directly proportional to the risk and value of the purchase.

3. Paper

This refers to the paperwork and documentation involved in every stage of the procurement process flow, all of which are collected and stored for reference and auditing reasons.

In business enterprise instead of manual record keeping system currently ERP (Enterprise Resource Planning) is in vogue.

Notes

It is realized that electronic record keeping system is time saving, easier, capture information quickly, generate reports and meet tax and legal reporting requirements.

What is ERP system?

Enterprise Resource Planning (ERP) is the integrated management of main business processes, often in real time and mediated by software and technology. ERP system provides automation that will reduce manual efforts involved in a particular process.

ERP is usually referred as a category of business management software typically a suite of integrated applications that an organization can use to collect, store, manage, and interpret data from many business activities. ERP systems track business resources—cash, raw materials, production capacity and the status of business commitments such as orders, purchase orders, and payroll.

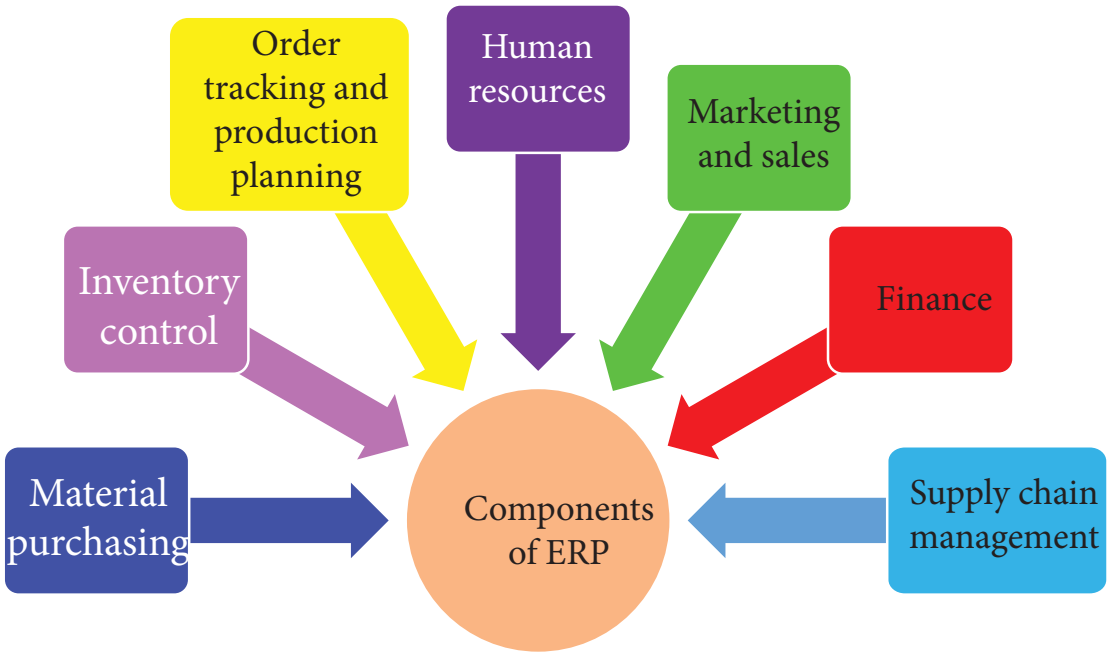
The applications that make up the system share data across various departments (manufacturing, purchasing, sales, accounting, etc.) that provide the data.

Need of ERP in the food processing industry

Food processing industry is one of the largest sectors and plays an important role in the development of the economy in terms of consumption, production and export food products. Just like any other speciality company, the food industries have their own challenges and problems such as product reliability, inventory management, and food safety. As a result of these challenges, industries have focused on the ERP systems that have been created to help solve these challenges head on.

Components of ERP

ERP software is made of several functional modules. Each ERP module mimics a specific functional area of an organization. Some of the main functional modules of ERP software solutions are



Flowchart 3.4. Components of ERP

From the above functional modules of ERP, Material purchasing module is used for loading procurement process of raw material by food processing industry.

Features of ERP purchasing module

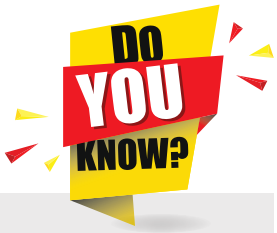
- Streamlines purchase and process cycles
- Detailed Supplier/Subcontractor/Service Provider database
- Capturing materials requirement
- The automatic firing of purchase requisitions based on Material Requisition Slip (MRS)
- Quotations from various suppliers
- Recording Payment terms in Purchase Orders (PO)
- Excise consideration in Purchase and Process Orders
- PO authorization
- PO amendments with complete amendment history
- Order cancellation and order closing

- Multiple delivery schedules
- Quality inspection of goods
- Quotation validity
- MIS for vendor evaluation based on quality, price and delivery time
- Subcontracting, generation of process orders
- Multiple indents for multiple items in a single PO
- Purchase order processing
- Purchase order entry with item details and other details like taxes, discounts
- Flexibility to generate Purchase Order in domestic and foreign currency.
- Advance adjustments
- Purchase bill with updating of GL and purchase book
- Service contracts, Service Bills, Service indents and PO
- Value-based approval of indents
- Bill of entry
- Complete import functionality with the handling of custom details. Purchase bill for import, excise consideration in imports
- Reports for order tracking for complete control over the procurement cycle.

Record loading process of raw material in ERP Purchasing module

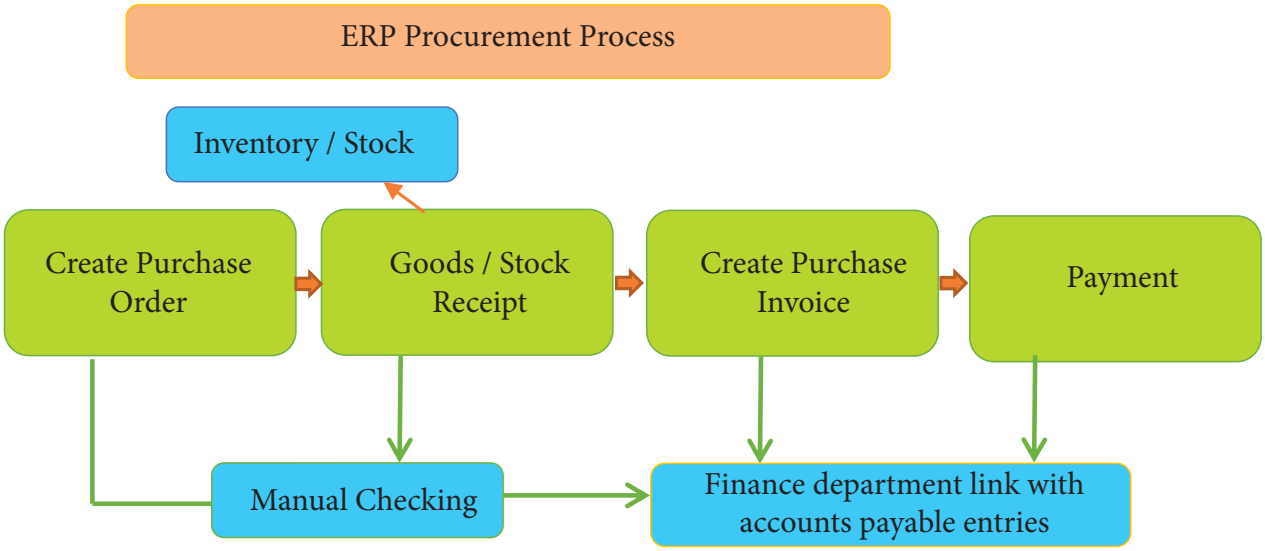
The purchase module streamlines the procurement of required raw materials. It automates the processes of,

- Identifying potential suppliers.
- Negotiating price.
- Awarding a purchase order to the supplier.
- Billing processes.



Characteristics of a purchasing manager

- Interpersonal skills
- Analytical decision making
- Loyal to the organization
- Computer literacy
- Technical skills
- Ability to make decisions
- Innovative
- Bargaining power



Flowchart 3.5. Raw Material Procurement Process in ERP

The purchase department is responsible for purchasing materials required for manufacturing products in the enterprise in the right quantities of the right quality at the right time. The purchase module assists the department with the right information inputs in this task.

The purchase module provides an option to record all the details pertaining to a vendor and these details are the master data for vendors who supply goods to the company.

Purchase module is integrated with the Material management and Financial Accounting management module. This is because all purchase transactions have a financial implications and a stock update. An example of this integration is that when a purchase invoice is raised, the vendor account which is an Accounts Payable account is credited and purchase account is debited. The transaction table in the ERP database will reflect the purchase invoice transaction entry and update of accounts is reflected in the accounts table.

Care should be taken to record multiple items with multiple delivery dates when developing Purchase module.

The vendors are also referred to as suppliers and managing these suppliers is possible with this module and so this module is also referred to as Supply Chain Module (SCM).

The main objective of this module is that the enterprise should not order material in excess of requirement. Suppliers and

Notes

the company can work in a tandem using the SCM module. The suppliers can optimize their resources while the company can optimize its resources while allowing the suppliers also to do the same.

A supply chain consists of the vendors who supply material to the seller. The seller may be a manufacturer or a multi-product distributor or an e-commerce business.

Purchase Order

The purchase department initiates the purchase process by raising the purchase order. Purchase orders are created when there is a requirement of materials for production of finished products. The vendor supplies goods based on the purchase order. All purchase orders are treated as pending purchase orders till the time material is received from the vendors.

In every purchase order, multiple items are included and sometimes with different delivery dates specified.

A purchase order is a reference document between the organization and the vendor. When payments have to be made to the vendor, the purchase order is the reference document. When the material is received, the stock is checked against the purchase orders.

Purchase module provide a feature to record purchase orders.

The details recorded in the Purchase Order are:

- Order number
- A unique number assigned to each order
- Order Date
- The date on which an order is created
- Vendor Name
- The vendor to whom this particular order has to be allotted.
- Item name, Quantity, Rate, Value
- Details of the products which have to be purchased from the vendor

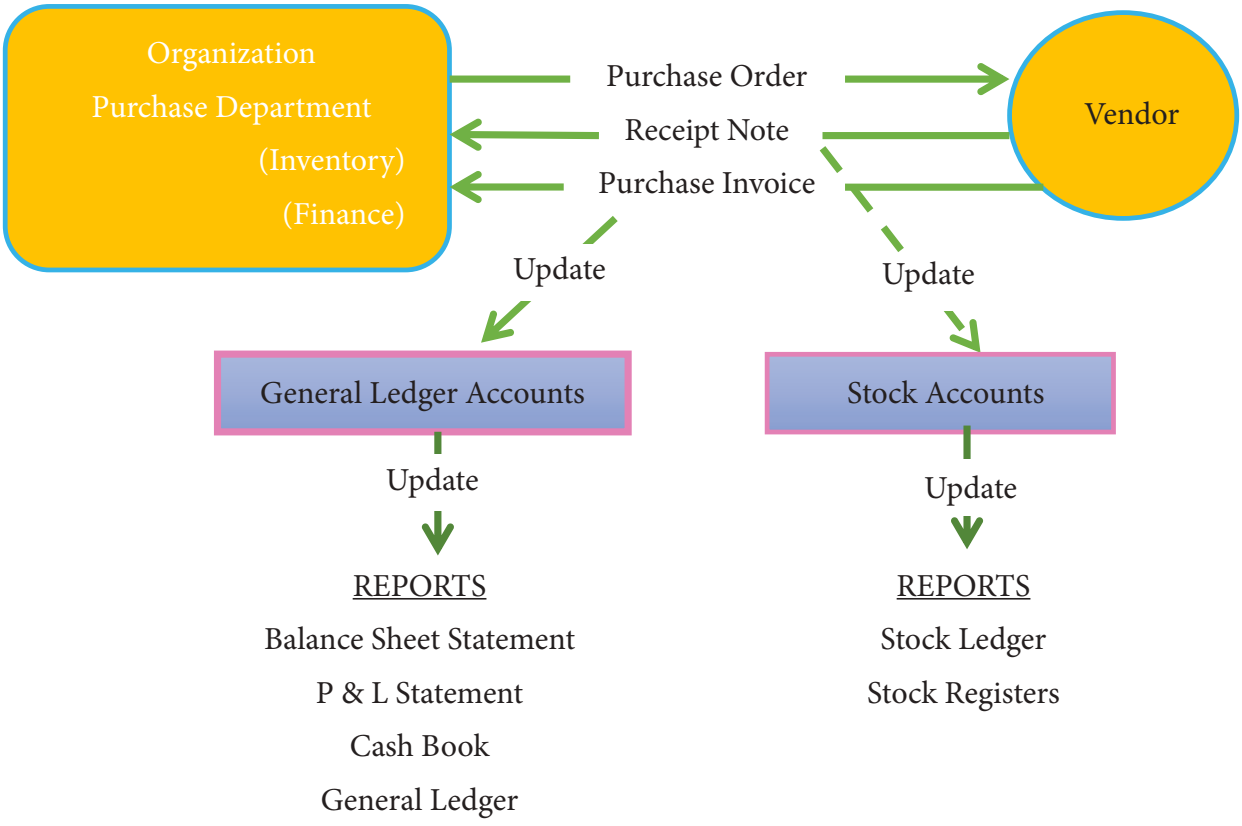
Receipt Note

On receipt of goods, a receipt note is raised. When the receipt note is raised, stock accounts are updated. After the receipt note is created, purchase invoice is created which is a reference for the finance department to make a payment.

Stock updates and Reports in purchase module

The stock updates are reflected in the stock ledger and the stock registers. General ledger account updates are reflected in the balance sheet, Profit / Loss statement and general ledger.

A good ERP Purchasing module allows tracking of each purchase order right from the stage when it is created and receipt of materials received against purchase order which is in parts or full, purchase invoices, and any purchase returns.



Flowchart 3.6. Stock Updates and Reports in Purchase Module

It also generates a list of reports of the purchase pipeline such as estimation of purchase of raw materials and costs, daily and monthly cumulated reports.

Importance of ERP purchasing module

- Minimizes the chaos made by paperwork

- Shortens the procurement lifecycle
- Reduces human dependency intervention and errors
- Lessens the workload of all stakeholders
- Keeps the process accurate and consistent
- Injects transparency into the process flow
- Sticks to the predefined procurement cycle

3.2.0. Maintain Record of Production Schedule and Process

Production process, are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the product design, and materials specification from which the product is made. These materials are then modified through manufacturing processes to become the required part.

What is Production Scheduling?

Production Scheduling is the allocation of raw materials, resources, and processes to produce products for customers.

The purpose of production scheduling is to make manufacturing process flow with maximum efficiency, by balancing production needs with available resources in the most cost-effective manner.

Stages of Production Scheduling

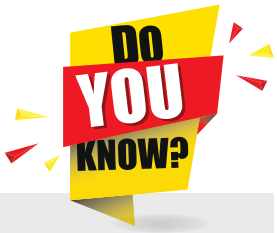
There are four stages in production scheduling which are discussed below:

1. Production Planning

Production planning is the process in manufacturing that ensures sufficient raw materials, labour and resources in order to produce finished products to schedule. It is a crucial step in production management and scheduling.

Complete production planning involves the accurate tracking of :

- Raw materials
- Team members
- Workstations



Five rights that every management experts or purchasing executives should know

- Right quantity
- Right quality
- Right time
- Right supplier
- Right cost

Notes

- Processes and
- Supplies.

Knowing measurements and figures is not enough, hence there is a need to understand how each part of manufacturing process interact and work together optimally.

2. Routing

Routing is the route or path, to be followed during each step of the manufacturing process. The manufacturing route defines the path from raw materials through to the production of a finished product. If done correctly, it helps to know at what stage the item is at and which machine, tool, or work center it needs to travel to next.

3. Scheduling

Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

In manufacturing, the purpose of scheduling is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment.

4. Execution

Execution related to the process of undertaking production plan. Having already established production planning, routing and scheduling, the execution stage is issue supporting orders or instructions in order to enable production.

3.2.1. Assess the documents at production schedule and process

Production records are an integral part of production planning and purchasing management since production records keep information on completed jobs and status of production units stocks up to date.

Details of documents at production schedule and process

Flowchart 3.7. Documents at production schedule and process

1. Stores or Material Requisition Note

Stores or Material Requisition is a document which authorizes and records the issue of materials for use. The storekeeper must not issue stores or materials unless a properly authorized Requisition Slip or Material Requisition. This is prepared by the foreman of the production department. Generally, it is signed by the foreman but in case of important materials higher authority would probably be necessary.

The contents of Stores or Material requisition

- Number and date of requisition
- Name of the section requiring the materials
- Particulars and code number of materials
- The quantity of material demanded and its unit of measurement
- The rate at which issue is to be made
- The total value of materials
- Authority for requisition.

Notes

Activity 3

Plan and prepare a digital store room requisition slip for jam industry.

2. Goods Issue record

A Goods Issue is defined as the issue of goods or materials from the warehouse. It results in a decrease in stock from the warehouse. For e.g. Goods are issued from the store to the production department to make the product.

3. Bill of material (BOM)

A bill of materials (BOM) documents the materials and processes necessary for manufacturing a finished product. Bill of Material may be defined as, "a document containing a complete list of materials and components required for manufacturing a particular product or for a particular job, process or work-order". It is also known as 'Specification of materials'.

Figure 3.5. Bill of Material

Bill of material is a schedule of materials required for each job, process or operation. The bill of material is prepared by production or planning department as soon as the order is

received. It is a requisition to the stores department for supplying the desired materials in proper time.

This will also serve as an indent upon the supply or purchase department, if materials are to be purchased and as a reservation order upon the Storekeeper. Wastage can be easily unearthed if only the exact quantity as laid down by Bill of materials is issued.

Four copies of Bill of Materials are prepared which are sent to production, stores, Cost Accounting department and one is retained by the Planning Department. Bill of Material provides an advance information to all concerned regarding orders to be executed. It enables the stores department to issue purchase requisition. It helps Cost Accounting department to prepare Material Cost Budget.

4. Manufacturing process record

Manufacturing process record is defined as the record maintained by the production department about the product manufactured on hourly basis, daily basis, weekly basis, monthly basis, the number of workers involved to produce the product and the number of machineries involved, the power consumed and the external things needed for production. E.g. Water. The document is compared to the target on regular basis for improving the production

5. Daily report of production on shift basis

A daily report is typically a document prepared by employees to submit to their supervisors. A standard report contains details on how they spent their work day, including any achievements or challenges they encountered. Often, the report also outlines plans for the following work day.

Shift hours of the workers and some other details related to the workers of the company are also included in the daily production report. The complete production and the pace of the production are checked by the production manager of the company which helps him in making the decision about increasing or maintaining the pace of the production.

6. Volume of manufactured goods

Production volume measures the total amount of products can produce over time. This tracks the total number of products

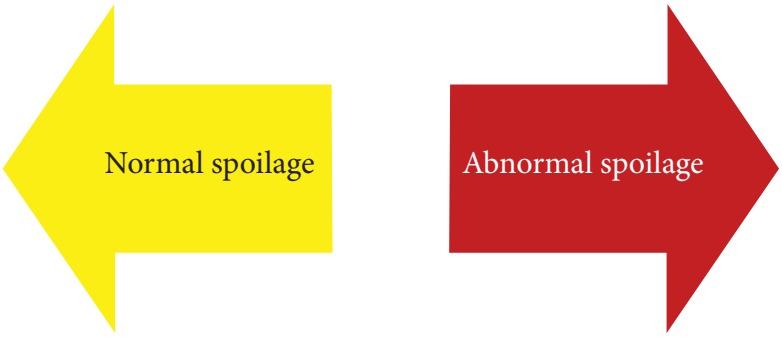
Notes

manufactured over a set period of time (days, weeks, months, quarters and years) and focuses on total output.

Production department sends a report to the finishing department containing the volume of produced goods, process of the goods manufactured, time taken to produce the goods, number of workers involved and details of the product will be given.

7. Spoilage or wastage details report

Spoilage is wastage or loss of material that occurs during the manufacturing process. In accounting, spoilage is classified into two types. They are,



Flowchart 3.8. Classification of Spoilage

(i) Normal spoilage

Losses which are unavoidable are called Normal losses. Normal losses of material cannot be completely avoided but may be controlled to a limited extent. These losses are transferred to factory overheads For example, transporting fruits by sea or ground will definitely incur spoilage for various reasons.

Figure 3.6. Spoilage

Notes

(ii) Abnormal spoilage

Losses that arises due to inefficiency in operations, carelessness is called as abnormal losses. These losses are charged to costing profit and loss account.

8. Goods Receipt

A Goods receipt is defined as the receipt of material in the store or the receipt of stock from the vendor or manufacturer. All good receipt results in an increase of stock in the warehouse. For e.g. receipt of the produced product into stores.

3.2.2. Understand record loading process of production schedule and process detail in Enterprise Resource Planning (ERP)

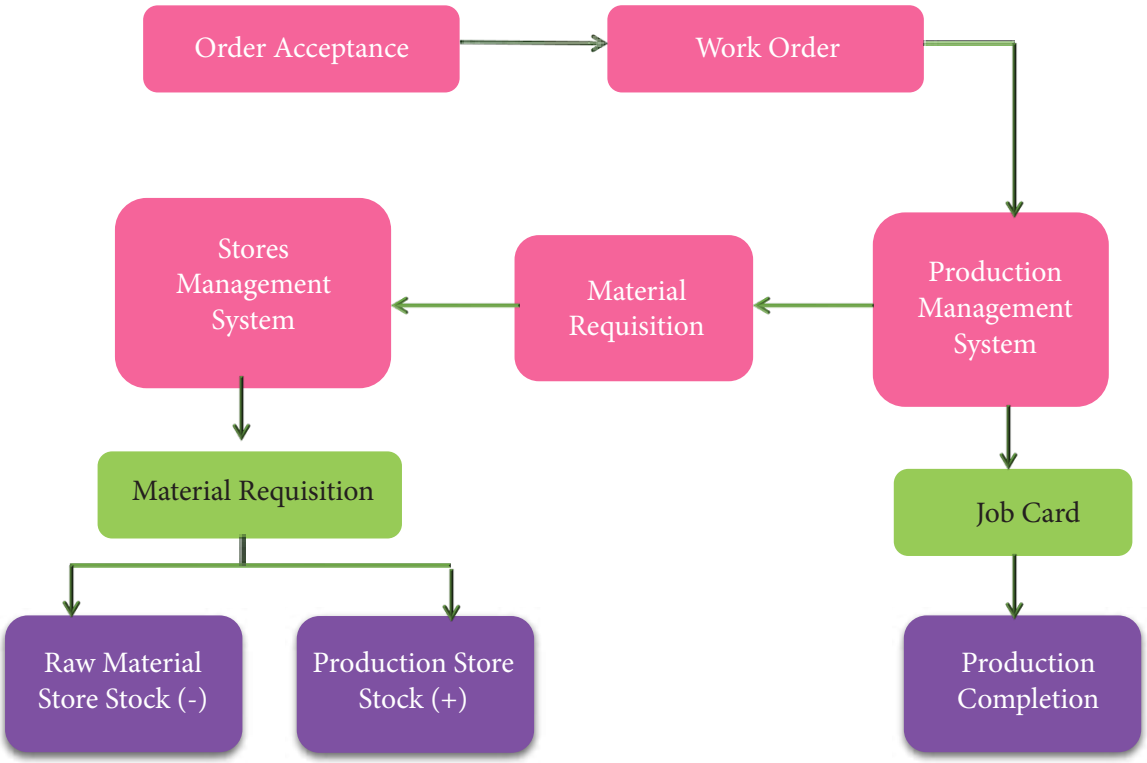
Production scheduling is heart of a process manufacturing business. A process manufacturing business should know what needs to be produced, when it needs to be produced and how much materials plus total resources will be needed as input to finish it.

Lack of automated planning tools hampers the swift flow of production activities, and businesses are forced to spend lots of time preparing the schedules for the manufacturing activities using paper, excel sheets and such. This information apart from being time consuming, is not fully reliable. But with an ERP production scheduling module, sound planning which is accurate, precise and updated leads to better efficient scheduling.

Record loading process of production schedule and process detail in ERP production scheduling module

ERP production module maintains production information. This module will help in doing the planning, scheduling, and recording production activities.

ERP production scheduling module is designed to track day-to-day production progress. On completion of any work order information will be sent for delivery. Reports on the delivery schedule will be available in this module.



Flowchart 3.9. Production Module Flow

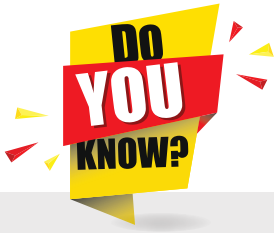
Activity 4

Develop a job description for a ketchup processing technician.

Main features of the ERP production planning module

- Process definition with inputs, outputs, by-products, and overheads
- Definition of Bill of Materials (BOM) for all products up to any number of levels.
- Planning based on customer wise production advice and sales forecast.
- Material requirement planning: MRP based on machine capacity and availability. Machine efficiency, raw material availability, lead time. It gives a workable quantity for production.
- Production plan for machines with the best use of all available resources. Resource like raw materials and machines.
- Option to revoke production plan to change input parameters, production priority, or quantity. This is done using fresh production advice.

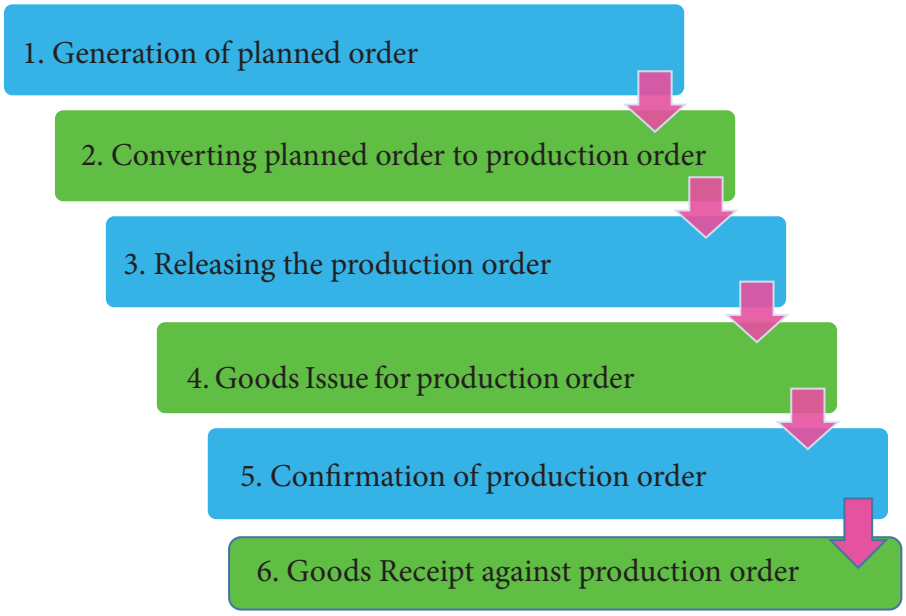
- Generation of the production schedule for machines detailing inputs and outputs.
- Analysis of machine efficiency and utilization.
- Automatic generation of MRS and purchase requisitions on finalization of the plan.
- Generation of process requisition for processes that have to be subcontracted.
- Reserving quantity for production.
- Automatic generation of job orders for production.
- Option to make daily plans for production.
- Generating reports related to production.



MRP is a tool that provides answer for several questions:

- What material is required?
- How many are required?
- When they are required?

Steps for loading process in ERP Production Scheduling module



Flowchart 3.10. Steps for loading process in ERP Production Scheduling Module

1. Generation of planned order

- Planning quantities are derived and maintained in the system.
- Material Requirement Planning run will generate the planned order for the net required quantity with the start date of the production process.

- Master data (BOM and Routing details) will be copied in to the planned order automatically during MRP run.

2. Converting planned order to production order

- Planned order has to be converted to production order to account the entire production.
- Production order or process order type has to be mentioned when converting the planned order. Entire master data will be copied to the respective order when converting the planned order.

3. Releasing the production order

Release of production order is an important step in production order. Releasing of production order indicates the commencement of production. Unless the order is released, further processing of order is not possible.

While releasing the production order system can perform:

a) Material availability

b) Capacity availability

c) Creation of Batch

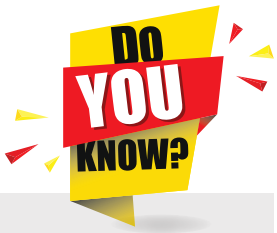
d) Reservation creation

4. Goods Issue for production order

- Goods issue covers issuing required components to make the finished product to a production order. While making the goods issue, the document number can be updated in the production order.
- Goods issue can be made in parallel during confirmation of operation.

5. Confirmation of production order

- Reporting of usage of components and activities are termed as confirmation.
- Confirmation to the each operation will be executed according to the control key attached with each operation.



What is meant by reservation creation?

Planning department creates production orders with reference to sales order. System generates the reservation for withdrawal of the materials from stores for executing the production job.

Figure 3.7. Food Production

6. Goods Receipt against production order

Once the production is completed, finished products will be received from the production order into the respective storage area.

This can be achieved through two ways

a) Through confirmation.

b) Through separate transaction.

Document number will be generated for each goods receipt. This document number can be updated in the production or process order.

Advantages of an efficient production scheduling

- Maintaining a smooth workflow
- Reduce inventory costs and risks of misinterpreting and running a huge loss.
- Increased customer service level due to on-time and high-quality deliveries.
- Increase in production capacity and sales rate.

Activity 5

Prepare one day production schedule for a bakery unit.

3.3.0 Maintain Record of Finished Product

Definition – Finished goods

Finished goods are goods that have been completed by the manufacturing process, or purchased in a completed form, but

Notes

which have not yet been sold to customers. It may or may not require any processing.

Food products are finished goods. Processed and unprocessed foods, both can be finished goods. Processing food means doing something to that food to change it from its natural state.

Unprocessed Foods

An unprocessed or a whole food is as close to its naturally occurring state as possible and have been prepared for sale. Fruits and vegetables have been picked and cleaned and are ready to eat or cook. The same goes with meats. Meat has been cut and packaged so it's ready to be used. Eggs have been gathered, cleaned, and packaged in cartons. When purchasing these food items, the seller or farmer has done all the processing needed to make it ready to be sold. Unprocessed foods however have gone through little or no changes before being considered ready to sell.

Figure 3.8. Unprocessed Fruits

Processed Foods

Food that has been changed from its natural state is considered as processed. Foods are minimally processed or highly processed. Minimally processed foods are cut, dried or cooked, but nothing much is added or removed from them. Some foods are highly processed in which bunch of other ingredients added to them like sugar or oil or artificial colors or preservatives. For example, if a food is cooked, frozen, or has had ingredients or nutrients added, then it is processed. Restaurants also sell processed foods.

Figure 3.9. Processed Vegetables

Activity 6:

Tabulate unprocessed and processed finished goods according to food groups.

3.3.1. Assess the details to be maintained and documented at finished product stages

Finished products records are established and maintained to provide evidence of conformity to requirements and of effective operation of the hygiene management system.

Flowchart 3.11. Finished Goods Records

1. Product requirement document (PRD)

The PRD should include all the chemical, physical, and microbiological characteristics of the final product. Physical standards are defined by dimensions, shape, weight, and volume of the food. Count per package and any other special features of the food product should also be added. Microbiological characteristics, on the other hand, would depend on a specific food item. For instance, pathogens and foreign materials present when processing the food should be involved in the document.

Notes

Containing all the requirements of a product, this particular document is one of the most vital tools to assure food quality control is being met.

2. Product specification record

A finished product specification is the information sheet that documents all of the attributes and information regarding the finished product. Documents that list the requirements that a product must meet before being released for use or sale.

Elements of a finished product specification

The minimum requirements that all finished product specifications should document includes:

- Product Name and description
- Weight
- Shelf Life
- Storage Conditions
- Directions for Use
- Ingredients
- Allergens
- Nutrition Information
- Manufacturers details
- Method of preservation
- Country of Origin
- Issue date
- Method of traceability

3. Product / Recipe standardization record

One of the most important tools to assure quality in a finished product is the product standard document.

A standardized product is a set of written instructions used to consistently prepare a known quantity and quality of food for a specific location. A standardized product will produce a product that is close to identical in taste and yield every time it is made, no matter who follows the directions. The use of standardized

products provides predictable information on the quantity of food inventory that will be used each time the product is produced.

This record includes the following elements:

- Product title
- Product category
- Ingredient list
- Weight/Volume of each ingredient
- Preparation procedures
- Cooking temperature and time
- Portion size
- Total yield
- Equipment and utensils to be used
- Service instructions, including hot/cold storage

Figure 3.10. Portion Size

4. Good Manufacturing practices (GMP) record

The food business has a legal and moral responsibility to produce and prepare food that will not harm the consumer. Good manufacturing practices (GMP) are important in order to produce safe food. Good manufacturing practices (GMP) can be defined as the operational requirements necessary to enable a food business to produce food safely.

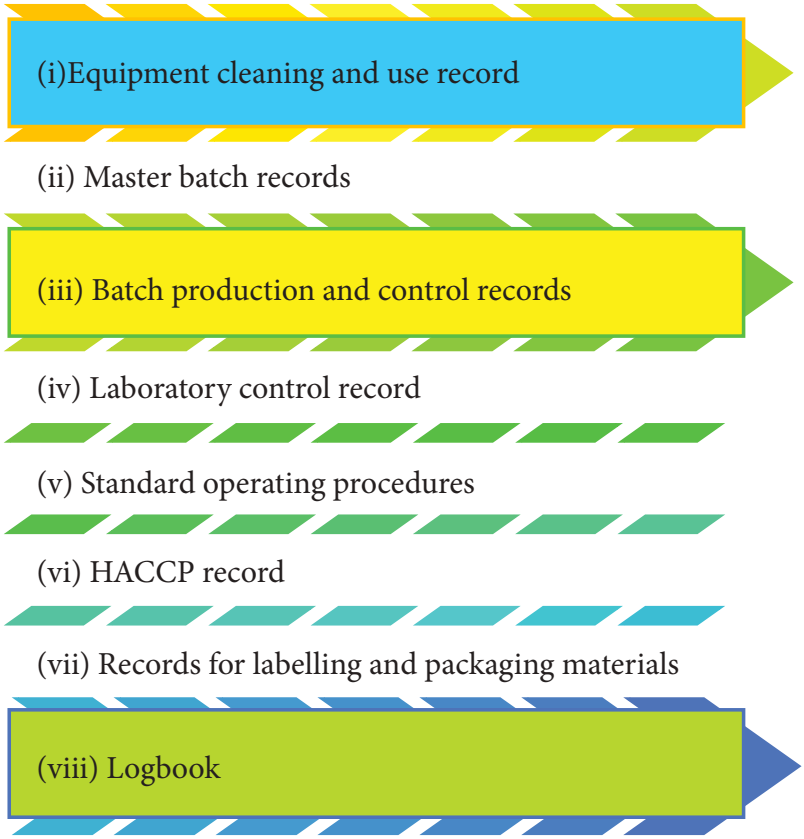
To assist in the effective implementation of Good manufacturing practices (GMP) within the food business it is advisable to document procedures on how the food business

Notes

is going to implement relevant Good manufacturing practices (GMP).

All aspects of the manufacturing process must be documented. Accurate recordkeeping can help managers and supervisors keep track of the historical record of manufacturing procedures and corrective measures implemented. Below are general documentation:

Good Manufacturing practices (GMP) record



Flowchart 3.12. Good Manufacturing Practices (GMP) Record

(i) Equipment cleaning and use record

It is a record of major equipment use, cleaning, sterilization, and maintenance should show the date and time, product, and batch number of each batch processed in the equipment and name and signature of the person who has performed the cleaning and maintenance. Entries in log should be in chronological order.

(ii) Master batch records (MBR)

Master Batch Records, also known as Master production records, are general manufacturing instructions. The purpose of an MBR is to ensure that all proper ingredients are added and that

each step in the process is completed. Each unique formulation and batch size must have its own MBR and should include:

- Identification of product name.
- Bill of Materials detailing the Weight, measure or count of each component needed to manufacture the batch.
- Equipment list.
- Component list.
- Statement of theoretical yield at each step in the manufacturing process.
- Expected yield of the finished product.
- Detailed manufacturing process.
- Sampling and testing procedures.
- Instructions for manual operations.

(iii) Batch production and control records (BPR)

Batch Production Records copies the Master Batch Record. The BPR records documents when, how, by whom, with what tools and in what environment a product was produced. The Batch Record is where operators record specific lot numbers as well as the specific weights, measure or count of ingredients and components actually used to produce that specific batch.

(iv) Laboratory control record

Laboratory testing is an important process, which relies on scientific analysis to identify problems with food products. It provides analytical data on the quality of a product or production process to support quality control in the HACCP system.

Figure 3.11. Laboratory Testing

The objective of quality control is to identify contaminants in raw material, or contamination after a product is produced and before it is placed on the market. Additionally, laboratory testing is important for the research and development of new products, including, for example, the choice of ingredients or components, the design of food processing, shelf-life studies and sensory evaluation of products.

Laboratory control records should include complete data derived from all tests conducted to ensure compliance with established specifications and standards, including examinations and assays, as follows:

Notes

- A description of samples received for testing
- A statement of each test method used
- A complete record of all raw data generated during each test
- A record of all calculation performed during test
- A statement of test result and comparison with established acceptance criteria
- A signature of the person who performed each of the test
- Date on which the test were performed

(v) Standard operating procedures (SOP)

It is a step-by-step instruction for performing operational tasks or activities. SOPs outline procedures, which must be followed to claim compliance with GMP principles or other statutory rules and regulations to ensure food safety.

(vi) Hazard Analysis Critical Control Point (HACCP) record

The primary purpose of a HACCP system is to protect people from food borne illness.

Records and documentation of HACCP needed to show that all activities have been performed according to approved procedures. Documentation provides clear instruction on the approved processes so that each person knows how to perform the process in the approved manner. Records show that the work performed was done in compliance with these procedures.

Seven basic principles are employed in the development of HACCP plans that meet the stated goal. These principles include hazard analysis, Critical Control Point (CCP) identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, and record-keeping and documentation.

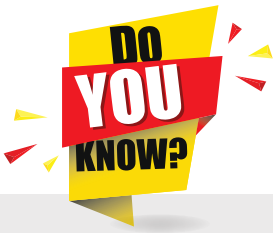
HACCP Documentation must include:

- Documents needed for the effective development, implementation and updating of the Food Safety Management System (FSMS)
- A documented Prerequisite program (PRP)

- Documentation of raw materials, ingredients and product contact materials
- Characteristics of end products
- Intended use of end products
- Flow diagrams for products or process categories
- Description of process steps and control measures
- Methodology and parameters used for selection of control measures
- HACCP Plan
- Procedure for Corrections
- Procedure for Corrective Action
- Procedure for Control of Nonconforming Product
- Procedure for Withdrawals
- Procedure for Internal Audits
- Procedure for Document Control
- Procedure for Records Control

HACCP record includes:

- Records of communication
- Records of management review
- Records of contracts with external experts
- Records of training
- Records of preliminary steps for hazard analysis
- Records of verification of PRPs
- Records of the food safety team members qualifications
- Verified flow diagrams
- Results of hazard identification and assessment
- Records of operational PRP monitoring
- Verification results



Prerequisite program (PRP)

PRP defines the "basic conditions and activities that are necessary to maintain a hygienic environment through the food chain suitable for the production, handling, and provision of safe end products and safe food for human consumption".

- Traceability records
- Records of HACCP monitoring
- Records of internal audits and verification activities
- Records of review of product manufactured when operational PRPs were not within conformance limits
- Records of corrective action
- Records of withdrawal
- Records of calibration
- System updating activities

(vii) Records for labelling and packaging materials

Packaging and labeling are the two vital requisites of the food industry. The quality of packaging and labeling is also important for maintaining the food quality. Packaging is important as it protects the product from physical, chemical, and microbiological invasion. It is also used for the identification of the products in marketing. It enhances the appearance of the label for promoting the product. In addition, labelling also helps to provide the information about a product to the prospective customer.

Flowchart 3.13. Packaging and Labelling

Packaging Records should be maintained, including:

Figure 3.12. Package

- The name of the product, the batch number and the quantity of the product to be packed
- The date and time of the packaging operation
- The name of the responsible person carrying out the packaging operation
- Details of a packaging operations carried out
- Documentation of the examination and review of labeling and packaging materials for conformity with established specifications

- The final decision regarding rejected raw materials, intermediates, or labeling and packaging materials.

Starting materials in the storage area should be appropriately labeled. Labels should bear at least the following information:

- The designated name of the product and the internal code reference, where applicable
- The batch number given by the supplier and, on receipt, the control or batch number (if any) given by the manufacturer; these must be documented so as to ensure traceability
- The status of the contents (e.g., on test, released, rejected, returned, recalled, etc.)
- Where appropriate, an expiry date or a date beyond which retesting is necessary
- Approved labels should be maintained for comparison with issued labels.

Figure 3.13. Label

(viii) Logbook

All companies are required to keep a logbook for the chronological documentation of equipment-related events such as validation and qualification work, calibration, equipment cleaning, preventive maintenance and repairs and unexpected events/deviations for manufacturing equipment, apparatus and quality control.

5. Waste record

Every business has waste of some sort. This may be items that have fallen on the floor, jammed in the packing process, used as

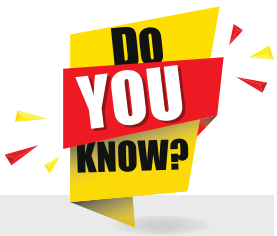
part of the product assessment process or line clearance between products. Recording the batch and also the destination of all waste generated as part of the production process should be included. This information really helps to calculate the mass balance. Any waste that goes to animal feed also included in this record.

Figure 3.14. Waste Food

6. Stock record

Finished goods inventory record refers to the number of manufactured products in stock that are available for customers to purchase. Maintaining good inventory control helps to

- Increases productivity and efficiency
- Creates a more organized warehouse
- Save time and money
- Improves accuracy of inventory orders
- Keeps customers coming back for more



What is Inventory control?

It is defined as the coordination and supervision of the supply, storage, distribution, and recording of materials to maintain quantities adequate for current needs without excessive oversupply or loss.

7. Distribution record

Distribution records are a great way to document who purchased the product or where it was sent to after it left from food business.

Distribution record should be maintained and must include:

- Batch number
- Quantity produced
- Name, address and contact details of customer
- Quantity supplied
- Date of supply

8. Returned finished products and raw materials

The name, batch codes and quantity of the returned finished products and raw materials should be included in this record.

3.3.2. Understand loading the finished product detail in Enterprise resource planning (ERP) for future reference

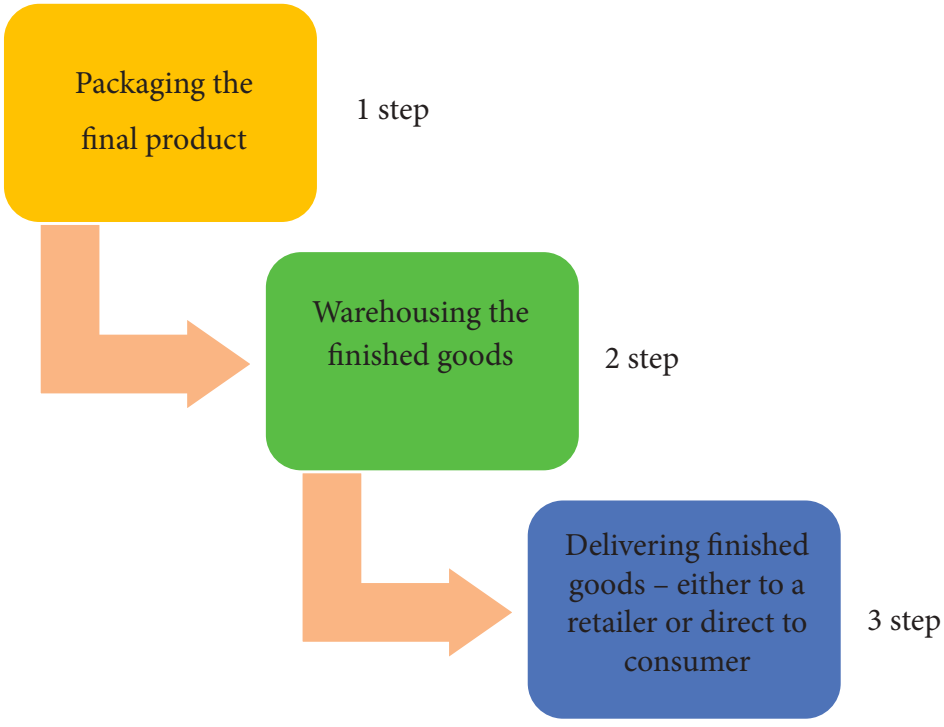
Supply chain management module in ERP solution streamlines the path of products go through from supplier to warehouse and finally to store for customer.

All Manufacturing Companies hold Finished Goods inventories in various locations and all through FG Supply Chain.

What is FG supply chain?

FG Supply Chain consists of all activities involved in movement, storage and distribution of finished Goods from the delivery point of plant to the Point of Sale. Supply chain is a system of organizations, people, activities, information and resources involved in moving a product or service from supplier to customer.

Activities involved in supply chain for finished goods



Flowchart 3.14. Activities Involved in Supply Chain for Finished Goods

Notes

1. Packaging the final product

Functionalities in the ERP system helps in deciding packaging methods and set criteria for quality check for both internal and external packages.

Figure 3.15. Packed Food

2. Warehousing the finished goods

In the supply chain, Warehouses management system (WMS) is mainly used in managing movement and storage of inventory by tracking and providing details on the location of the materials.

Figure 3.16. Warehousing Finished Goods

WMS majorly deals with management of finished products within the warehouse. WMS takes over the finished product by receiving, storing, tracking and shipping of the merchandise.

3. Delivering finished goods

Once the item has been shipped, the ERP software can create an invoice that has to be finally sent to the customer. An ERP system helps in maintaining a central repository for customer shipments and all delivery details to ensure that items are delivered on time.

Notes

Figure 3.17. Delivering Goods

Advantages

- It helps to achieve better inventory control.
- It is used to provide better information on customer needs, tastes etc.,
- It helps to achieve regular and better communication with the customers.
- It increases performance and profitability.
- It is used to lower transportation, warehousing and packaging costs.

Summary

Food processing entrepreneurs are expected to maintain records of the products they handle and the processes they follow. This information is intended to be used if a problem arises and there is a need to identify the potential scope of the problem as well as the source of the problem. Food processing entrepreneurs should not view records as **"a threat of exposing themselves to liability" but as "a means of documenting that they handled the food as expected and that a problem did not arise from their operation."**

Notes

Glossary

Balance sheet	:	It is more like a snapshot of the financial position of a company at a specified time, usually calculated after every quarter, six months or one year
Batch creation	:	It is a method of manufacturing where the products are made as specified groups or amounts, within a time frame
General Ledger	:	It is a central repository for accounting data transferred from all sub ledgers like accounts payable, accounts receivable, cash management, fixed assets, purchasing and projects
HACCP	:	Hazard Analysis Critical Control Point
Job Card	:	It is a detailed description of work that is performed for a work order
Lead time	:	It is the time between the initiation and completion of a production process.
MIS	:	Management Information System
Overheads	:	It is a regular and essential expenses, such as salaries, rent, electricity, and phone bills
P & L Statement	:	A profit and loss statement is a document that summarizes all revenues and expenses incurred during a specified period
Quotations	:	A formal statement setting out the estimated cost for a particular product or service.
Traceability	:	Ability to track any food, feed, food-producing animal or substance that will be used for consumption, through all stages of production, processing and distribution.

Notes

EVALUATION

I. Choose the best answer (1 mark)

1. ……. is a set of documents provided on paper or online or a digital media.

   a) Documentation b) Record keeping

   c) Document d) Record

2. A delivery note can also be known as a ……..

   a) Invoice b) Stock record

   c) Dispatch note d) Purchase order

3. Which functional module of ERP is used to procure raw material by food processing industry?

   a) Human resources b) Purchasing

   c) Finance d) Inventory control

4. …….is a schedule of materials required for each job, process or operation.

   a) Bill of material b) Goods Receipt

   c) Goods Issue record d) Daily report

5. Find out the first stage of production scheduling

   a) Routing b) Scheduling

   c) Execution d) Production Planning

6. Match the following

   1) Waste record - i) Supply

   2) Product Standardization - ii) Animal feed

   3) Laboratory testing - iii) Portion size

   4) Distribution record - iv) Quality control

   a) 1-(ii), 2-(iii), 3-(iv),4-(i) b) 1-(i), 2-(ii), 3-(iii), 4-(iv)

   c) 1-(iv), 2-(iii), 3-(ii), 4-(i) d) 1-(iii), 2-(iv), 3-(i), 4-(ii)

II. Very Short Answer (2 marks)

1. Define record keeping?
2. State the classification of raw materials.
3. What are the contents to be mentioned in purchase order form?

Notes

4. List out the components of ERP.
5. Write on Production Scheduling?
6. Expand

   i) MRP ii) PRP

7. Enumerate the advantages of an efficient production scheduling.
8. Draw the production module flowchart.
9. Give a short note on HACCP record.
10. Enlist the advantages of inventory control.
11. How do you write product specification document?
12. How does supply chain module helps to maintain finished goods records for future reference?

III. Short Answer (3 Marks)

1. Differentiate the record and document.
2. Bring out the importance of record keeping.
3. What are the details to be documented at raw material collection stages?
4. Describe 3 P's of procurement process.
5. Write the importance of ERP purchasing module.
6. Explain the steps for loading process in ERP Production Scheduling module.
7. Give an account on Stores or Material Requisition Note.
8. Classify spoilage with examples.
9. Laboratory testing is the part of the quality control program – justify
10. What is GMPs? Write about the purpose of GMPs.

Notes

PRACTICAL EXERCISE

3.1. Importance of Record keeping

Aim:

To gain knowledge on need to maintain records in a food processing industry

Procedure:

A legal requirement in food firms is to maintain records relating to the manufacture, processing, packing, distribution, receipt, holding, or importation of food products. The purpose is to assist in determining whether anything has happened to the food or been done to the food that would render it unsafe (i.e., adulterated). Accordingly, firms must maintain records and government authorities may access the records.

The food industry also is demanding that food businesses retain records which buyers (other food processors) can access or rely on to assure that the seller has taken reasonable steps to reduce the risk of a food borne problem. Although expectations are imposed by statutory and regulatory law, it is important to realize that food buyers also are imposing contractual expectations on food sellers, including the expectation that the seller have records to adequately document how the product is being sold and has been handled by the seller.

Need:

- To know how the food has been handled
- To facilitate traceability of purchase and delivery
- To know if the food is adulterated or misbranded
- To help determine the source and scope/magnitude of a food safety problem
- To know the HACCP procedure followed
- To maintain the correct nutrient content
- To know the standard recipe to be followed
- To know the transactions made
- To label product formulation and processing procedures

Notes

- To know the canning method used
- To know about the machinery and their maintenance
- To know about accidents and the procedure followed
- To provide information on the FSSAI certification of the processing unit
- To get facts on the persons working, their attendance and their work shifts
- To help know the safety procedures maintained in the unit
- To know about the buyers and suppliers
- To assess the financial status of the industry
- To know about the management and the laws maintained in the unit
- To understand the contracts made by the industry

Result and Discussion:

3.2. Demonstration of record maintenance process at production schedule and process stages

Aim:

To understand the records maintained in a production schedule and process stages.

Procedure:

Various records to be maintained in the various section

- Purchase Order
- Indent
- Invoice
- Stock Register for Assets- Equipment, Perishables, and Cleaning agents
- Physical Inventory
- Perpetual Inventory
- Recipe

Notes

- Production details
- Quality Assessment
- Details of Sales
- Attendance Register
- Ledger
- Profit and Loss Account

Tabulate the following records

Section	Records maintained	Uses
Factory/unit		
Employees		
Finance		
Buyers/Suppliers		
HACCP		
Purchase and Delivery		
Labelling		
FSSAI		
Accidents and Safety		
Attendance		

Result and Discussion:

Project

- List and record the format of the records maintained in any food processing industry.
- Survey any three bakery units to identify the raw materials used, method of storage of raw materials and finished products and equipment used.
- Collect five labels of different kinds of food products and indicate the details in the label.
- Report on the quality of five processed foods after assessing the various attributes using a check list.

Notes

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Unit 4

Food Quality And Sanitation Laws For Processed Food Products

Learning Outcomes

- Understanding meaning and importance of food quality
- Acquire knowledge on factors affecting food quality
- Become aware of and recognize the food quality control standard, act and legislation
- Learning the importance of food additives.

4.1 Introduction

"Food should be safe for human consumption and free from hazards that may compromise the health of the consumer"

Food quality is an important factor in the success of a food product, particularly as food businesses aim to remain competitive in the global market place. Some consumers eat foods whenever they feel hungry without bothering of the safety of food. However consumers also expect the food they eat should be fresh and of

Notes

high quality Food quality and food safety are the major aspects of the food supply that need to be considered for a healthy life.

4.1.1. Meaning of food quality

"Food quality is the characteristics of food that is acceptable to consumers". This includes external factors like appearance, texture and flavor; factors such as federal grade standards and internal (Chemical, physical, microbial) factors.

Figure 4.1. Food Quality

Food quality is an important food manufacturing requirement, because consumers are susceptible to any form of contamination that may occur during the food manufacturing process. Many consumer also rely on manufacturing and processing standards, particularly to know what ingredients are present, due to dietary, nutritional requirements (Kosher, halal, vegetarian) or medical conditions (eg., diabetes or allergies). Besides ingredient quality, it is important to ensure sanitation in food processing environment to produce and supply safest food to the consumer.

4.1.2. Definition

The term food quality represents the sum of all properties and attributes of a food items that are acceptable to the consumer. These food quality attributes include: Appearance including, size, shape, colour, gloss and consistency; Texture; Flavour; Nutritional content; and Ethical and sustainable production.

Examples for food quality attribute

- Products must be properly packaged and sealed
- Ingredients standards are maintained
- Food quality also deals with product traceability
- Labeling to ensure that there is correct ingredients, nutritional information and list of supplier / manufacturer

4.1.3. Importance of Food Quality

Quality of food stuff, raw as well as processed is of public health concern and food safety have gained tremendous importance. A number of factors are responsible for this.

- Better quality check
- Increasing product consistency
- Easy processing and formulations
- Better preservation
- Easing marketing and distribution tasks
- Increases yearly availability of many foods
- Enables transportation of foods across long distances
- Food safety measures to protect from spoilage and micro-organisms.
- Reduces the incidence of foods borne disease.
- Improve the quality of life for people with allergies, diabetics,
- Enables better food fortification
- Fulfills many different needs: eg. fully prepared ready meals
- Controlling the quality of food at national and global level to safeguard the human health.

Activity 1:

Visit any food processing unit, observe and write what type of sample tests done to for food quality.

4.1.4 Food Quality Control Measures

Consumer understanding of food quality and the ultimate concern for health and food safety increases. Hence food quality control measures are imperative in food industries to ensure consistent standards, keep them safe and reliable for consumers.

Figure 4.2. Quality Control Measures

Factors to ensure good quality supply to the consumers

1. Ingredient Specifications

A final product can only be as good as the raw materials and ingredients put into it. The ingredient specifications such as name of ingredients, vital product attributes, and important dates should be documented to maintain consistency and assure that the supplier has not changed the materials or standards.

Notes

2. Approved Supplier List

For each ingredient, an approved supplier list namely ingredient name and internal code, supplier name, address, phone number, trade name of ingredient and supplier code number are needed for purchasing and quality control.

3. Product Formulation/Recipe

Every food product should have a written documentation of the formula or recipe and be available for use as a means to assure consistency between batches, lots, and even days of production. For highly confidential formulas, the production worker does not need all the details and a simplified recipe can be put in place to assure that the product information stays secret.

4. Product Standards

Product standards are defined by the physical, chemical and microbiological characteristics of the final product. Physical characteristics including size, shape, dimensions, weight, and volume are important, as count per package or container, or any other special features which define the particular product.

Microbiological standards determine the food safety so consider pathogens and foreign materials when developing product standards. Minimum basic rejection standards and acceptable methodology are established based on regulatory requirements and practical production experience.

5. Manufacturing Procedures

There should be documentation for the processing procedures to such as time, temperature, equipment required, and order of addition for ingredients and weight to ease duplication from lotto lot, shift to shift and day to day. After the product is prepared, make manufacturing procedures or portions of the procedures available to production employees.

6. In-Process Record

In-process record keeping is important to know what is happening with the product during the manufacturing process. Both the quality control and production personnel should participate in daily maintenance logs.

Notes

Things such as product weight, temperature, size and shape, ingredient usage, product yield, scrap or waste, material balance and rework are examples of things that need to be measured during the manufacturing process. The basin process measurements used in each operation are called Critical Control Points.

Keeping track of critical control points is important because small differences, changes or mistakes can cause the finished product to be a health hazard, unsafe, and costly to the business. Critical control points may be self-imposed or defined by regulation when public health or product identity is of concern. In-process record keeping can be done manually or by an automatic operation, and in some cases both.

7. Packaging and Labeling

The two basic packages primary package and the secondary package are necessary for food products: The primary package encloses the food and has direct contact with the product; typically, a film, jar, bottle, carton or box. The secondary package is used to hold together multiple packaged food items for shipment and is meant to provide protection.

Packaging is selected and designed based upon the needs of that particular food item. Regardless of the design of the packaging, the law requires product name, ingredient statement, and manufacturing or distribution location, date of manufacture and expiry to be labeled on the package.

8. Good Manufacturing Practices and Sanitation

There are federal regulations called Good Manufacturing Procedures (GMPs) that define specific procedures meant to minimize the contamination of food products by those in manufacturing, processing, packaging, and warehousing facilities. GMPs are an integral part of quality control.

It is the responsibility of food business management and ownership to ensure that GMPs are carried out by employees. Along with GMPs, a regular cleaning and sanitizing program is essential to prevent contamination.

9. Warehousing

Warehousing involves three activities: receiving, storage and shipping.

Notes

(i) Receiving

Some basic guidelines for incoming shipments are:

- Clean the storage space and consistent with the first-in-first-out (FIFO) or first-expiring-first-out (FEFO) rotation principle.
- Before unloading materials, inspect the condition of the trailer. If it does not meet standards, reject the load.
- Collect random samples from the shipment to analyze or evaluate the samples to make sure that they meet specifications.
- After unloading, inspect the condition of the trailer and materials.
- If the shipment does not meet specifications, be prepared to reject all or part of the load.

ii) Storage

If the product is not stored properly, it can impact the quality of the product. The product should be stored in an orderly manner under the proper conditions necessary to maintain quality.

(iii) Shipping

Shipping is the last step in which food businesses have direct control over product quality. Ship items on a FIFO/FEFO basis and use the same guidelines in shipping that were set up in receiving.

10. Laboratory Analysis

Laboratory analysis is the part of the quality control program that is implemented after the product is produced. The samples that will be tested in this phase should be random and pulled out regularly for every batch.

All laboratory analyses should be performed in a room away from the processing area. If there is not space for a separate area, there are other ways to obtain laboratory analysis results from outside, independent labs or from a combination of in-house and independent testing.

A qualified individual should conduct all analyses and report the results to ensure they are in line with quality control

Notes

standards. All test results should be recorded and compared to the product specifications and standards. Failure to meet these standards should be communicated so that additional action can be taken if necessary.

4.1.5 Factor Affecting Food Quality

Food quality needs to be maintained in conformity with the requirements of the consumers. The quality and safety of foods that are eaten daily by every individual becomes a major factor in maintaining the health of the population. It is observed that the quality of foods are influenced by the Farming practices, Storage of Foods, Processing, Handling and Methods of Cooking Foods; Sensory Attributes and additional factors.

Figure 4.3. Factor Affecting Food Quality

1. Farming Practices

Now a day's foods are treated with pesticides or antibiotics, as against the conventionally grown produce and animal products; The pesticides and hormones used can be harmful to health, affecting reproduction in men and women .Pesticide exposure is especially dangerous for children and pregnant women, potentially causing developmental problems in young children and fetuses, according to the University of California, San Francisco. It is a known fact that organically grown foods are good and safe.

Figure 4.4. Farming Practices

Notes

2. Storage of foods

The amount of time food is stored before the consumption and the conditions in which it is stored affect its quality. Produce is especially vulnerable to long storage times; generally the longer the time between the produce harvest and consumption the lower its nutritional value. The temperature in storage also affects food quality. According to the Food and Agriculture Organization, foods deteriorate quickly when they are stored in hot, humid conditions.

Figure 4.5.Storage of Foods

3. Processing and Handling

Fresh cut fruits and vegetables are common place at many supermarkets because they offer convenience to the consumer. However, research studies stated that fresh cut produce deteriorates more quickly than intact produce. Foods packaged are heavily processed, often enhanced with artificial flavouring or odor, man-made fats and other unhealthy additions that reduce their nutritional quality and value.

Figure 4.6. Processing and Handling

Notes

4. Methods of cooking food

Figure 4.7. Methods of Cooking

Even the way of preparation of food can affect its quality. Studies showed that cooking methods namely Microwaving, boiling, stirring frying and stir-frying then boiling caused substantial losses in chlorophyll, vitamin C and glucosinolates, active compounds that may have cancer fighting effects. Steaming was the only cooking method that did not result in such significant losses.

5. Sensory Attributes for Food Quality

Food quality of the product based on the Sensory attribute includes appearance, color, flavor, texture, and shelf life. The appearance of a product can be separated into two categories, the color attributes and geometric attributes size and shape. Color typically is an indication of ripeness or spoilage and the end point of cooking processes can be judged by color. In addition, changes in expected colors can indicate problems with the processing or packaging. The size and shape and weight can be easily measured by computerized electronic equipment.

The texture of food refers to the sensation a person feels with the fingers, tongue, palate and teeth. There are a lot of methods to check on texture such as compression, shearing, shear-pressure, cutting, tensile strength, and elasticity.

4.2.0 Quality Assurance (QA)

Figure 4.8. Quality Assurance

Quality assurance (QA) is a set of activities for ensuring quality in the processes by which products are developed. It is a proactive process and aims to prevent defects by concentrating on the process used to make the product.

Definition

Planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality".

Quality Assurance is a system for evaluating performance, and service of the product against system, standard or specified requirement for customers.

Objectives of Quality Assurance

1. Managing good manufacturing practices (GMP) including
2. Managing good laboratory practices (GLP)
3. Managing a safety programme
4. Assuring the quality of raw materials
5. Assuring the quality and traceability of finished product
6. Evaluating plant environment
7. Developing HACCP plan

Quality Assurance in the Food Industry– Defect Prevention

Quality control (QC) is a reactive process and aims to identify and rectify the defects in finished products. It can be achieved by

DO YOU KNOW?

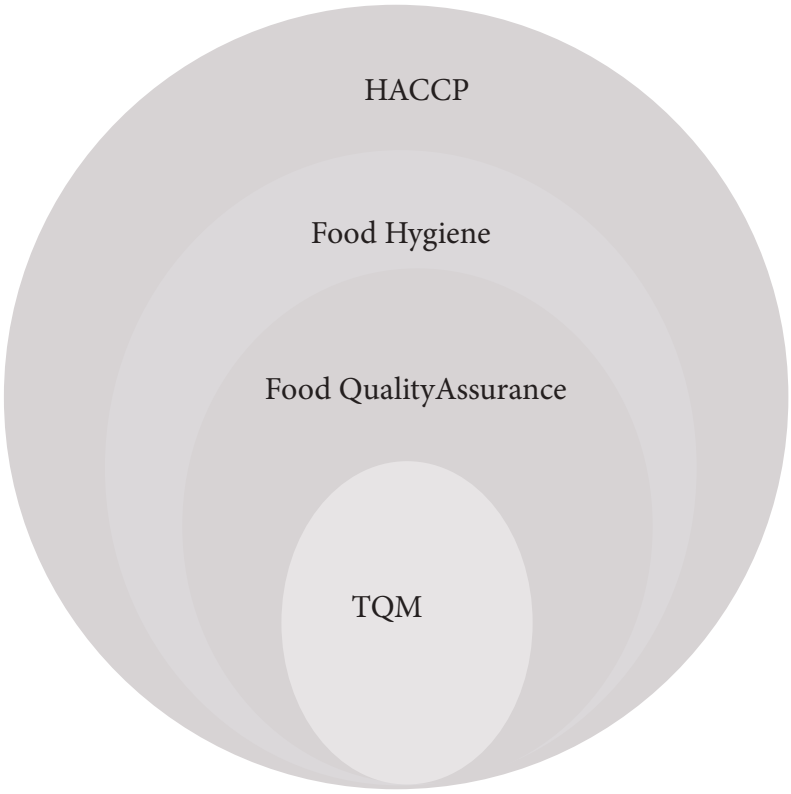
Additional Quality Factors

Three very important quality factors that may not always be apparent by sensory observation are nutritional quality, sanitary quality, shelf life and grading.

Notes

identifying and eliminating sources of quality problems to ensure customer's requirements are continually met. The goal of **Quality Assurance QA** is to improve development and test processes so that defects do not arise when the product is being developed.

QA can be achieved by establishing a good quality management system and assessing its adequacy. Everyone on the team involved in developing a product is responsible for quality assurance.

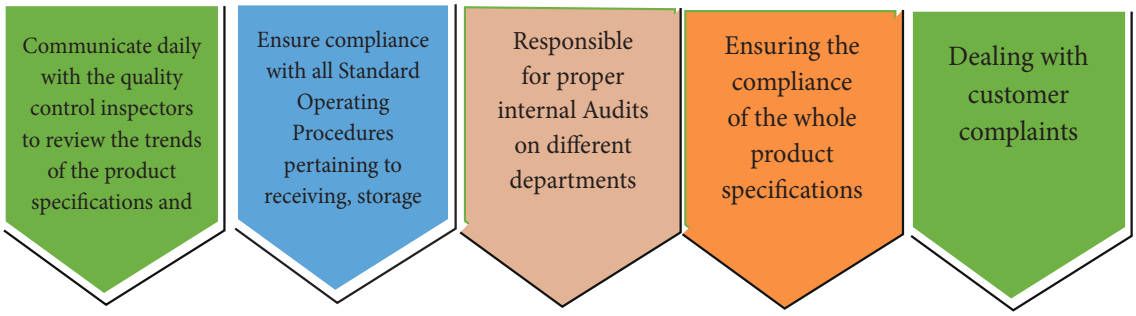


Flowchart 4.1. Quality Assurance in Food Industry

Quality Control in the Food Industry– Defect Identification

Quality control (QC) is a set of activities for ensuring quality in products by identifying defects in the actual products produced. It is a reactive process and aims to identify (and correct) defects in finished products.

QC can be achieved by identifying and eliminating sources of quality problems to ensure customer's requirements are continually met. It involves the inspection aspect of quality management and is typically the responsibility of a specific team tasked with testing products for defects.



Flowchart 4.2.Role of Quality Assurance in the Food Industry

Examples of quality assurance activities include process checklists, process standards, process documentation and project audit. Examples of quality control activities include inspection, deliverable peer reviews and the software testing process.

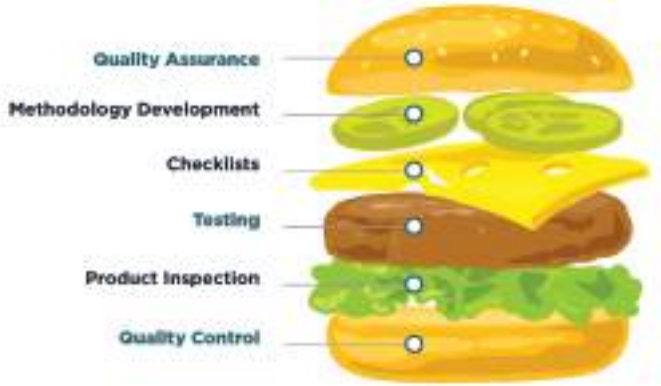


Figure 4.9 Quality Assurance Activities

4.2.1. Essential Steps to Implementing a Process of Quality Assurance

Quality assurance systems are designed with customers' satisfaction in mind. It is the procedures, processes, organization, and resources that are needed to keep the organization focused on its goals and the activities it puts in place to achieve its goals.

The seven essential steps in the implementation of a Quality Assurance System, lead to higher levels of customer satisfaction. They are as follows:

Step 1: Identify Organizational Goals

The process of quality assurance starts by defining employees' jobs tied to the organizations goals. All employees need to know the organization's mission, vision, values, and their role. Knowing their individual goals and how it relates to the organization's goals is the first step in the process of quality assurance.

Notes

Step 2: Identify Critical Success Factors

The factors that make an organization's quality assurance system successful should be identified. These factors can be a well-designed production process, great product, technical support, customer support, financial security, or employee satisfaction.

Step 3: Identify Internal and External Customers

Internal customers are stakeholders who work within the company (employees) and require assistance from another individual or department to get their job done. This is in contrast to external customers who pay money for the services of the company and are not directly connected to the organization. Often customers are vendors, suppliers, employees, volunteers or direct customers.

Step 4: Customer Feedback

Customer feedback is essential in the process of quality assurance. Consistent customer feedback enables organizations to detect and solve quality problems before it become a serious issue.

Customer feedback could be obtained through regular customer surveys, monitoring customer satisfaction or review customer complaints and Returned Products. The continuous feedback from the customers is to ensure a successful process of quality management.

Step 5: Implement Continuous Improvements

The essential factor is to study the feedback received and uses it to continuously improve the organizations processes in delivering the products and services it sells to its customers.

Step 6: Select Quality Management Software

Select quality assurance software that not only helps to implement a quality assurance process, but also helps to maintain and improve the process.

Step 7: Measure Results

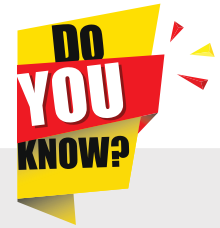
Right from the first moment make sure that there are measurable goals and everyone involved knows what needs to be achieved. When they are not achieved, make sure everyone is clear on what required corrective action is necessary to ensure customer assurance and satisfaction.

Activity 2

As a food technologist what kind of knowledge and skills does the industry require you to have?

4.2.2 International trade

International trade and the accompanying financial transactions are generally conducted for the purpose of providing a nation with commodities it lacks in exchange for those that it produces in abundance; such transactions, functioning with other economic policies, tend to improve a nation's standard of living. Much of the modern history of international relations concerns efforts to promote free trade between nations.



EXIM BANK

set up by an act of parliament in September 1981, wholly owned by government of India, Commenced operations in March 1982.

Established "for proving financial assistance to exporters and importers and for functioning as the principal financial institution for coordinating the working of institutions engaged in financing export and import of goods and services with a view to promoting the country's international trade."

Types of International Trade

1. Import Trade means purchasing goods and services from a foreign country because within the country they cannot be produced in sufficient quantities or at a competitive cost.
2. Export Trade is a type of international trade which relies on selling locally manufactured goods and services to foreign countries.
3. Entrepot Trade comprises both – import and export trade. Under this type, goods and services are imported from one country so that they can further be exported to another country. Thus the importing country just adds some value to the goods before exporting them.

International food trade: food quality and safety considerations

The international trade of food is growing as countries rely on each other to secure an adequate and varied food supply. More countries are becoming both significant importers and exporters of food. Countries that are self-sufficient in food or have an excess of food also import some food products. Countries that are not self-sufficient in food may export some food products, especially when these foods command premium prices.

The expansion and diversification of the global food trade can be attributed to innovations in food preservation, processing and packaging techniques which make foods safer, less perishable and more attractive to consumers; rapid transport and improved handling methods which reduce the length of time and difficulties

of moving food long distances; and changing tastes and increased purchasing power which stimulate consumer demand for traditional and new foods from other regions.

The main instrument to assist countries in the harmonization of food standards is the Codex Alimentarius.

While improved access to export markets brings new opportunities, increased trade will be accompanied by greater competition and the need to ensure confidence in the food supply. This is particularly challenging to developing countries where quality assurance systems in the food industry and food control systems should be strengthened. Much needs to be done so that all countries can take full advantage of new possibilities for free international trade.

4.2.3 Food Safety, Laws and Standards

Figure 4.10. Food Safety

Food Safety :

Food safety is used as a scientific discipline describing handling, preparation and storage in ways that prevent food-borne illness. The occurrence of two or more cases of a similar illnesses resulting from the ingestion of a common food is known as a food-borne disease outbreak. This includes a number of routines that should be followed to avoid potential health hazards. In this way food safety often overlaps with food defense to prevent harm to consumers.

Notes

Food laws and Standards-The Government of India is fully aware to the possibilities of food being adulterated. It has therefore, empowered several agencies and promulgated a number of acts and orders to contract the menace. Agencies and institutions have also been created to lay down standards for the quality of foods. The manner in which the food is processed and packaged is also covered by a number of regulations.

Measures taken by the government to control the quality of food.

1. Prevention of Food Adulteration Act (PFA 1954)

Keeping the large scale adulteration in view, Prevention of Food Adulteration Act was passed in the year 1954 with the objectives to ensure pure and wholesome food to the consumers and also to prevent fraud or deception. Protect the public from poisonous and harmful food. Prevent the sale of substandard foods.

2. Essential Commodities Act, 1954

The main objectives of this act is to maintain supply of essential commodities to the public by proper regulation, prevention of black market and making it available to the public at reasonable price.

3. Milk and Milk Products Order, 1992

The milk and milk products order is to set sanitation and hygiene standards for dairy plants and establish an advisory board to advise the government on production, sale, purchase and distribution of milk and milk products.

4. Fruit Products Order,(FPO) 1955

Figure 4.11. Food Products Order

Notes

The Government of India promulgated a Fruit Products order in 1946. And revised In 1955,. The Fruit Products Order (FPO) lays down statutory minimum standards in respect of the quality of various fruits and vegetable products and processing facilities. The FPO and PFA are enforced by the Department of Health.

5. Meat Food Products Order, 1973

The meat Food Products Order was promulgated on 28thMarch, 1973 and came into force on 25th June, 1975. The order covers animals including ovines, caprines, suilines, bovines and poultry.

It provides means to:

a. Detect and destroy meat of diseased animals.

b. Ensure that the preparation and handling of meat and meat products be conducted in a clean and sanitary manner.

c. Prevent the use of harmful substances in meat roods.

d. See that every cut of meat is inspected before sale to ensure its wholesomeness.

The order also lays down rules and conditions for procedure to be adopted for the selection of disease-free animals, slaughterhouse practices.

6. Cold storage order

The cold storage order, 1980, promulgated under the Essential commodities Act, 1955, has the objective of ensuring hygienic and proper refrigeration conditions in a cold store, regulating the growth of cold storage industry and rendering technical guidance for a the scientific preservation of food stuffs.

Figure 4.12.Cold Storage Order

Notes

Standards

(i) Indian Standards Institution (ISI) Standards

Various committees, including representatives from the government, consumers and industry, formulate the Indian Standards Institution (ISI). Standards are laid for vegetable and fruit products, spices and condiments, animal products and processed foods.

The products are checked for quality by the ISI in their own network of testing laboratories at Delhi, Bombay, Calcutta, Madras, Chandigarh and Patna or in a number of public and private laboratories recognized by them.

Figure 4.13.Indian Standards Institution

(ii) Bureau of Indian Standards (BIS)

Standards for achievement in all areas are provided by the nodal institution for standards in India, called the Bureau of Indian Standards (BIS). These include standards for equipment, food, environmental hygiene and sanitation and so on.

The Eco mark was a standard launched by the BIS in an attempt to preserve the environment from pollutants. The mark ensures the consumer those products such as detergents, sanitizers and others do not produce hazardous waste materials, are biodegradable and can be recycled. The ISI certification mark on packaging and equipment also serves the same purpose.

Figure 4.14.Bureau of Indian Standards

(iii) The AGMARK Standard

The AGMARK standard was set up by the Directorate of Marketing and Inspection of the Government of India by introducing an Agricultural produce Act in 1937. The word 'AGMARK' seal ensures quality and purity of cereals, spices, oil seeds, oil, butter, ghee, legumes and eggs and provides for the categorization of commodities Grading of commodities like tobacco, spices, basmati rice, essential oils, etc. which are meant for export is compulsory under AGMARK. AGMARK ensures the quality of the product to the importers.

Figure 4.15.AGMARK

(iv) Export Inspection Council

The council has been constituted to check the quality of a number of food materials meant for export. The council has powers to reject any food, which does not measure up to the standards prescribed for the food. Canned food such as mango juice, pineapple juice, frozen food such as shrimp, pomfrets are subject to scrutiny by this body before export.

Figure 4.16. Export Inspection Council

Agmarkbesan Sl.no. B-162002

Grade-standard

Place of packaging…….

Date of packaging……

Net weight……..

The quality of a product is determined with reference to the size, variety, weight, colour, moisture, fat content and other factors are taken into account. The grades incorporated are grades 1, 2, 3 and 4 or special, good, fair and ordinary.

Notes

4.2.4 The Hazard Analysis and Critical Control Points (HACCP)

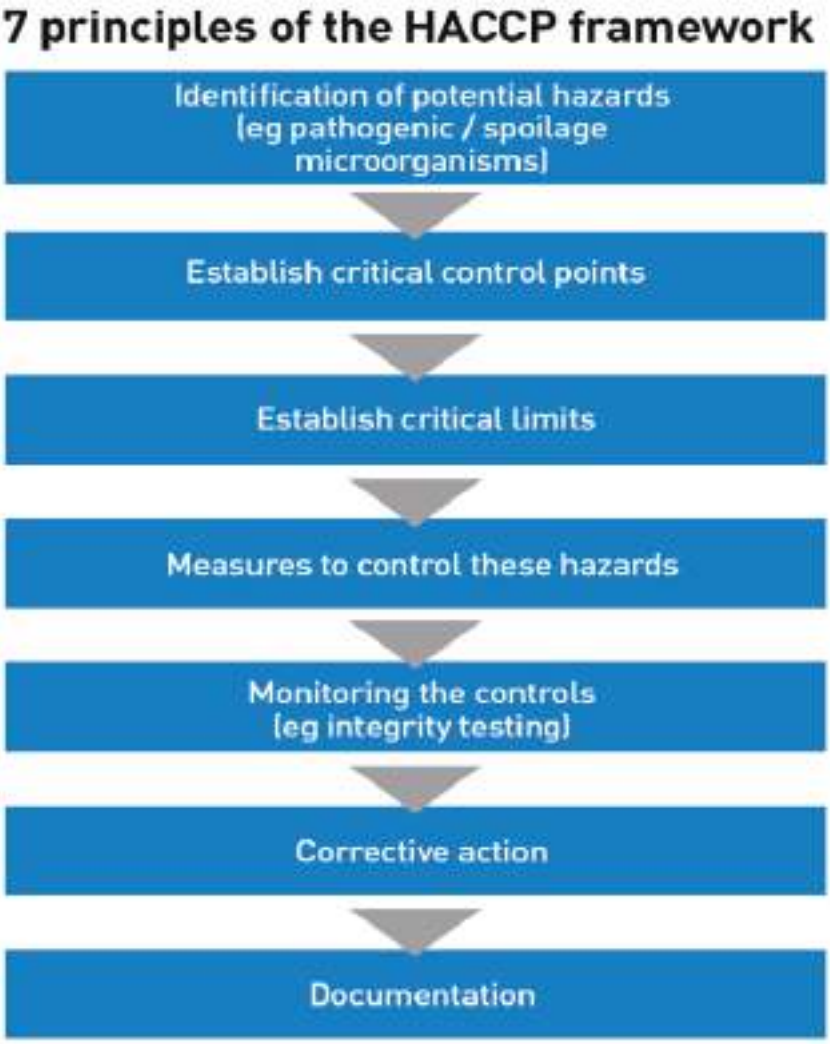
An HACCP system allows to identify hazards and put in place controls to manage these throughout the supply chain during production. The HACCP scheme meets the requirements of the Codex Alimentarius Commission (CAC) – established by the World Health Organization and the Food and Agriculture Organization of the United Nations to bring together international food standards, guidelines and codes of practice to ensure fair trade. It can also be used to support the requirements of management standard requirements.

Figure 4.17. Hazard Analysis and Critical Control Points

4.2.5 Principles of HACCP

A food safety management system based on the principles of HACCP will enable hazards to be identified and controlled before threaten the safety of food and customers. There are seven discrete activities that are necessary to establish, implement and maintain a HACCP plan, and these are referred to as the 'seven principles' in the Codex Guideline (1997).

Notes



Flowchart 4.3. Seven Principles of the HACCP Framework

Principle 1 - Conduct a Hazard Analysis

The application of this principle involves listing the steps in the process and identifying where significant hazards are likely to occur. The HACCP team will focus on hazards that can be prevented, eliminated or controlled by the HACCP plan. A justification for including or excluding the hazard is reported and possible control measures are identified.

Principle 2 - Identify the Critical Control Points

A critical control point (CCP) is a point, step or procedure at which control can be applied and a food safety hazard can be prevented, eliminated or reduced to acceptable levels. The HACCP team will use a CCP decision tree to help identify the critical control points in the process. The number of CCP's needed depends on the processing steps and the control needed to assure food safety.

Notes

Principle 3 - Establish Critical Limits

A critical limit (CL) is the maximum and/or minimum value to which a biological, chemical, or physical parameter must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of a food safety hazard. The critical limit is usually a measure such as time, temperature, water activity (Aw), pH, weight, or some other measure that is based on regulatory standards.

Principle 4- Monitor CCP

The HACCP team will describe monitoring procedures for the measurement of the critical limit at each critical control point. Monitoring procedures should describe how, when, who and how frequently the measurement is taken during production.

Principle 5 - Establish Corrective Action

Corrective actions are the procedures that are followed when a deviation in a critical limit occurs. The HACCP team will identify the steps that will be taken to prevent potentially hazardous food from entering the food chain and the steps that are needed to correct the process. This usually includes identification of the problems and the steps taken to assure that the problem will not occur again.

Principle 6 – Verification

Those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan. The HACCP team may identify activities such as auditing of CCP's, record review, prior shipment review, instrument calibration and product testing as part of the verification activities.

Principle 7 – Record Keeping

A key component of the HACCP plan is recording information that can be used to prove that the food was produced safely. The records also need to include information about the HACCP plan. Record should include information on the HACCP Team, product description, flow diagrams, the hazard analysis, the CCP's identified, Critical Limits, Monitoring System, Corrective Actions, Recordkeeping Procedures, and Verification Procedures.

The benefits of implementing HACCP

- Save business money in the long term.
- Implement internationally recognized food safety hazard controls
- Demonstrates business' commitment to food safety
- Ensure you are compliant with the law
- Give producers, stakeholders and suppliers confidence in your controls
- Effectively manage food safety risks across the entire supply chain
- Organize your process to produce safe food
- Offer due diligence defense in court
- Coordinate your staff, thereby promoting teamwork and efficiency.
- Recommended by the Codex Alimentarius Commission
- Can be applied throughout the food chain, from primary producer to the final consumer.
- Facilitate a more effective use of resources
- Better inventory control
- Promote an increase in product quality
- Facilitate an increase in profit
- Controlling major food risks, such as microbiological, chemical and physical contaminants

The **FSSAI** has its headquarters at New Delhi. The authority also has 6 regional offices located in Delhi, Guwahati, Mumbai, Kolkata, Cochin, and Chennai. 14 referral laboratories notified by FSSAI, 72 State/UT laboratories located throughout India and 112 laboratories are NABL accredited private laboratories notified by FSSAI.

4.2.6. Food Standardization and Regulatory Agenesis in India

Food Safety and Standards Authority of India (FSSAI)

FSSAI is the regulatory body authorized under the Food Safety and Standards Act of 2006. It is set up under the Ministry of Health and Family Welfare, Government of India. It is also known as the Food Authority of India. The Food authority monitors and checks for safe food manufacture, storage and administering practices of Food Business Operators (FBOs). FSSAI inspect for

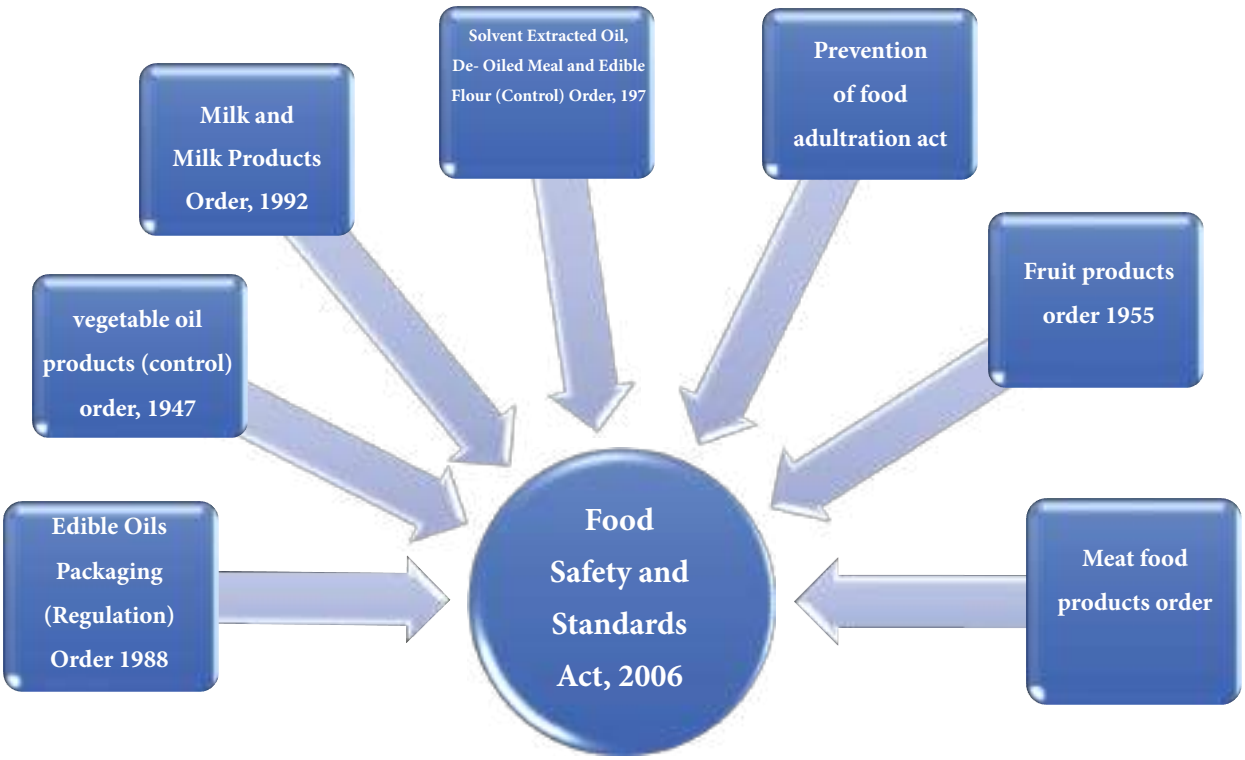
Figure 4.18. Food Safety and Standards Authority of India

all FBO's that they are following all the rules and regulations stated in the Food Safety and Standards Act, 2006. Even, FSSAI is responsible to promote and protect public health by executing and supervising the regulation of food safety by appointing food authorities on the state level.

Objectives

The main aim of FSSAI is to

1. Lay down science-based standards for articles of food
2. Regulate manufacture, storage, distribution, import and sale of food
3. Facilitate safety of food



Flow chart 4.4. FSS Act took Seven Older Acts

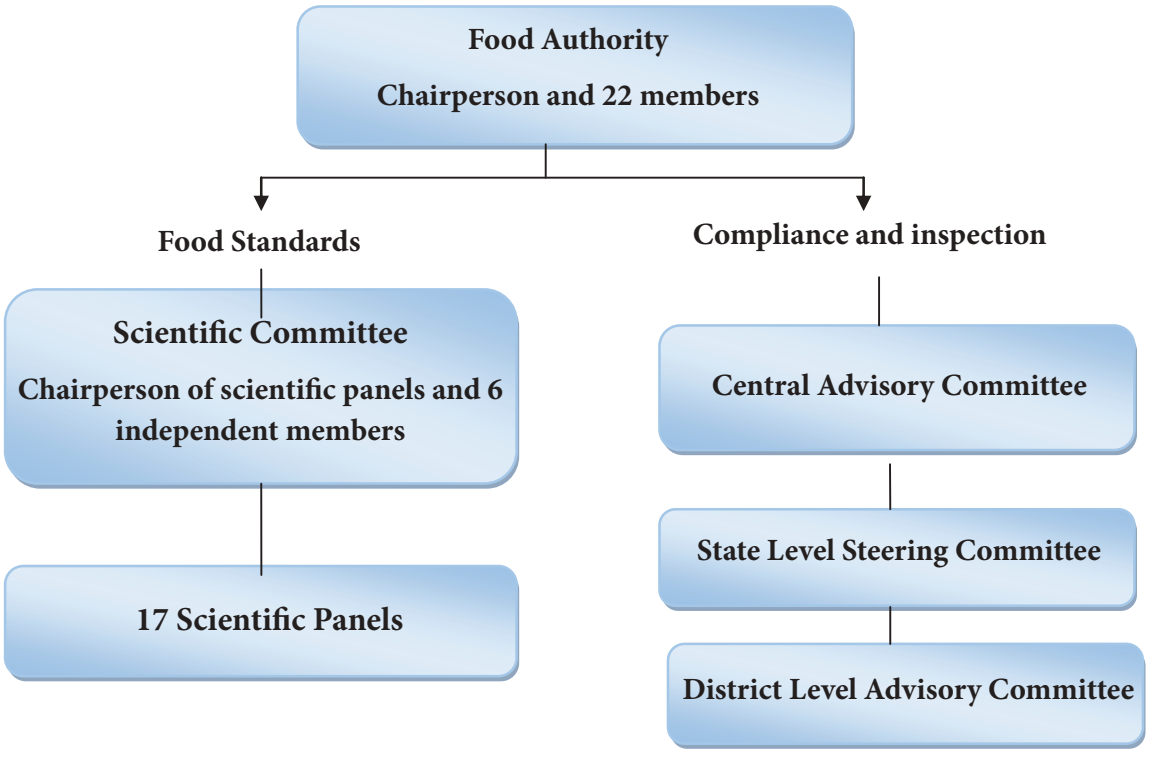
Functions of FSSAI

- **Setting Rules and Guidelines** – FSSAI sets up rules and guidelines which need to be followed by all food manufacturing companies, keeping into consideration hygiene and food safety
- **Granting License** – To pursue any food related business, the owner needs to get a certificate and license with the permission of FSSAI

- **Test the Standard of Food –** the standard and quality of food manufactured by all companies registered under FSSAI, is done by the organization themselves
- **Regular Audits –** Proper inspection is done for food-producing and manufacturing companies to ensure the standards are at par with the guidelines
- **Spreading Food Safety Awareness –** It is the responsibility of FSSAI to spread awareness and inform the citizens about the importance of safe and hygienic food consumption
- **Maintain Records and Data –** FSSAI also has the responsibility to maintain proper records and data of all the registered organizations. Any violation of rules prescribed by FSSAI can lead to the termination of the license
- **Keeping the Government Updated –** Any food safety-related threat must be informed to the Government authorities for further action. Also, assist them in framing food standard policies

Governing structure of FSSAI

Governing structure of FSSAI given below:



Flowchart 4.5. Governing Structure of FSSAI

FSSAI works through 11 departments

1. Standards Division
2. Regulations / Codex Division
3. Regulatory Compliance / Surveillance Division
4. Quality Assurance / Surveillance Division
5. Human Resource / Vigilence and Training Division
6. Finance Division
7. Imports Division
8. Risk Assessment and R & D Division
9. FSMS Division
10. General Administration Division
11. Legal Division

Flowchart 4.6.FSSAI Works through 11 Divisions

Food Safety Authorities in States / UTs

The frame work for food safety enforcement machinery provided under Food Safety and Standards Act, 2006 and Rules and Regulations has the following officers:

Flowchart 4.7.Food Safety Authorities

Notes

AN FSSAI License

FSSAI issues the FSSAI License Registration India. In FSSA Registration and FBO receives a 14-digit license number. This FSSAI License Number is provided to regulate the purpose of food security in India. There are various rules and regulation which all FBOs have to comply under the FSSAI Act of 2006. The license number should be printed on the food packages along with FSSAI Logo to certify that the food is fit for consumption.

Types of FSSAI License Registration

There are 3 types of FSSAI License formulated by the regulatory body FSSAI. All the FBOs must apply for FSSAI Registration according to their requirements and category:

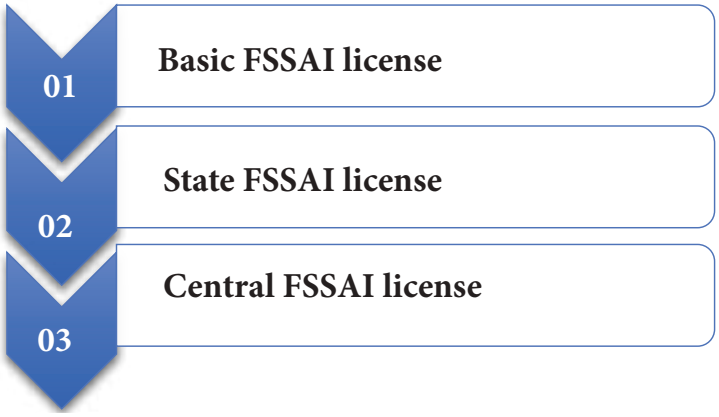


Figure 4.19.FSSAI License

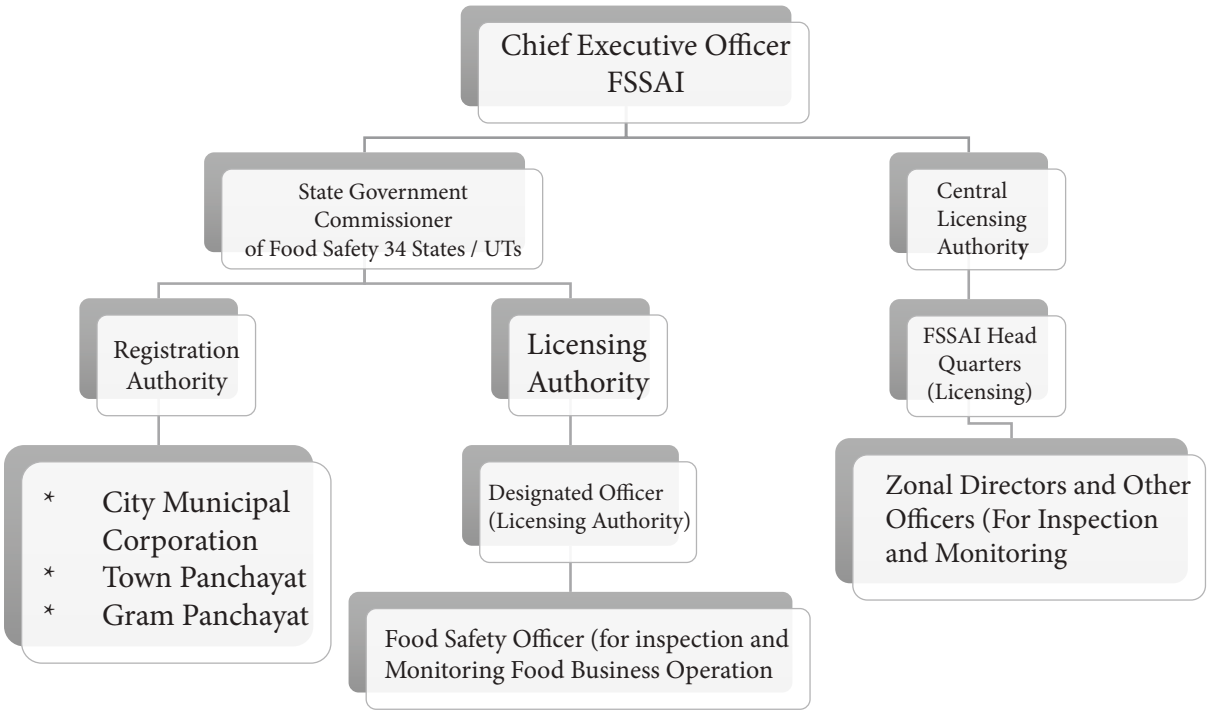
- **Basic FSSAI Registration:** This type of license registration is for all the small food businesses having their annual turnover more than ₹ 12 lakh. For example-
- **State FSSAI License:** This type of license is for medium-sized food businesses having annual turnover more than ₹ 12 lakh and up to ₹ 20 crore.
- **Central FSSAI License–** The central FSSAI License is a type of license is for large-sized businesses having an annual turnover of more than ₹ 20 crore.

Benefits of Registering FSSAI License

- **Consumer awareness-** The consumer nowadays has more information regarding which food has a good quality for consumption. The consumers are much interested in knowing about food products.

- **Legal Advantage**-The FSSAI registration is a legal process and all food business is inspected under FSSAI so food security is at a high level.
- **Public acceptance**- It is clear as The FSSAI license is legally processed and certifies FBOs so it can make trust and faith among the public to buy products.
- **FSSAI logo- FSSAI** has given a logo that is printed on food packages and makes its certified food product for consumers. Along with the FSSAI logo, the FSSAI License number is also printed.
- **Business Expansion**- With FSSAI certification you can expand your business and its easy to get loans from banks and funding which is required for expansion of the business.
- **Quality check**-FSSAI as the regulatory body do conducts inspections for all food business operators who directly and indirectly provide food products.

Framework of Food Safety Regulators



Flowchart 4.8. Framework of Food Safety

4.2.7. Prevention of Food Adulteration Act

Prevention of Food Adulteration Act of 1954 has been in force since June 1, 1955. The objective of this act was to ensure that food articles sold to the customers are pure and wholesome. It

also intended to prevent fraud or deception and encourages fair trade practices. The act was amended in 1964 and again in 1976 in the light of experience gained, to plug loopholes of escape in the Act and to insure stringent punishment for those indulging in this nefarious practice.

Figure 4.20. Prevention of Food Adulteration Act

The Act prohibits the manufacture, sale and distribution of not only adulterated foods but also foods contaminated with toxicants and misbranded foods. A Central Food Laboratory located at Calcutta and the Central Food Technological Research Institute, Mysore has also been recognized for testing of adulterated foods. "A central committee for food standards" has been constituted under the Act and has been charged with the function of advising the Central Government on matters relating to the Food standards.

According to the Act, an article of food shall be deemed to be adulterated.

1. If the article sold by a vendor is not of the nature, substance or quality demanded by the purchaser and as it is represented to be.
2. If it contains any other substance or processed as to affect injuriously the nature.
3. If any inferior or cheaper substance has been substituted wholly or in part for the article.
4. If the article had been prepared, packed or kept under unsanitary conditions whereby it has become contaminated or injurious to health;
5. If the article consists of any filthy, putrid, disgusting, rotten, decomposed or diseased animal or vegetable substance or is insect-infested or otherwise unit for human consumption.
6. If the article is obtained from a diseased animal;
7. If the article contains any poisonous or other ingredient which renders its contents injurious to health;
8. If the container of the article is composed of any poisonous or deleterious substance which renders it contents injurious to health;
9. If any colouring matter other than as prescribed and in amoun not within the prescribed limits of variability is present in the article;

Notes

10. If the article contains any prohibited preservative or permitted preservative in excess of the prescribed limits;

11. If the quality or purity of the article falls below the prescribed standard or its constituents are present in quantities, which are in excess of the prescribed limits of variability.

Administrative hierarchy

- The Food Health Authority (FHA) is appointed at state level who is the Director of Public Health and Preventive Medicine. He is responsible for the good quality and standards of foods available to the consumers.
- Under FHA is the Local Health Authority (LHA). There is a Local Health Authority appointed in each city in every state.
- The food Inspector is appointed by the Central or State Government by notification in official gazette. The Food Inspector undergoes a three months training in food inspection and sampling.

1. The central food laboratory

The laboratory carries out the following functions as entrusted by law;

1. Analysis of samples of food sent by any officer or authority authorized by the Central Government for the purpose and submission of the certificate of analysis to the authorities concerned.

2. Investigation for the purpose of the fixation of standard of any article of food.

2. Commissioner of Food Safety of the State

Functions

- Prohibit the manufacture, storage, distribution or sale of any article of food
- Survey of the Industrial Units
- Conduct or organize training programmes
- Uniform implementation of the standards and other requirements as specified.

Notes

- Ensure a high standard of objectivity, accountability, practicability, transparency and credibility
- Sanction of prosecution for offences punishable with imprisonment under this Act.

3. Designated Officer

- Issue or cancel license.
- Prohibit the sale of any article of food.
- Receive report and samples of article of foods.
- Recommend to the Commissioner of Food Safety for sanction to launch prosecutions.
- Sanction or launch prosecutions.
- Maintain record of all inspect
- Investigate any complaint.

4. Food Safety Officer

(i) Powers

- Take sample
- Seize any article of food
- Can enter and inspect any place
- May destroy, deteriorated, perishable product after giving notice in writing
- May seize any article of food and books of account or other documents found in position of manufacturer, distributor and dealer where position of adulterant found
- In case of non availability of the FBO, the FSO may seize the adulterant food and seal the premises for investigation after taking a sample of such adulterant or food for analysis
- May cause a person to be examined by a qualified medical professional duly authorized by the Designated Officer.

(ii) Duties

- Inspect all licensed units as frequently as may be prescribed by the Designated Officer;

Notes

- Verify/satisfy the conditions of licenses' are being complied and report to the Designated Officer; Procure sample and send for analysis in case contravention, surveillance;
- Investigate any complaint in respect of any contravention of the provisions of the Act;
- Maintain a data base;
- Recommend issue of improvement notices;
- Maintain a record of all inspections made and action taken by FSO;
- Make inquiries and inspections as may be necessary;
- Stop and inspect any vehicle suspected to contain any unsafe food;
- Carry out food safety surveillance to identify and address the safety hazards;
- Respond to incidents of food poisoning in his area and to send report to the Designated Officer;
- Preparation of Food safety plans for Panchayats and Municipalities;
- Detain imported packages which are suspected to contain articles of food, the import or sale of which is prohibited;
- Coordinate and facilitate the introduction of food safety systems;
- Other duties.

4.3.0 Food Additives

Food Additives are various chemical substances added to foods to produce specific desirable effects. Additives such as salt, spices, and sulfites have been used since ancient times to preserve foods and make them more palatable. With the increased processing of foods in the 20th century, there came a need for both the greater use of and new types of food additives. Many modern products, such as low-calorie, snack, and ready-to-eat convenience foods, would not be possible without food additives. Food additive is not normally consumed as a food by itself and not normally used as a typical ingredient of the food

Notes

Food additive means any substance, either natural or synthetic, intentionally added to food for a technological purpose in the processing, packaging, transport or storage of such food. Some of the technological functions of food additives include the following –

Figure 4.21. Food Additives

- Enhancing the safety and quality by the inhibition of microbial growth;
- Extending the shelf-life by protection against antoxidative deterioration;
- Preventing rancidity of oils and for maintaining the shelf life of high-moisture containing foods
- Enhancing the flavour and odour;
- Stabilizing or retaining the colour; and
- Improving the texture and consistency of a food.

Definition

According to the Food Protection Committee of the Food and Nutrition Board, **Food additives** may be defined as a substance or mixture of substances, other than a basic food which is present in a food as a result of aspect of production, processing, storage, and packaging.

Activity 4

List some of the old methods of food preservation followed at home giving examples and their viability present times.

4.3.1 Types of Food Additives

Figure 4.22. Food Additives

Food additives can be divided into six major categories

1. Preservatives
2. Nutritional additives
3. Flavoring agents
4. Coloring agents
5. Texturizing agents and
6. Miscellaneous additives

The Codex Alimentarius Commission Committee on the Food Additives and Contaminants has developed an International Numbering System (INS) for food additives based on the E system. The INS systems is broader than the E system and is intended as an identification system for food additives approved for use in one or more countries. The INS numbers are largely the same numbers used in the E system without the E and also include a listing of the technical function for each additive based on 23 functional classes.

A. Preservatives

Three types of preservatives are Antimicrobials, Antioxidants and Anti-browning agents

DO YOU KNOW?

The E numbers are categorized as follows:

- E 100-E199 (colors)
- E200- E299 (preservatives)
- E300-E399 (antioxidants, acidity regulators)
- E400-E499 (thickeners, stabilizers, emulsifiers)
- E500-E599 (acidity regulators, anti-caking agents)
- E600-E699 (flavor enhancers)
- E900-E999(surface coating agents, gases, sweeteners)
- E1000-E1999 (additional chemicals)

Antimicrobials

- The antimicrobials, with E and INS numbers ranging from 200 to 290, are used to check prevent the growth of microorganisms.
- Antimicrobials play a major role in extending the shelf-life of numerous snack and convenience (useful) foods and have come into even greater use in recent years as microbial food safety concerns have increased.
- The antioxidants (INS 300-326 AND E300-E326), are used to prevent lipid and /or vitamin oxidation in food products.
- They are used primarily to prevent antoxidation and subsequent development of rancidity and off - flavour.

Antioxidants

Antioxidants are used as food additives to preserve food for a longer period of time. Antioxidants act as oxygen scavengers as the presence of oxygen in the food helps the bacteria to grow that ultimately harm the food.

The unsaturated fatty acids present in the lipids of many foods are at risk to chemicals breakdown when exposed to oxygen. The oxidation of unsaturated fatty acids proceeds by a free-radical reaction.

- The antioxidants vary from natural substances such as: vitamins C and E to synthetic chemicals such as butylatedhydroxy anisole (BHA) and butylated hydroxyl toluene (BHT).
- The antioxidants are especially useful in preserving dry and frozen foods for an extended period of time.

Figure 4.23. Artificial Food

Anti browning agents

- **Anti browning agents** are chemicals used to prevent both enzymatic and nonenzymatic browning in food products, especially dried fruits or vegetables.
- **Enzymatic browning** is a chemical process which occurs in fruits and vegetables by the enzyme **polyphenol oxidase**, which results in **brown pigments.**

Notes

Non enzymatic browning:

results from a chemical reaction between an amino acid and a sugar, usually requiring heat.

The most commonly used additives in this category (Anti-browning) are:

1. Vitamin C (E300)
2. Citric acid (E330), and
3. sodium sulfite (E221)

- These additives are classified as either antioxidants or preservatives in the INS system, but retain the same numbers as in the E system without the E.

B. Nutritional Additives

Nutritional additives have increased in use in recent years as consumers have become more concerned about and interested in nutrition. Vitamins, which as indicated before are also in some cases as preservatives, are commonly added to cereals and cereal products to:

- Restore nutrients lost in processing and
- Enhance the overall nutritive value of the food.
- The addition of vitamin D to milk and of B vitamin to bread has been associated with the prevention of major nutritional deficiencies in the United States.
- Minerals such as iron and iodine have also been of extreme value in preventing nutritional deficiencies.
- Amino acids are not commonly used in foods. However, lysine is sometimes added to cereals to enhance protein quality.
- Proteins or proteinaceous materials such as soya protein are also sometimes used as nutritional additives.
- Fiber additives have seen increased popularity in recent years with the increase in consumer interest in dietary fiber. Various cellulose, pectin and starch derivatives have been used for this purpose.
- Recently, naturally derived fiber from apples and other fruits as well as sugar beets has been introduced as a fiber additive.

Notes

- Fiber additives also provide improved texture to food products and are categorized in the INS and E system as bulking agents, thickeners, or stabilizers.

C. Colouring Agents

Figure 4.24.Colouring Agents

- Most colouring agents are used to improve the overall attractiveness of the food.
- A number of natural and synthetic additives are used to colour foods.
- In addition, sodium nitrite is used not only as an antimicrobial, but also to fix the color of meat by interaction with meat pigment.
- The colours are included in the E system as E 100-E180 and in the INS as 100-182.

D. Flavouring Agents

Flavouring agents comprise the greatest number of additives used in foods. There are more than **1700 natural and synthetic substances** used to flavor foods. The major **three types of flavouring additives** are: Sweeteners, Natural and synthetic flavours and Flavour enhancers.

Sweeteners

The most commonly used sweeteners are: sucrose, glucose, fructose and lactose

- These additives are used to provide sweet taste or to mimic flavors. Its aim is that the flavour is the most similar to the common sugar and resists similar treatments in which sugar is used. They are very important in products for diabetics or low calorie products. The most common additives used as **sweeteners** are low calorie or non-caloric sweeteners, such as saccharin and aspartame.

Notes

- **Flavours: Artificial Flavor**s come from petroleum and other inedible substances, while **"natural flavor"** can refer to anything that comes from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf.
- **Flavor enhancers:** These are substances that enhance the taste and / or aroma of a food without giving its own flavor. They are widely used in sauces and soups. Flavor enhancers, which include chemicals such as monosodium glutamate (E621) and others, are often used in Asian foods or in soups to enhance the perception of other tastes.

E. Texturizing Agents

These agents are used to add to or modify the overall texture or mouth feel of food products. The primary additives in this category are: **Emulsifiers, Stabilizers, Phosphate** and **Dough conditioners.**

Emulsifiers are substances that allow the maintenance or formation of a homogeneous mixture of two or more non-miscible phases. For example, water and oil.

A **stabilizer** is an additive to food which helps to preserve its structure. Typical uses include preventing oil, water emulsions from separating in products such as salad dressing; preventing ice crystals from forming in frozen food such as ice cream; and preventing fruit from settling in products such as jam, yoghurt and jellies.

Phosphates (E338-E343) are often used to modify the texture of foods containing protein or starch. These chemicals are especially useful in stabilizing various dairy and meat product. The phosphates apparently react with protein and / or starch and modify the water-holding capacity of these natural food components.

Dough conditioners such as steroyl-2-lactylate E481 and sodium silico aluminate E554.are also used as texturizing agents.

F. Thickeners

Thickeners are used to thicken food. Acacia gum can act as a thickener as well as a stabilizer. Thickeners are substances which, when added to the mixture increase its viscosity. They are Binder, Bodying agents and Texturizing agent.

Activity 5

- In your region / Community, list the foods that are preserved and identify the method and preservatives used for preservation.
- Identify the artificial sweeteners that are available in your area.

4.3.2. Some additives that are found in processed foods

Table 4.1 Some Additives that are Found in Processed Foods

Type of additives	First digit number of the E number	Purpose	Example
Colourings	1	to improve colour	**tartrazine (E 102),** a synthetic yellow dye added to sweets, fizzy drinks and packet food
Preservatives	2	to preserve food so that it goes bad less quickly	**benzoic acid (E210)** added to beer, sauce and jam
Flavourings	(not numbered)	to add or enhance flavour	**ethyl ethanoate,** a synthetic ester, added to give a pineapple flavour in drinks and sweets
Anti-oxidants	3	to stop fats and oils getting oxidized, changing colours and tasting bad	**BHA (E 320)** added to biscuits, butter, margarine and oils
Emulsifiers and stabilizers	3 or 4	to make oil and water mix and alter the texture of food	**lecithin (E 322)** added to ice cream, salad dressings and margarine
Acid and bases	5	to control pH	**citric acid** added to soft drinks: **sodium hydrogencarbonate (E 500**) added to canned custard etc.
Sweeteners	4 or 6	to sweeten food without using sugar	**sorbitol (E 420)** added to certain drinks and sweets (suitable for diabetes and those on diet)
Sweeteners	4 or 6	to sweeten food without using sugar	**sorbitol (E 420)** added to certain drinks and sweets (suitable for diabetes and those on diet)
Nutrients	(not numbered)	to increase the nutritive value	**vitamin C** added to soft drinks: **minerals** added to milk powder

20 INGREDIENTS TO MEMORIZE AND AVOID IN ANY FOOD YOU CONSUME

1. Potassium benzoate and sodium benzoate
2. Hydrogenated or fractionated oil
3. Artificial colouring
4. Polysorbate 80
5. Aspartame
6. Sodium chloride
7. Soy lecithin
8 .Propylegallate
9. Soy
10. e-Corn
11. Monosodium glutamate (MSG)
12. High fructose corn syrup
13. Potassium sorbate
14. Enriched wheat
15. Acesulfame-K
16. artificial flavours
17. BHA and BHT
18. Artificial sweetner
19. Sucralose
20. Canola oil

4.3.3. Principles for Using Food Additives

1. The food additives being used should present no risk to the health of the consumer at the levels of use.

2. The use of food additives is justified only when such use has an advantage, does not present a hazard to health and does not deceive the consumer, as well as serves one or more of the following technological functions and needs, and only where these objectives cannot be achieved by other means which are economically and technologically practicable –

    a. to preserve the nutritional quality of the food;

    b. to provide necessary constituents for foods manufactured for groups of consumers having special dietary needs;

    c. to enhance the keeping quality or stability of a food or to improve its organoleptic properties; and

    d. to provide aids in the processing, packaging, transport or storage of food, provided that the additive is not used to disguise the effects of the use of faulty raw materials or of undesirable (including unhygienic) practices of techniques during the course of any of these activities.

3. All food additives shall be used under conditions of good manufacturing practice (GMP) which include the following –

a. the quantity of the additive added to food shall be limited to the lowest possible level necessary to accomplish its desired effect;

b. the quantity of the additive that becomes a component of food as a result of its use in the manufacturing, processing or packaging of a food and which is not intended to accomplish any physical, or other technical effect in the food itself, is reduced to the extent reasonably possible; and

c. The additive is prepared and handled in the same way as a food ingredient.

4.3.4. Advice to the Public

1. Buy foods from reputable sources.

2. Read the label of prepackaged food carefully and check whether the accepted food additives are added.

Notes

3. People with allergic condition, such as asthma patients, may experience hypersensitive reaction due to some food additives like sulphur dioxide and should be careful in selecting food. Advice from medical professionals may be sought when necessary.
4. In choosing foods, avoid as far as practicable those which have abnormal colour, odour and texture; stop consuming the food when it tastes abnormally.
5. Report any abnormalities of foods to the authority for investigation and other follow-up actions.
6. Members of the public are advised to take a balanced diet so as to avoid excessive exposure to food additives from a small range of food items.

4.3.5. Permitted limit of food colour, flavour and preservative used in food industry

FSSAI has given a green signal to various colours as safe to be used in foods, but they have to fulfill standard requirements of specific criteria to be used as a food additive.

The food should be completely free from copper, mercury, and chromium. It should also be free from aromatic nitro compounds, cyanides, aromatic hydrocarbons and aromatic amines.

Food products in which FSSAI permits colour as an additive

- Ice-cream, milk lollies, frozen desserts, flavored milk, yogurt, ice-cream mix-powder
- Biscuits including biscuit wafer, pastries, cakes, confectionery, thread candies, sweets, savories (dalmoth, Mongia, phululab, sago papad, dal biji only)
- Peas, strawberries, and cherries in hermetically sealed containers, preserved or processed papaya, canned tomato juice, fruit syrup, fruit squash, fruit crushes, fruit cordial, jellies, jam, marmalade, candied crystallized or glazed fruits
- Non-alcoholic carbonated and non-carbonated ready to serve synthetic beverages including synthetic syrups, sherbets, fruit bar, fruit beverages, fruit drinks, synthetic soft-drink concentrates

- Custard powder
- Jelly crystal and ice-candy
- Flavour emulsion and flavor paste for use in carbonated or non-carbonated beverages only under label declaration

In India, only those colours and flavours are permitted for use in Food Products which have been approved by the Food Safety and Standards Authority of India (FSSAI).

Permitted limit of Preservative

According to FSSAI **"Preservative"** means a substance which when added to food, is capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food.

Preservatives inhibit the growth of microorganisms like bacteria and fungi. Preserve the appearance of food and the food characteristics like odour, taste and food is preserved for a long time. It also Increase shelf life for long period.

Preservatives are **Class I preservatives** - Natural namely Common salt, Sugar, Vinegar, Dextrose, Glucose, Spices, Honey, Edible vegetable oils and

Class II preservatives –Chemicals namely Benzoic acids and its salts, Sulphurous acids and its salts, Nitrates/ Nitrites of Sodium or Potassium, Sorbic acid, Propionates of Calcium, Sodium, lactic acid, Nisin, and Methyl/ Propyl parahydroxy Benzoates Sodium Diacetate.

Maximum permissible Limits of Class II Preservatives

Table 4.2 Maximum permissible Limits of Class II Preservatives

Food Preservative	Type of preservative	Type of Food Products	Maximum Permissible limit
Benzoates and sorbates	Antimicrobial	Pickles, Margarine, Fruit Juice, Jams and Cheese	200 ppm (parts per million)
Propionates	Antimicrobial	Bakery products, Cheese Fruits	0.32 percent

Sulfites and sulfur dioxide	Antimicrobial	Dry Fruits, Fruits, Molasses, Wine, Fried or Frozen Potatoes, Lobster, Shrimp	200-300 ppm
Nitrites and nitrates	Antimicrobial	Meat products	100-120ppm
Propyl Gallate	Antioxidant	Baked products, Meat	200 ppm
BHA -Butylatedhydroxyanisole and BHT-Butylatedhydroxytoluene	Antioxidants	Baked foods, snacks, meat, breakfast cereals, potato products	100 ppm for meat products, 200 ppm for breakfast cereals and ,potato products
TBHQ-TertButyhydroquinone	Antioxidant	Baked foods, snacks, meat	100 ppm
Erythorbic acid (Isoascorbic acid) ,Citric acid	Antienzymatic	Soft drinks, Juices, Wine, Cured meat	200-300ppm

Glossary

Microbial adaptation	:	The ability of microbes to endure the selective pressure of their environment.
Antibiotic Resistance	:	The ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive.
Nutraceuticals	:	Food or part of a food that provide medical or health benefits, including the prevention and treatment of disease.
Warehouse	:	Warehousing is the act of storing goods that will be sold or distributed later
Antioxidant	:	Antioxidants are additives capable of delaying or preventing rancidity of food due to oxidation, and lengthen the shelf life of products

Notes

Shelf life	:	The period of time during which a material (as a food or drug) may be stored and remain suitable for use.
INS	:	International Numbering System
CAC	:	Codex Alimentarius Commission
FSSAI	:	Food Safety and Standards Authority of India
FDA	:	Food and Drug Administration
USDA	:	United States Department of Agriculture
HACCP	:	Hazard Analysis and Critical Control Points
Entrepot trade	:	It comprises both import and export trade
Quality control measures	:	(Food safety) Activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Evaluation

I. Choose the best answer (1 mark)

1. _____is the characteristic of food that is acceptable to consumers.

   a. Food safety b. Food quality

   c. Food assurance d. Food quantity

2. _____ standards will depend on the specific food item.

   a. Microbiological b. Physiological

   c. Biological d. Psychological

3. The basin process measurements used in each operation are called _____

   a. Critical control limit b. Critical note

   c. Critical side d. Critical Control Points.

Notes

4. _____is the part of the quality control program that is implemented after the product is produced.

   a. Good manufacturing practices

   b. In-process record

   c. Packaging and labeling

   d. Laboratory analysis

5. _____ are an integral part of quality control.

   a. GMPs b.GLP

   c. CCP d. FIFO

6. _____measures are imperative in food industries to ensure consistent standards, keep them safe and reliable for consumers.

   a. Quality control b. Quality Assurance

   c. Quality management d. Quality improvement

7. _____usually is measured by counts of bacteria, yeast, mold, and insect fragments, as well as by sediment levels.

   a. Nutritional quality b. Shelf life

   c. Sanitary quality d. Sensory attributes

8. The main instrument to assist countries in the harmonization of food standards is the_____

   a. Codex Alimentarius commission

   b. World Health Organization

   c. Food and agricultural organization

   d. International standard organization

9. State FSSAI License is for medium-sized food businesses having annual turnover more than Rs_____

   a. 10 lakh and up to Rs.12 crore

   b. 12 lakh and up to Rs.20 crore

   c. 10 lakh and up to Rs.15 crore

   d. 20 lakh and up to Rs.25 crore

Notes

10. _____can act as a thickener as well as a stabilizer.

a. Silicoaluminate b. Sodium sulfite

c. Acacia gum d. Aspartame

11. _____provide improved texture to food products.

a. Flavour enhancers b. Emulsifiers

c. Sweeteners d. Fiber additives

12. Match the following in different food additives and its substances\

1.	Antioxidants	-	(i) sorbitol
2.	Coloring Agent	-	(ii) ethyl ethanoate
3.	Sweeteners	-	(iii) Ascorbic acid
4.	Flavouring agent	-	(iv) tartrazine

a. 1-(iii), 2-(i), 3-(iv), 4-(ii)

b. 1-(iii), 2-(iv), 3-(i), 4-(ii)

c. 1-(iv), 2-(ii), 3-(i), 4-(iii)

d. 1-(ii), 2-(iii), 3-(iv), 4-(i)

13. Standards for achievement in all areas are provided by the nodal institution for standards in India, called the _____

a. Bureau of Indian Standards

b. Indian standards Institution

c. International standards organization

d. Export inspection council

II. Very Short Answer (2 marks)

1. Define – food quality
2. Write a short note on examples for food quality attribute.
3. List out the factors affecting food quality.
4. Write about the meaning of quality assurance.
5. List out the objectives of food quality.

6. What is international trade?
7. Write on food safety.
8. What is HACCP?
9. Expand – FSSAI, PFO, FDA, BIS, CAC
10. What are the Benefits of Registering FSSAI License?
11. Food additives - Definition.

III. Short Answer (3 marks)

1. Write the importance of food quality.
2. Define quality assurance.
3. What do you understand by food quality control measures?
4. Enumerate the factors need to be maintained to ensure good quality supply to the consumers?
5. Why quality assurance is needed in food industries?
6. Write a short note on prevention of food adulteration.
7. Indicate the seven Essential Steps to Implementing a Process of Quality Assurance?
8. Indian Standards Institution – explain.
9. Enlist the principles of HACCP.
10. How does industry and consumer benefit from implementing HACCP?
11. Write the functions of FSSAI.
12. What are the functions assigned to Commissioner of Food Safety of the State?
13. What are the Functions of food additives?
14. Arrange the types of food additives.
15. Describe the Nutritional Additives in food preservative.

Notes

Notes

PRACTICAL EXERCISE

4.1 Food Quality Standards and Measures

Aim : To gain Knowledge about Food Quality Standards.

Procedure : ISO 9000

ISO 9000 (International Organization for Standardization) is a quality standard system with a main focus on finding and preventing nonconformities during production and supply process and preventing their recurring appearance. ISO has been initially adopted by the food industrial sector. Later, it has been extended to other areas, such as production of fresh fruit and vegetables, packing and distribution.

Hazard Analysis Critical Control Points (HACCP)

A living plant is not controllable yet, at least not in the way it is possible to control a production line. Therefore, despite good supervision, poor quality products and/or services can be produced. Thus, the main purpose of the risk management is to identify and minimize potential hazards. The HACCP system has been introduced as the most effective "diligence" demonstration instrument to control food safety. The product must be traceable during its journey from the farmer/producer to the consumer. That is to say, HACCP is a structured preventive system, identifying hazards at each step of the process and introducing relevant measures.

Codex Alimentarius Commission

CAC is an intergovernmental body formed with the objective of establishing international standards to protect the health of the consumers and facilitate food and agricultural trade. In 2017, the membership of Codex was 187 member countries and one Member Organisation (European Community) respectively. India is a member through the Ministry of Health and Family Welfare. CAC has become the single most important international reference point for developments associated with food standards. The document published by the CAC is Codex Alimentarius which means 'Food Code' and is a collection of internationally adopted Food Standards. The document includes Standards, Codes of Practice, Guidelines and other recommendations in order to protect consumers and ensure fair practices in food trade. Different countries use Codex Standards to develop national standards.

Notes

"Codex India" is the National Codex Contact Point (NCCP) for India. It is located at the Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare, Government of India. It coordinates and promotes Codex activities in India in association with the National Codex Committee.

World Trade Organisation (WTO)

WTO was established in 1995. The main objective of WTO is to help trade flow smoothly, freely, fairly and predictably, by administering trade agreements, settling trade disputes, assisting countries in trade policy issues. The WTO Agreement covers goods, services and intellectual property. In order to enforce adoption and implementation of standards, there is a need for a strong Food Control System. An effective food control system must consist of — (i) Food Inspection and (ii) Analytical capability.

BIS quality standards important for processed food

BIS has on record, standards for most of the processed foods. These standards in general cover raw materials permitted and their quality parameters, hygienic conditions under which the product is manufactured and packaging and labelling requirements. Manufacturers complying with the standards laid down by BIS can obtain an ISI mark which can be exhibited on their product packages. The activities of the Bureau of Indian Standards (BIS) are twofold - formulation of Indian Standards in the processed food sector and their implementation by promotion and through voluntary and third party certification system.

Food Safety and Standards Authority of India

FSSAI is an autonomous body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established under the Food Safety and Standards Act, 2006, which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety.

Standards framed by FSSAI are prescribed under Food Safety and Standards (Food Product Standards and Food Additives) Regulation, 2011, Food Safety and Standards (Packaging and Labelling) Regulation, 2011 and Food Safety and Standards (Contaminants, Toxins, and Residues) Regulations, 2011.

Result and Discussion:

4.2 HACCP plan for Jam

Aim: To understand the HACCP process in jam preparation.

Procedure:

Step CCP	Hazard	Critical Limits Paramaters	Control measure	Monitoring method System	Monitoring method Frequency	Connective Action	Responsibility Authority	Record
Receipt of fresh apple and sorting	Foreign bodies and mould from rotting fruits. Pesticides residue	Presence of mould infestation in apple lot.	Assessment of lot (accept or reject batch) Supplier assessment. Certificate of conformance from suppliers	Visual inspection Presence of signed certificate from supplier	Each batch intake of ingredients	Appropriate action with supplier (reject lot)	Purchasing Manager	PUX 1
Water Source screening	Presence of excess ions (chlorine) and off flavours. High bacteria count	pH level of 6 to 8 and chloride level of 250mg/lit	Sensory and on-site kit test (for chlorine) Scheduled Microbiological analysis of water samples	Tasting and smelling. Instant test kit results	Daily	Inform water suppliers. Regulate chlorine control system (in-house)	Quality assurance officer	QAW 1
Boiling of Jam Mixture	Survival of bacterial spores, moulds and toxins	Temperature of 105 degrees C for 15 minutes	Measurement and observation of temperature throughout boiling	Temperature measurement	Each batch	Rework-reheat over extended period	Production Supervisor	PDX 1

Holding of Jam	Cross contamination by bacteria and mould in air	Functioning air pressure system in holding room. Temperature of 54 degree C	Monitoring of air pressure control system in holding room Zoning of holding room as high rick zone (using colour such as red) Measuring of holding temperature and cooling rate.	Temperature measurement. Checking of filter in air system	Continuous per batch (temperature) Daily (filters)	Rework Hold affected batch till confirmation by laboratory analysis.	Production Supervisor. Quality assurance officer	PDH 2 QAH 2
Container cleaning and Filling (packaging)	Cross contamination from the containers. Improper sealing. Cleaning agent residue	Negative random ATP swab of containers. Low cleaning agent concentration in rinse water. Pass random sealing test containers and covers. Periodic /batch of cleaning agent concentration in rinse water. Sealing efficiency test	Random ATP swab of	Visual inspection and ATP kit swabs. On-site rinse water concentration measurement. Sealing efficiency test	Twice per batch.	Quarantine suspected product, pending laboratory analysis results.	Production Supervisor Quality assurance officer	PDC 3 QAC 3

Result and Discussion:

Notes

4.3 Preparing a label

Aim:

To prepare a label for the following products

1. Jam
2. Jelly
3. Tomato ketchup

Procedure:

Prepare label for your own product using the sample given.

Result and discussion:

4.4 Label

Aim:

To know how to read a label.

Procedure:

Find the Requisites of a label for products Jam, Jelly and Ketchup.

Requisites of a label	Mark Yes or No	Details
Name of the Product		
Brand logo / Symbol		
MRP		
Net Weight		
Display of FSSAI label		
FSSAI License number		
Batch number		
Consumer care number		
Website		

Notes

Bar code		
Vegetarian/Non-vegetarian		
Pre-packed food		
Packaging material used		
Date of manufacture		
Date of packing		
Date of expiry		
List of ingredients		
Nutrition Information		
Food additives		
Permitted Colours		
Country of origin		

Result and discussion:

4.5 Food Additives

Aim:

To gain knowledge about Food Additives used internationally

Procedure:

ACIDITY REGULATORS

INS No	Name of the Food Additive	Maximum Level
300	Ascorbic acid, L-	GMP
330	Citric Acid	GMP
331(i)	Sodium dihydrogen citrate	GMP
331(iii)	Trisodium citrate	GMP
332(i)	Potassium dihydrogen citrate	GMP
332(ii)	Tri -potassium citrate	GMP
333(iii)	Tricalcium citrate	GMP
380	Triammonium citrate	GMP
507	Hydrochloric acid	GMP

Notes

515(i)	Potassium sulphate	GMP
514(i)	Sodium sulphate	GMP
575	Glucono delta-lactone	GMP
578	Potassium gluconate	GMP
580	Magnesium gluconate	GMP

(GMP – Good Manufacturing Practice)

ARTIFICIAL SWEETENERS

INS No	Name of the Food Additive	Uses
E 951	Aspartame	Used in jams ,jellies and sauces normally with the description 'no added sugar', 'diet', 'light' or 'lite'.
E 954	Saccharin and its Na, K and Ca salts	Used in , jams, jellies, margarine, marmalades and sauces, normally with the description 'no added sugar' or 'diet'.
E 959	Neohesperidine DC	Used in , jams, jellies, margarine, marmalades and sauces, normally with the description 'no added sugar'
E 965	Maltitol	Used in , jams, jellies, margarine, marmalades and sauces, normally with the description 'no added sugar'

Chemical Preservatives

INS No	Name of the Food Additive	Uses
E 330	Citric Acid	Used in jams and jellies

Notes

E 211	Sodium Benzoate	Used in tomato ketchup
E 210	Benzoic acid	Used in low sugar jams and jellies, candied fruits, sauces
E 220-228	Sulphur dioxide and sulphite compounds	Used in fruit preserves and jams

Emulsifiers and Gelling Agents

E440 (b)	Amidated Pectin	Chemically treated Pectin used as an emulsifier and gelling agent.	Preserves and jellies
E441	Gelatin	Gelling agent	Used in the production of jelly and jelly powder, and the main component of the commercially available jelly-making powder is gelatine.

Codex General Standard For Food Additives

Acidity regulators, antifoaming agents, firming agents, preservatives and thickeners used in accordance with Codex General Standard for Food Additives (CODEX STAN 192-1995) are acceptable for use in foods conforming to the Standard in the following table.

1. Acidity Regulators

INS No.	Name of the Food Additive	Maxmimum Level
334; 335(i), (ii); 336(i), (ii); 337	tartrates	3,000 mg/kg

Notes

2. Antifoaming Agents

INS No.	Name of the Food Additive	Maxmimum Level
900a	polydimethylsiloxane	10 mg/kg

3. Colours

INS No.	Name of the Food Additive	Maxmimum Level
100(i)	Curcumin	500 mg/kg
101(i),(ii)	Riboflavins	200 mg/kg
104	Quinoline yellow	100 mg/kg
110	Sunset yellow FCF	300 mg/kg
120	carmines	200 mg/kg
124	ponceau 4R (cochineal Red A)	100 mg/kg
129	Allura Red AC	100 mg/kg
133	Brilliant Blue FCF	100 mg/kg
140	Chlorophylls	GMP
141(i),(ii)	Chlorophylls and Chlorophyllins, copper complexes	200 mg/kg
143	Fast Green FCF	400 mg/kg
150a	caramel I- Plain Caramel	GMP
150b	caramel II- Sulfite Caramel	80,000 mg/kg
150c	caramel III- Ammonia Caramel	80,000 mg/kg
150d	caramel IV- Sulfite Ammonia Caramel	1,500 mg/kg
160a(i)	carotenes , beta - sythentic	500 mg/ kg singly or in one combination
160a (iii)	carotenes , beta - Blakeslea trispora	
160e	carotenes , beta - apo-8	
160f	carotenoic acid ethyl ester beta - Blakeslea	
160a(ii)	carotenes , beta - vegetable	1,000 mg/kg

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160d(i), 160d (iii)	Lycopenes	100 mg/kg
161b(i)	lutein from tagetes erects	100 mg/kg
162	Beet Red	GMP
163(ii)	Grape skin Extract	500 mg/kg
173 (i),(iii)	Iron Oxides	200 mg/kg

4. Preservatives

INS No.	Name of the Food Additive	Maxmimum Level
200-203	sorbates	1,000 mg/kg
210-213	Benzoates	1,000 mg/kg
220-225, 227, 228, 539	Sulfites	50 mg/kg as residual SO2 in the end product exepect when made with sulfied fruit when a maxmimum level of 100 mg/kg is permitted in the end product.

5. Flavourings

The following flavourings are acceptable for use in foods conforming to this Standard when used in accordance with good manufacturing practices and in compliance with the Codex Guidelines for the Use of Flavourings (CAC/GL 66-2008): natural flavouring substances that are extracted from the named fruits in the respective product; natural mint flavour; natural cinnamon flavour; vanillin, vanilla or vanilla extracts.

Result and discussion:

4.6 WHO "Golden Rules" for Safe Food Preparation

Aim:

To gain Knowledge about WHO "Golden Rules" for Safe Food Preparation.

Notes

Procedure:

WHO data indicate that only a small number of factors related to food handling are responsible for a large proportion of foodborne disease episodes everywhere. Common errors include:

- preparation of food several hours prior to consumption, combined with its storage at temperatures which favour growth of pathogenic bacteria and/or formation of toxins;
- insufficient cooking or reheating of food to reduce or eliminate pathogens;
- cross contamination; and people with poor personal hygiene handling the food.

The Ten Golden Rules respond to these errors, offering advice that can reduce the risk that food borne pathogens will be able to contaminate, to survive or to multiply.

The World Health Organization regards illness due to contaminated food as one of the most widespread health problems in the contemporary world. For infants, immuno-compromised people, pregnant women and the elderly, the consequences can be fatal. Protect your family by following these basic rules. They will reduce the risk of food borne disease significantly.

1. Choose foods processed for safety

2. Cook food thoroughly

3. Eat cooked foods immediately

4. Store cooked foods carefully

5. Reheat cooked foods thoroughly

6. Avoid contact between raw foods and cooked foods

7. Wash hands repeatedly

8. Keep all kitchen surfaces meticulously clean

9. Protect foods from insects, rodents, and other animal

10. Use safe water

Result and discussion:

Notes

Project

1. Prepare Critical review of controlled packaging to improve food safety and quality.
2. Prepare a Quality control in the commerce of irradiated foods

Linkages

1. https://medium.com/blog-getqwerks/food-quality-factors-8dea8aff9bad
2. https://habib-ahmad.wixsite.com/foodscience/post/quality-factors-in-food
3. file:///C:/Users/WINS/Desktop/Food%20Preservatives%20-%20How%20Safe%20Are%20They_.html
4. http://blog.oziva.in/class-1-preservatives-vs-class-2-preservatives-all-that-you-must-know/
5. https://ec.europa.eu/knowledge4policy/food-fraud-quality/topic/food-quality_en#foodquality
6. https:/medium.com/blog-getqwerks/11-food-quality-control-procedures-that-every-company-should-know-b166a39a6751
7. https://www.leaf.tv/articles/factors-that-affect-the-quality-of-food/
8. https://www.eaglepi.com/in/blog/quality-control-or-quality-assurance-in-the-food-industry/
9. https://reqtest.com/testing-blog/quality-assurance-vs-quality-control-differences-2/
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11. https://www.thebetterindia.com/65429/artificial-food-preservatives-india/
12. https://www.slideshare.net/KeerthanaSurakala/food-additives-47462726

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13. The Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011 (Pg no: 503-507, 512, 513, 529, 530). Published by Food Safety and Standards Authority of India, New Delhi –.

14. https://www.fssai.gov.in/dam/jcr:99067191-c774-4c81-b9c8-708b9e72b770/Food_Additives_Regulations.pdf

15. Potter, Norman N. and Joseph H. Hotchkiss (1995). Food Science. 5th Edition. New York

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S.Roday. (1998) Food Hygiene and Sanitation, Tata McGraw-Hill Education.

SeemaYadav (2002) Food Hazards and Food Hygiene, STM Traders Pvt. Ltd.

Avantina Sharma. (2006). Textbook of Food Science & Technology, IBDC

Unit 5

OCCUPATIONAL HEALTH, HYGIENE AND FIRST AID PRACTICES

Learning Outcomes

- Recognizing and adopt strategies of preventing hazardous conditions and work practices
- Administering first aid or undertake most important action in a life threatening emergency
- Understanding the physical and biological methods of treating waste materials.

5.1.0. Introduction

Food is a major source of energy and it is a prime objective of any manufacturing industry to produce finest quality products. Food safety and control on hazards in food manufacturing industry have always been important. Population growth puts unrelenting pressure on the multibillion dollar food manufacturing industry and its workers. At the same time the industry cannot neglect employee's safety. Beyond the direct impact of employee's injuries, workplace accidents have additional indirect inputs. Like other

Notes

professions, the workers employed in various sections of food industry are also exposed to certain hazards.

It is not always an easy task for food industry to produce both quality and safety food products. But with the upcoming technologies and testing techniques, it is possible to achieve desired quality of the food. Firstly, it is important to define what kind of hazard in a food industry occurs. Food and manufacturing industries face hazards of different types like biological, chemical, physical and allergenic which may harm human health. Industries must learn how to manage the risks originating from different hazards.

5.1.1. Types of Hazards

Hazards may be introduced into the food supply any time during harvesting, formulation and processing, packaging and labelling, transportation, storage, preparation and serving.

Figure 5.1. Food Safety Hazards

A food safety hazard refers to any agent with the potential to cause adverse health consequences for consumers. Food hazards may be biological, chemical, physical, allergenic, and nutritional or biotechnology related. There are four primary categories of food safety hazards to consider.

1. Biological Hazards

It is characterized by the contamination of food by microorganisms (bacteria, virus and parasites) found in the air, food, water, animals and the human body. There are several factors which influence harmful microorganisms growth, pH levels and moisture of the food. Foods that are less acidic like milk to foster

bacteria at higher rates than more acidic foods like lemon juice. Moist foods easily get affected by microbes because it prefer warm and wet environment.

Figure 5.2. Biological Hazards

Some examples of biological hazards in foods are shown in Table 5.1.

Table 5.1. Biological Hazards in Foods

S.No.	Biological Hazards	Sources
1.	*Salmonella*	Eggs, poultry, meat, unpasteurized milk and juice, cheese, fruits and vegetables, spices and nuts
2.	*Norovirus*	Shellfish, ready-to-eat foods
3.	*Campylobacter*	Raw and undercooked poultry, unpasteurized milk, contaminated water
4.	*E.Coli*	Undercooked ground beef, unpasteurized milk or juice, raw milk, cheeses, raw fruits and vegetables, contaminated water
5.	*Listeria*	Ready-to-eat meats, unpasteurized milk or juice, raw milk, cheeses
6.	*Clostridium perfringens*	Beef, poultry, gravies

Proper temperature management for storage and packaging methods like vacuum sealing can dramatically reduce microbe growth.Techniques like thorough cooking,pasteurization of milk and juices help to prevent biological hazards. Effective sanitation practices throughout the distribution chain will reduce cross contamination of food products.Assign different containers for the preparation of each kind of food and avoid unsanitized food surfaces, utensils and equipment.

Notes

2. Chemical Hazards

Chemical hazards are harmful substances that can be found in food. It includes naturally occurring chemicals (mycotoxins), intentionally added chemicals (sodium nitrate – preservative) and unintentionally added chemicals (pesticides). Some examples of chemical hazards in foods are shown in Table 5.2.

Figure 5.3. Chemical Hazards

Table 5.2. Chemical Hazards in Foods

S.No.	Chemical Hazard	Sources
1.	Mycotoxins	Produced by fungi and can be toxic to humans. They are formed by moulds which grow on crops and foods under certain conditions
2.	Natural toxins	Biochemical compounds produced by plants in response to certain conditions
3.	Marine toxins	Decomposition or microscopic marine algae accumulated in fish and shellfish
4.	Environmental contaminants	Accidentally or deliberately enter the environment
5.	Food Additives	Chemical substance that is added to food during preparation or storage
6.	Processing-induced chemicals	Undesirable chemicals can be formed in certain foods during processing
7.	Pesticides	Used to control, destroy or repel a pest or to mitigate the effects of a pest

Proper cleaning procedures and sanitation requirements are the best methods of prevention. Training employees to follow strict guidelines like, limiting the use of chemicals and ensuring that chemicals are stored in safe places separated from food products are essential in preventing a chemical hazard.

3. Physical Hazards

Physical hazards are foreign objects that are found in food products. Usually results from accidental contamination and poor food handling practices. Unnatural physical hazards are generally more dangerous to health, whereas natural physical hazards can be harmless.

Figure 5.4.Physical Hazards

Some of the physical hazards in food are shown in Table 5.3.

Table 5.3. Physical Hazards in Foods

S.No.	Physical Hazard	Sources
1.	Unnatural	Metal fragments, pieces of plastic, wood chips, glass, human hair, nails, piece of jewellery and stones.
2.	Natural	Stems in blueberries, microscopic airborne debris, dirt on potatoes or minute insect fragments in figs.

Physical hazards can be avoided through inspection of food and strict adherence to food safety regulations such as Hazard Analysis Critical Control Point (HACCP).Care should be taken during food preparation, process and storage will help to prevent physical contamination.

4. Allergenic Hazards

Allergic reactions occur when the human body produces an abnormal immune response to specific proteins found in food.

Figure 5.5.Allergenic Hazards

Notes

Table5.4. Allergenic Hazards in Foods

S.No.	Allergenic Hazard	Sources
1.	Milk	Butter, cheese, cream, milk powders and yogurt
2.	Eggs	Cakes, mayonnaise, mousse, pasta, sauces and foods brushed with eggs
3.	Nuts	Breads, biscuits, crackers, desserts, ice cream, nut oils, sauces and curries
4.	Soy	Desserts, ice creams and sauces
5.	Wheat	Baking powders, batter, bread crumbs, cakes, pasta, pastries, sauces, soups and foods dusted with flour
6.	Fish	Fish sauces, pizzas, salad dressings and stock cubes
7.	Shellfish	Shrimp paste and curries of salads

Processing industries should embrace proper sanitation techniques while product production, packaging and labelling of ingredients to reduce the risk of an allergenic reaction.

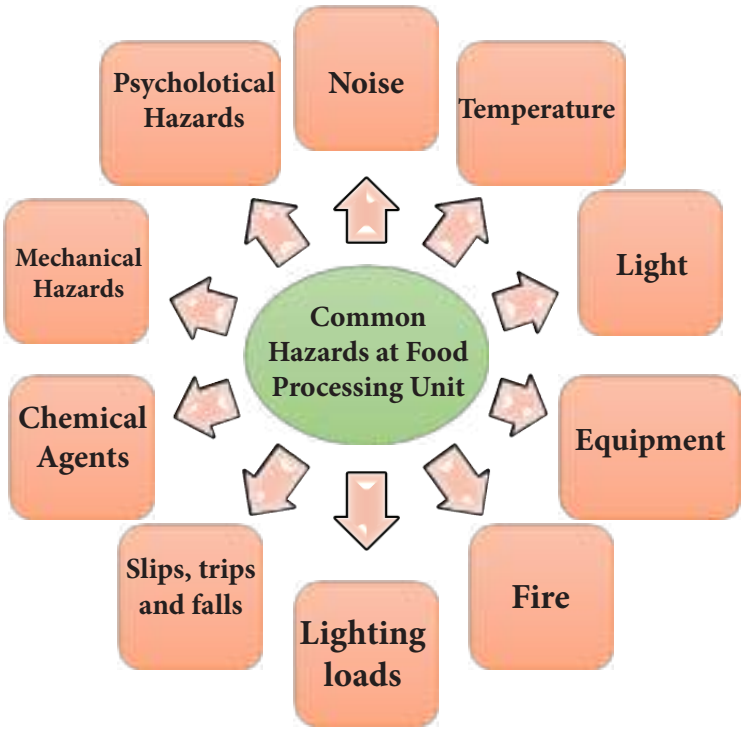
Activity 1

Tabulate the different types of food safety hazards.

S.No.	Biological	Chemical	Physical	Allergenic

5.1.2. Common Hazards at Processing Unit / Industry

"Hazard analysis" reads proper knowledge of biological and chemical sources and how their effects vary in the production line from raw material to processing unit and then at the end to the consumers. Employees in the food processing industries face numerous health and safety hazards. They are exposed to many potential hazard and danger including knife cut, falls and exposure to infectious diseases and hazardous chemicals. Machines used to clean, process and package food are wrought with risks and hazards including conveyors with moving parts, collapsing structures, falling objects and compressed equipment.



Flow chart 5.1. Common Hazards at Food Processing Unit

1. Temperature

Food processing employees often have to work in environment with high or low temperatures. High humidity along with high temperature can make the working environment uncomfortable for workers.

Figure 5.6. Hazards in Food Industry

2. Lighting

The workers may be exposed to the risk of low illumination or excessive brightness. Poor illumination can lead to eye strain, headache, lachrymal congestion and eye fatigue. There should be sufficient and suitable lighting, natural or artificial.

3. Noise

The machine utilized in the food processing industry often operate a high noise levels, require frequent wash downs and can be more susceptible to mould and vermin. Because of these factors there will be high noise levels in the food industries.

4. Equipment

Various equipment and machines in the food processing unit cause auditory and non-auditory problems. This may leads to nervousness, fatigue and decreased efficiency.

Notes

5. Fire

Fire hazards or explosion of gas cylinders or ammonia (refrigerants) leakage can be highly dangerous even in small quantities.

6. Lifting Loads / Ergonomic

Workers have to lift heavy loads in carrying raw food items like vegetables, fruits and grains. Like many jobs, food industry also requires repetitive motion in workplace. So workers may be susceptible to musculoskeletal problems like back ache, sprain, strain and pain in the limbs. They also have to stand for long hours and can develop varicose veins.

7. Slips, Trips and Falls

The frequent wash down required by the food processing industry creates slippery surfaces that puts workers at risk for slips, trips and falls.

8. Chemical Agents

Prolonged exposure to chemical detergents and disinfectants can cause allergic infections.

9. Psychological hazards

Workers face monotony in their work environment. They continue to work at same levels or a long time without any scope of career progression. They are exploited with low wages.

10. Mechanical hazards

The machinery utilized for food processing can place workers at risk for amputations or other injuries like cuts and burns with sharp equipment. Industry management should ensure proper machine guarding and Personal Protective Equipment (PPE).

Activity 2

Prepare a chart on various hazards in food processing industry.

5.1.3. Principles of Safety and Health

Health and safety is the key for a food processing operation to protect its employees. It helps to create better work environment,

retain good workers, increase workers participation in decision making and improve productivity. A well-managed work place safety programme can benefit the processing unit to achieve their goals and policies.

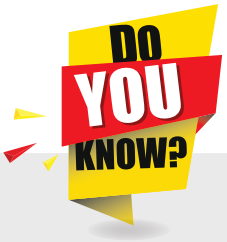
Figure 5.7. Health and Safety

Occupational Health Definition (WHO/ILO, 1950)

- Promotion and maintenance of the highest degree of physical, mental and social well-being of workers of all occupations.
- Prevention among its workers of departures from health caused by their working conditions.
- Protection of workers in their employment from risk usually from factors adverse to health.
- Placing and maintenance of the worker in an occupational environment adapted to his / her psychological ability.

Strategies for preventing hazardous conditions and work practices

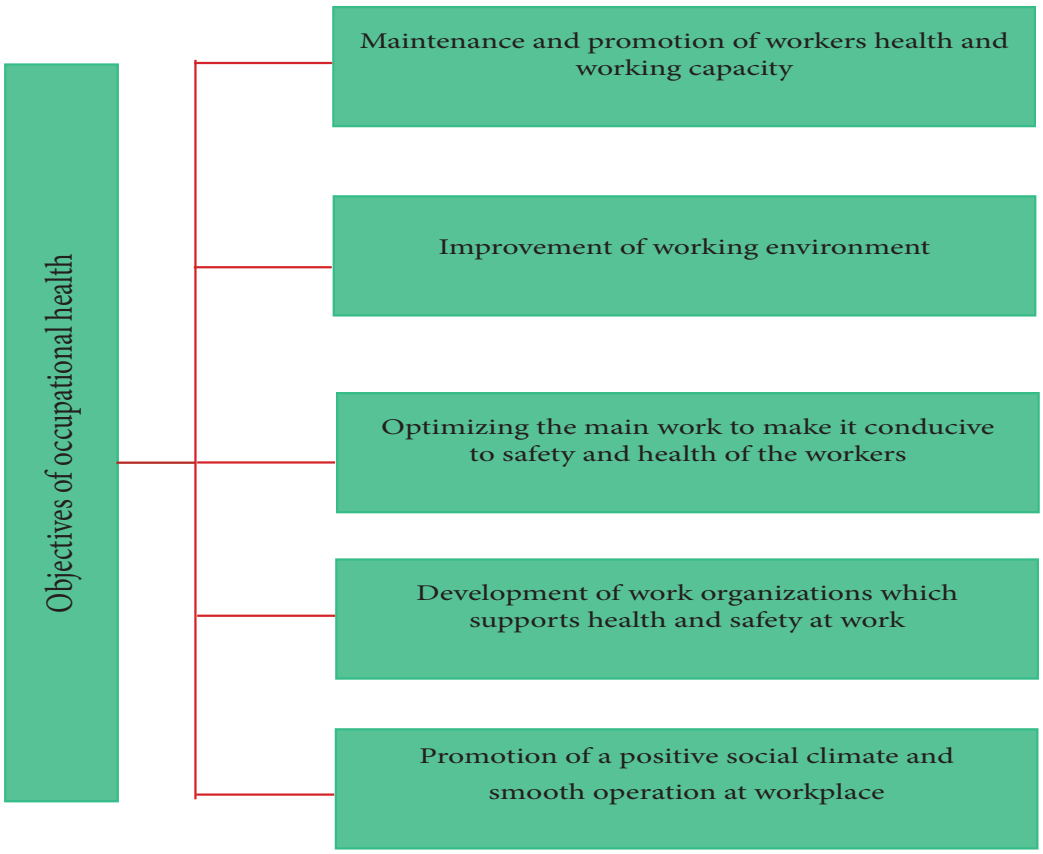
Adaption of work to people and people to their jobs is one of the main strategies of occupational health. It seeks to prevent departures from health among the workers as well as control to jobs related health risks. A safe and healthy work environment is essential for control of risks arising from physical, chemical and other work place hazards.



Six Safety and Health Principles for the Industry

1. All injuries and work related illness can and must be prevented
2. Management is responsible and accountable for safety and health performance
3. Employee engagement and training is essential
4. Working safety is a condition of employment
5. Excellence in safety and health suggests excellent business results
6. Safety and health must be integrated all business management process.

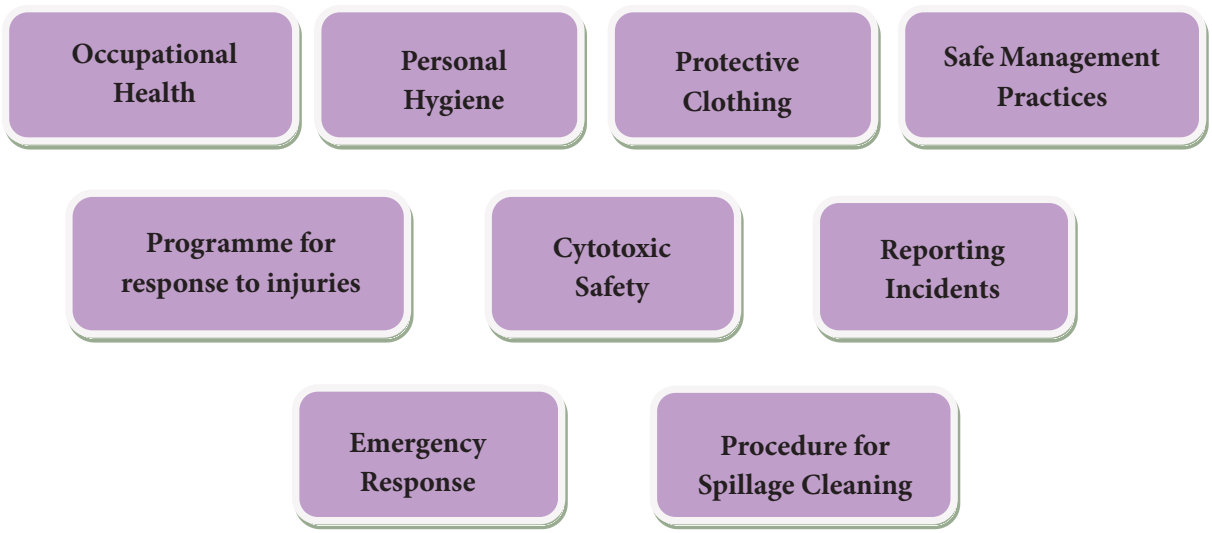
The main objectives of occupational health are shown in Flowchart 5.2.



(Source: Joint ILO / WHO Committee on Occupational Health)

Flowchart 5.2. Objectives of Occupational Health

According to WHO, worker's health and safety principles are shown in Flowchart 5.3.



Flowchart 5.3. Worker's Health and Safety Principles

Notes

a) Occupational Health and Safety

Proper training to employees with personal protective clothing and equipment results in good occupational health and safety. Effective health programmes like immunization, post-exposure prophylaxis medical surveillance and personal hygiene training should be conducted.

b) Personal Hygiene

- Convenient washing facilities with warm water and soap should be available for personnel handling hazardous work. They should be trained on personal hygiene to reduce the risks in heavy works.
- Clean water, clean towels, hot air hand dryers are essential for the workers.
- Wear single use gloves while preparing or serving ready-to-eat food.
- Wear a hat or hairnet and apron all the time.
- Cover all cuts and burns, sores and abrasions with a clean water proof dressing.
- Do not allow employees to handle any food, if they have septic spots, a bad cold, chest infection, sore throat or a stomach upset.
- Keep finger nails cut short and do not use nail polish and perfumes.

c) Protective Clothing

Figure 5.8. Protective Clothing

Notes

Helmets, respiratory face masks, eye protectors, overalls, industrial aprons, leg protectors, industrial boots, disposable gloves and heavy duty gloves for heavy work should be available according to the need of workers. Clothing with insulating characteristics according to the temperature must be used.

d) Safe Management Practices

- Safe management practices like waste management; appropriate packaging of waste, waste identification, proper storage of waste and adequate transportation should be done for the worker's safety.
- Wear shoes that protect from falling and prevent staff from running inside the unit. Clean up any spilled water, oil or grease on the floor immediately.
- Have a first aid box containing sterilized dressings, cotton wool, adhesive plasters and bandages.
- Trained staff must be allowed to enter to operate machines. When purchasing or replacing equipment, select an appropriate safety measures.
- Train staff to be familiar with potential hazards and use charts to show safety procedures.
- Regular checking of electrical connections and appliances are essential.

e) Programme for Response to Injuries

The following programmes must be arranged for response to injuries.

- Immediate first aid measures
- Immediate reporting
- Identifying source of injury
- Obtaining additional medical care
- Maintaining medical surveillance
- Blood tests if required
- Recording the full incident
- Investigating the causes and reporting
- Implementing preventive measures for similar incidents

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f) Cytotoxic Safety

Special measures should be taken when using cytotoxic drugs.

- A specially assigned safety officer should supervise the safe management of these products and wastes
- Set up written procedures for handling products and waste
- Training of the staff about hazards and handling and decontamination procedures
- Develop emergency programme for spills and accidents.

g) Emergency Response

In emergency the waste management plans must be followed. The contaminated areas should be cleaned with disinfectants and the exposure of workers must be limited, so that the impact on patients, personnel and environment can be controlled.

h) Procedure for Spillage Cleaning

- Evacuate the area
- Decontaminate eyes and skin
- Inform designated person
- Determine nature of spill
- Provide first aid
- Secure area
- Protective clothing
- Limit the spill
- Neutralize or disinfect
- Collect the spill
- Decontaminate the area
- Rinse the area
- Seek medical care where necessary

i) Reporting Incidents

All incidents including near misses must be notified as description of incident, where and when it occurred, which staffs were involved and other relevant circumstances. A report should be made and records should be kept.

Notes

Activity 3

Role play the safety measures of safe management practices in food processing industry.

5.1.4. Procedures and Steps to be taken to Report any Accidents

Food manufacturing has one of the highest injury and illness rates compared to all industries. Repetitive motions (Bureau of Labour Statistics, 2011), manual handling, slips and trips and being hit by moving objects (Health and Safety Executive, 2011) are among the most common sources.

Figure 5.9.Reporting Accident

Hazards can creep at any time or any place even in safest workplaces. A well planned safety programme must be followed in industries. Employees should be encouraged to report hazards immediately to an organised trained team to investigate and analyse incidents. Investigations help to frame corrective actions that prevent repeat incidents. Industry personnel cannot count on equipment, processes, supplies, surroundings and people to stay the same. Even a subtle change can introduce new hazards.

Hazards result in injury, illness and property damage. The natural response is to ask why an incident occurred. Take time to encourage employees to report hazards and to explain how incidents and hazards reports are investigated.

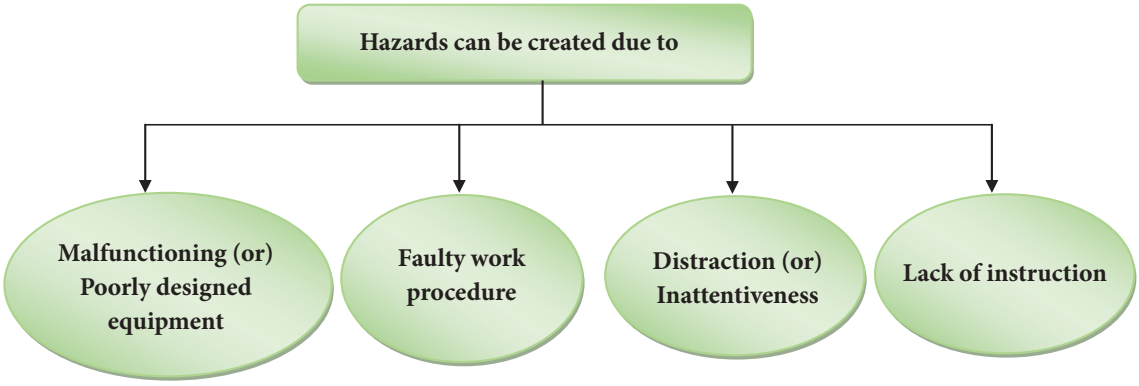
Steps to be taken to Report any Accident in a Food Industry

1. Define incident and near miss accident

Incidents include events that result in injury or property damage and adversely affect the completion of a task. An unusual or unexpected injury or damage can be considered to be a near miss accident. Incident can be classified as severe or minor depending on the actual or potential outcome.

2. Introduce the importance of reporting hazards

A change in the work environment can create a hazard.



Flowchart 5.4. Reasons for Hazards

Always follow the available procedures for reporting hazards so that the appropriate people can take action to rectify them.

3. Review the reasons to investigate hazards and incidents

Prevention is the motive behind investigating hazard and incident reports. Similar or more disastrous incident may be prevented by using the information gained through an investigation. A hazard or incident can impact many departments in an organisation, so the reporting system should include a way to inform the managers of various operations, including safety, environment, human resources, production, scheduling, maintenance, purchasing and quality assurance. A good place to start is to report hazards and incidents to the immediate supervisor, so that the preliminary investigation can start.

4. Introduce the investigation team

The members of the investigation team should be selected for their skills and knowledge. A variety of expertise like an excellent interviewer, technical persons and non-team specialists need to be included to make sure the investigation is effective. Serious incidents can involve outside agencies like OSHA (Occupational Safety and Health Administration), fire, police departments and insurance companies. The internal investigation team should cooperate with other investigators.

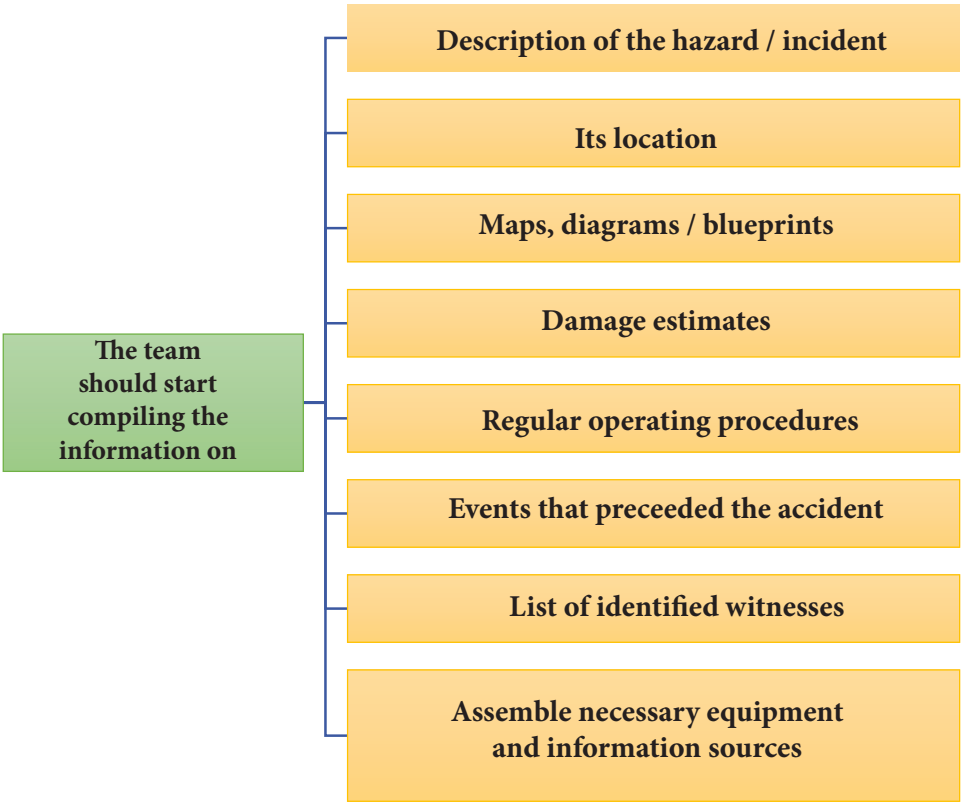
5. Emphasise the need to start investigators promptly

A reported hazard that puts employees in imminent danger must be investigated immediately. Less serious hazards also

need full investigation that may be used for later time. An area may still be hazardous right after an incident. It is important to everyone, including the incident inspection team, to follow the facility's emergency action plan for rescues, evacuations and other response activities until the area is safe. An investigation should start as soon as possible when conditions are safe. Even before the incident site is accessible, the team can still start the investigation by identifying and interviewing witnesses.

6. Explain the investigation process

The leader or head of the team should define scope of the investigation and assign tasks to team members.



Flowchart 5.5. Accident Investigation Process

7. Describe the references used during an investigation

Written procedures, instruction manuals, medical reports, inspection and maintenance records, training records, job safety analyses and exposure monitoring results are to be reviewed. The team must interview the person who reported the hazard or incident, injured persons, witnesses and supervisors.

8. Explain the hands on investigation process

The team secures the location of the hazard or incident, so that people are not endangered. They take photos, mark locations on

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maps, measure distance, and record time sequences, collect samples for analysis and restrict entry to the area. The team determines where and how the abnormality occurred, when it was first noted and whether the situation was influenced by outside area.

9. Discuss how the causes of the hazard or incident are determined

The team uses the information they have gathered to determine the direct and indirect causes of a hazard or incident.

10. Outline how the team makes recommendations and reports its findings

The team's findings and recommendations are detailed in a written report. A report should include:

- Background information on where and when the hazard was reported or the incident occurred and the persons involved.
- An account of the potential effects of a hazard, the types of incident, sequence of events and extent of damage.
- An analysis of the hazards or incidents causes.
- Recommendations for immediate and long-term actions to remedy the hazard or prevent the recurrence of an incident.

11. Explain how completed reports are used

Management uses the report to decide on corrective action recommendations. It takes time to implement, so it is helpful to set up a time table and assign some person to be responsible for keeping track of the progress. Periodically analyzing the incident reports helps to identify areas that need more safety. The reports can be useful, in case of illness or injury of the workers.

Activity 4

How do you respond to an injured employee in a food processing unit? Prepare a report.

5.1.5. Applicable hygiene and safety standards regulations and codes for processing unit / Industry

"Food Safety" refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and injury. From farm to factory to fork, food products may encounter any number of health hazards during their journey through the supply chain. Safe food handling practices and procedures are thus implemented at every stage of the food production cycle in order to curb these risks and prevent harm to

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consumers. To avoid potential hazards, a number of procedures to be followed from industries to market, food labelling, food additives and food hygiene. The food ought to be safe in the market as well as the safe delivery to the consumers.

The five key principles of food hygiene according to WHO are:

1. Prevent contaminating food with pathogens spreading from people, pets and pests.
2. Separate raw and cooked foods to prevent contaminating the cooked foods.
3. Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
4. Store food at the proper temperature.
5. Use safe water and raw materials.

Every country has different regulatory bodies that preside over the definition and enforcement of domestic food safety standards and these may vary from country to country. In order to sell or manufacture food products in any country, domestic and international businesses alike are subject to the food safety legislation and enforcement measures of the nation. Around the world, the majority of laws about food safety are based on two concepts: HACCP and GMP.

Hazard Analysis and Critical Control Point (HACCP):

Figure 5.10. HACCP

Hazard Analysis and Critical Control Point is a systemic risk based approach to prevent the biological, chemical and physical contamination of food in production, packaging and distribution environment. The HACCP concept is designed to counter health hazards by identifying potential food safety problems before they

happen, rather than inspects food products for hazards after the fact. HACCP concept entails controlling for contaminants at a number of key junctures in the food production process and strict adherence to hygiene practices throughout.

Good Manufacturing Practices(GMP):

Figure 5.11.Good Manufacturing Practices

Good Manufacturing Practices are internationally recognized quality assurance guidelines for the production of food, beverages, cosmetics, pharmaceuticals, dietary supplements and medical devices. These guidelines lay out the protocols which manufacturers must implement to assure that their products are consistently high quality for human use, including mandatory product inspection at critical point.

The Codex General Principles of Food Hygiene

- Identify the essential principles of food hygiene applicable throughout the food chain (including primary production throughout to the final consumer), to achieve the goal of ensuring food is safe and suitable for human consumption.
- Recommended a HACCP based approach of a means to enhance food safety.
- Indicate how to implement those principles
- Provide guidance for specific codes which may be needed for sectors of the food chain; processes; or commodities, to amplify the hygiene requirements specific to those areas.

Figure 5.12. Codex General Principles of Food Hygiene

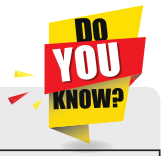
Table 5.5. Basic Codes of Hygiene, Sanitation and Safety in Food Processing

S.No.	Sections	Code of Practice
1.	Hygienic production of food sources	• Control contamination from air, soil, water, food stuffs, fertilizers, pesticides, veterinary drugs or agents used in primary production • Protect food sources from faecal contamination
2.	Handling, storage and transport	• Sort food and food ingredients for human consumption • Protect food and food ingredients from contamination by pests, chemical, physical or biological contaminants
3.	Processing unit – layout and facilities	• Design and layout permit appropriate maintenance, cleaning, disinfections and minimize airborne contamination • Surfaces and materials those in contact with food should be nontoxic, durable and easy to maintain and clean. • Appropriate, suitable facilities should be available for temperature, humidity and other controls • Effective protection against pest and harbourage.
4.	Location	• Away from polluted areas • Away from infestations of pests • Areas where wastes, either solid or liquid cannot be removed effectively must be avoided.
5.	Equipment	• Permits adequate maintenance and cleaning • Functions in accordance with its intended use • Facilitates good hygiene practices, including monitoring.
6.	Internal structure and fitting in premises and rooms	• Floors should be constructed to allow adequate drainage and cleaning. • Ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation. • Windows and doors should have smooth, non-absorbent surfaces and be easy to clean. • Working surfaces that come into direct contact with food should be durable and easy to maintain.
7.	Facilities a) Water supply	• An adequate supply of potable water with appropriate facilities for storage, distribution and temperature control should be available.
	b) Drainage and waste disposal	• Adequate drainage and waste disposal systems and facilities should be designed and constructed, so that the risk of contaminating food or the potable water supply is avoided.

	c) Cleaning	• Adequate facilities, suitably designed for cleaning food, utensils and equipment (hot and cold potable water)
	d) Personnel hygiene	• Adequate means of hygienically washing and drying hands, lavatories of appropriate hygienic design and changing facilities for personnel.
	e) Temperature control	• Adequate facilities should be available for heating, cooling, cooking, refrigerating and freezing.
	f) Air quality and ventilation	• Adequate means of natural or mechanical ventilation must be provided.
	g) Lighting	• Adequate natural or artificial lighting should be provided to enable the process in a hygienic manner
	h) Storage	• Adequate facilities for the storage of food, ingredients and non-chemicals should be provided.
8.	Control of operation a) Control of food hazards	• Food business operators should control food hazards through the use of system such as HACCP.
	b) Time and temperature control	• Temperature control systems should be place to ensure the safety and suitability of food (ex.nature of the food, pH, intended shelf life, method of packaging and processing etc.)
	c) Microbiological cross-contamination	• Pathogens can be transformed from one food to another by food handlers, contact surfaces or the air. So raw or unprocessed food should be effectively separated from ready-to-eat foods and other finished products.
	d) Physical and chemical contamination	• Prevent contamination of foods by foreign bodies such as glass or metal shards from machinery, dust, harmful fumes and unwanted chemicals.
9.	Incoming Material Requirements	• Raw materials should be inspected and sorted before processing, where necessary, laboratory tests should be made.
10.	Packaging	• Packaging design and materials should provide adequate protection for products to minimize contamination, prevent damage and proper labeling
11.	Management and Supervision	• Managers and Supervisors should have enough knowledge of food hygiene principles and practices to be able to judge potential risks and take appropriate preventive actions.

12.	Documentation and Records	• Appropriate records of processing, production and distribution should be kept and retained for a period that exceeds the shelf life of the product. • Documentation can enhance the credibility and effectiveness of the food safety control system

(Source: fao.org. – Recommended International Code of Practice, General Principles of Food Hygiene).



5S in the Food Industry for Hygienic Practices

5S Element	Criteria	Food Industry
"SORT" Everything has a purpose	Select what is needed and remove everything from the work area	Colour-coding helps visually identify tools used in different hygienic zones
"SET IN ORDER" Everything has its place	Arrange items in order for easy selection use and return to their original location	Colour-coded wall brackets and shadow boards can be used for efficient tool tracking and management
"SHINE" everything is clean and well maintained	Spot dirty / non-confirming items must be cleaned, repaired or removed from service	Using the right cleaning tool for the right job, as well as hygienically designed tools that can be easily cleaned are important for effective cleaning
"STANARDIZE" Every action is well-known and clearly stated	Develop and implement visual standards that employees are able to consistently follow	Colour-coded, hygienically designed sanitation and material handling tools can be used with zone planners for easy visual standardization
"SUSTAIN" Every action can be replicated and be improved upon	Create a continuous improvement culture among employees so they can find better ways of reducing efforts	Facilitate employee education, training and evaluation for continuous 5S and food safety improvements

All kinds of Food hygiene legislation in India is developed by "Food Safety and Standards Authority of India". It is a premier organization that is administered by Ministry of Health and Family Welfare dedicated to ensuring food safety and hygiene requirements in India. Every establishment dealing with the food handling, processing, manufacturing, packaging, storing and distribution by any food business operator should adhere to the food safety and hygienic norms.

Figure 5.13 FSSAI

Food Safety and Standards Regulations in India (Licensing and Registration of Food Business – 2011)

1. Location and neighbourhood of the food establishment

The Food and Safety guidelines given by FSSAI suggest that the location of the food establishment should be away from environmental pollution and industrial activities that have the potential to contaminate the food through disagreeable odour, fumes, dust, smoke, chemical emissions, pollutants and infestation of pests.

Notes

2. Layout and design of food establishment

General hygienic and sanitary practices include that the floors, ceilings and the walls of the unit must be maintained to prevent entering insects and rodents.

3. Equipment and containers

All the containers used must be made of corrosion free materials, in order to protect the food from dust, dirt, flies and insects. Appropriate cleaning and disinfecting of equipment are necessary.

4. Facilities

Water supply facilities must be adequate in order to ensure no risk of contamination of food articles. Only potable water must be used for cooking and processing.

5. Food operations and controls

Food hygiene system must ensure that the food establishment is careful about procurement of raw materials. Expiry of the food ingredients must be carefully checked. Temperatures of high risk food such as milk products, frozen food, meat must be maintained to ensure safe storage of raw materials.

Figure 5.14. Safety Food Processing

6. Sanitation and maintenance of establishment premises

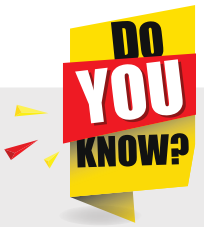
Proper cleaning and maintenance facilities, pest control systems must be ensured to meet Food Safety and Standard Rules.

7. Personnel hygiene

Protective clothing, head covering, face mask, gloves and footwear are mandatory for the food handlers and for those visiting the processing unit. The workers must undergo regular health checkups.

Activity 5

List the basic personnel hygiene that should be followed in a industry.



Indian Standard Code of Personal Protective Equipment

IS CODE OF PPE's (Examples)

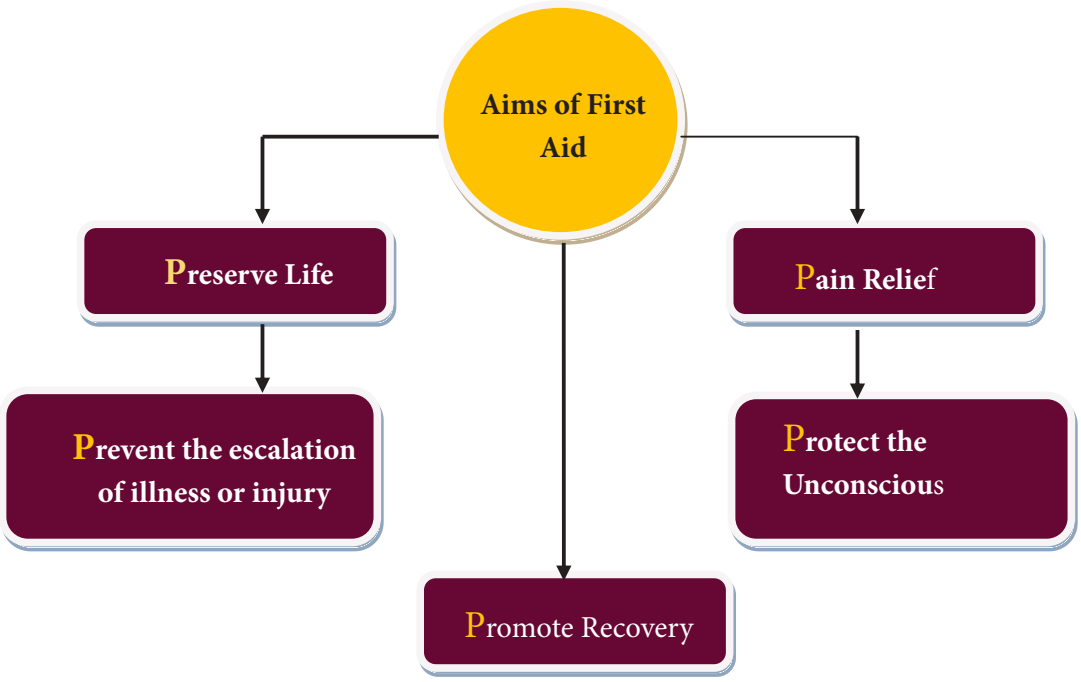
IS CODE 2925	:	1984 – Specification Industrial Safety Helmet
IS CODE 4501	:	1981 – Specification for aprons
IS CODE 8519	:	1977 – Guide for selection of industrial safety equipment for the body
IS CODE 8990	:	1978 – Code of practice for care and maintenance of industrial safety clothing
IS CODE 8550	:	1977 – Guide for selection of industrial safety equipment for eye, face and ear protection
IS CODE 6519	:	1971 – Code of practice for selection, care and repair of safety footwear
IS CODE 8807	:	1978 – Guide for selection of industrial safety equipment for the protection of arms and hands
IS CODE 9473	:	2002 – Respiratory protective devices

5.2.0. Administer First Aid and Undertake Most Important Action in a Life Threatening Emergency

First aid is the immediate care given to victims of accidents before trained medical workers arrive. It involves rapid and simple measure such as clearing the air passage way, applying pressure to bleeding wounds or dousing chemical burns to eye or

skin. It is impossible to predict when accident would happen in the workplace / industry. However, it is the employer's duty to do everything in their power to prevent accidents and provide access to first aid to their employees.

The main aims of first aid are shown in Flowchart 5.6.



Flowchart 5.6. Aims of First Aid

First aid requires an organized approach involving people, equipment and supplies, facilities, support and arrangements for the removal of victims and non-victims from the site of an accident. Organizing first aid should be a cooperative effort, involving the employers, occupational health and public health services, the labour inspectorate, plant managers and relevant non-governmental organizations.

5.2.1. Importance of First-aid in Life Threatening Emergency

Figure 5.15. First Aid Kit

Notes

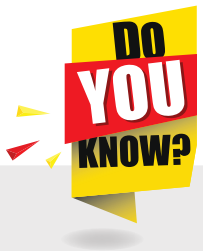
All employees are trained in workplace emergency procedures. This may include what to do in case of a fire, earthquake or other emergency like identifying locations of emergency exits and process to follow to evacuate the building. These procedures are site specific and should be a part of the training for all new employees. Regular drills or reviews of procedures are essential to ensure that if an actual emergency occurs, everyone is able to react accordingly and safely. First-aid and Cardio Pulmonary Resuscitation (CPR) training is encouraged for employees. Orientation training should always include the following information:

- Location of emergency exits
- Location of first aid supplies
- Location of fire extinguishers
- Evacuation procedures and muster stations
- CPR trained personnel

5.2.2. General Steps to Administer Immediate First-aid to Injured or Exposed Employers

1. Check the sense for danger before providing help.
2. Move injured personnel if necessary to prevent their exposure to further harm
3. Apply gentle pressure, disinfectant and bandages to treat cuts and scrapes.
4. Apply ice and compression at intervals and keep the limb elevated to treat sprains and fractures.
5. Use cool fluids, clothes and shade to treat heat exhaustion.
6. Use warm fluids and warm covering to treat hypothermia.
7. Determine the burn type and severity. Cover the wound with loose cloth to prevent infection.
8. Use an Epi Pen to treat allergic reactions.
9. Do not use creams, lotions or salves, except to neutralize the spilled material.
10. For splashes into the eyes, immediately irrigate the eyes with eyewash for at least 15 minutes.
11. Perform CPR (only by a trained personnel) if an injured person stops breathing.

In all cases, the exposed or injured person must seek medical attention.



Safety Data Sheets (SDS)

Material Safety Data Sheet (MSDS) or Product Safety Data Sheet (PSDS) are documents that list information relating to occupational safety and health for the use of various substances and products.

1. Call 108 for medical emergencies.
2. Relevant safety information such as an SDS should accompany the person.
3. Notify the injured person's supervisor as soon as possible.

Some of the possible hazards in food processing industries and its first aid procedures are given in Table 5.6

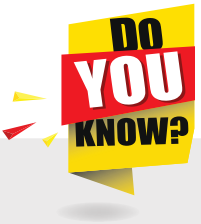
Table 5.6. Hazards in Food Processing Industries and its First-aid Procedures

S.No.	Hazard	Potential Harm	First Aid Procedure
1.	Manual Tasks	Overexertion can cause muscular sprains, cuts and grazes  Figure 5.16.Cuts and Grazes	**Cuts and grazes** • Wash and dry hands thoroughly • Apply gentle pressure for 20 to 30 minutes • Clean the wound gently with running clean water and avoid using soup • Apply antibiotic on the wound • Cover the wound with a bandage • Deeper wounds may require faster medical attention
2.	Working at height	Slips, trips and falls can cause fractures, bruises, lacerations, dislocations, concussion and bleeding  Figure 5.17. Fractures	**Fractures** • Fractures are broken bones,so the affected part should be immobilized • It could cause the rupture to blood vessel or a nerve, so care must be taken. • Transport to the patient to the hospital as early as possible. **Bruises** • Ice the bruise with an icepack wrapped in a towel • Elevate the injured area • If abnormal bleeding from nose or gums, immediate medical attention is necessary.

3.	Electricity	Exposure to live electrical wires can cause shock, burns cardiac arrest and injuries from fire  Figure 5.18. Electric Shock	**Electric shock** • Move the source away from the affected person, using a dry, non-conducting object made of cardboard, plastic or wood. • Begin CPR if the person shows no signs of circulation, such as breathing, coughing or movement. Try to prevent the injured person from becoming chilled.
4.	Machinery and Equipment	Being hit by moving vehicle or being caught by moving parts of machinery can cause fracture, amputation, bruises, lacerations, dislocations  Figure 5.19.Amputations	**Amputations** • Calm the person • Stop the bleeding – Bleeding is likely to occur, so apply pressure and bandage to lessen the flow (not so tightly) • Save the body part • Wrap the severed body part – Both the patient and the body part be taken immediately to the hospital. • Support the affected area and prevent shock
5.	Hazardous chemicals	Toxic or corrosive chemicals may be inhaled, contact skin or eyes causing poisoning, chemical burns and irritation  Figure 5.20.Chemical Burns	**Chemical Burns** • Remove the cause of the bum by cool running water for 10 minutes • Remove clothing or jewels that has been contaminated by the chemical • Bandage the burn. Cover the burn with a sterile gauze bandage or clean cloth

6.	Extreme temperatures	Hot surfaces and materials can cause burns. Exposure to heat can cause heat stress and fatigue. Exposure to extreme cold can cause hypothermia and frost bitten  Figure 5.21.Burns	**Burns** **Minor Burns** • Run cool water (Avoid ice or very cold water) over the affected area. • Don't break any blisters and apply moisturizer **Major Burns** • Don't apply ointments, cover wound with loose materials (if necessary) to prevent from contaminants and take the person to the hospital as early as possible. **Hypothermia** • Move the person out of cold and remove any wet clothing • Cover the person with blankets and use heat packs. Don't apply heat directly to the skin because this could cause major skin damage. • Give the person warm fluids.
7.	Biological	Infection and allergic reactions  Figure 5.22 Allergic Reactions	**Allergic Reactions** • Keep the person calm, make sure the person's clothing is loose, so he or she is able to breathe. • Avoid giving them food drink or medicine • Take the affected person to the hospital. • Use epinephrine auto injector into the person suffering severe allergic reactions.

8.	Animals	Bite stings and scratches  Figure 5.23. Insect Bites	**Insect bites and Sting** • If the insect left a stinger, gently scrape the skin with finger and remove without breaking it. • Wash the affected area with soap and water. • Apply a cold compress or an ice pack at any swelling for at least 10 minutes • Severe reactions like wheezing or difficulty in breathing, a swollen face of mouth and fast heart beat may need immediate medical attention.



Food Processing Industry Minimum Requirements (First Aid Kit)

Quality	Item	Size
50	Adhesive bandages	1” x 3”
2	Adhesive tape	2.5 yard
25	Antibiotic Treatment Application	1/57 oz
50	Antiseptic Applications	1/57 oz
1	Breathing Barrier	
2	Burn Dressing, Gel soaked	4” x 4”
25	Burn Treatment	1/32 oz
2	Cold Pack	
2	Eye Covering	
1	Eye wash	40z
1	First aid Guide	
10	Hand Sanitizer	
2	Roller Bandage	2” x 4 yards
1	Roller Bandage	3” x 4 yards
1	Scissor	
1	Splint	4” x 24”
4	Sterile pad	3” x 3”
1	Tourniquet	
4	Trauma Pad	5” x 9”
2	Triangular Bandage	40” x 40” x 56”

Activity 6

Tabulate the minimum requirements of first aid material for a food processing unit.

Notes

5.3.0. Physical and Biological Methods of Treating Waste Materials

Food processing industries produce large quantities of both liquid and solid wastes annually, resulting from the production, preparation and consumption of food. These waste materials contain biodegradable organic matter and disposal of them creates environmental problems. Environmental legislation has significantly contributed to the introduction of sustainable waste management practices worldwide.

The characteristics of the food wastes from food processing industries are high moisture content, high ferment ability, good nutrient status and lower content of inert contaminants. The food processing wastes are divided into two categories;

1. Solid Wastes
2. Liquid Waste/Waste Water

1. Solid waste:

Solid wastes include both organic and packaging wastes. Rinds, seeds, kernels, skin and bones from raw materials are organic wastes. Excessive packaging items like plastic glass and metal are inorganic wastes.

2. Liquid waste/Waste water:

Water used for washing fruits and food stuffs in food processing industries are nontoxic and organic. But water used to clean meat, poultry and seafood processing contain pathogenic organisms. Wash water can be treated and reused.

A number of waste treatment processes are available to make the waste suitable for reuse. The most applied processes are physical and biological treatment. Most solid wastes are disposed by returning to the land.

Wastes can be classified into biodegradable (paper, wood, fruits and others) and non-biodegradable (plastics, bottles, machines, cans and styrofoam containers). Waste management is the collection of all thrown away materials in order to recycle them and as a result, decrease their effects on our health, surroundings and the environment.

Notes

During the canning of fruits and vegetables and the preparation of juices, squashes, jams and jelly, large quantity of waste materials are left over and thus have to be utilized to reduce the cost of production in the main product. Example: Apple by product – Left over extraction of apple juice can be dried and utilized for the preparation of pectin. Guava by product – Core, seeds and peels utilized for preparation of guava cheese and pectin.

Figure 5.24.Waste Management

The three R's of waste management in food processing industry is – Reduce, Reuse and Recycle.

There are effective and profitable waste management options including:

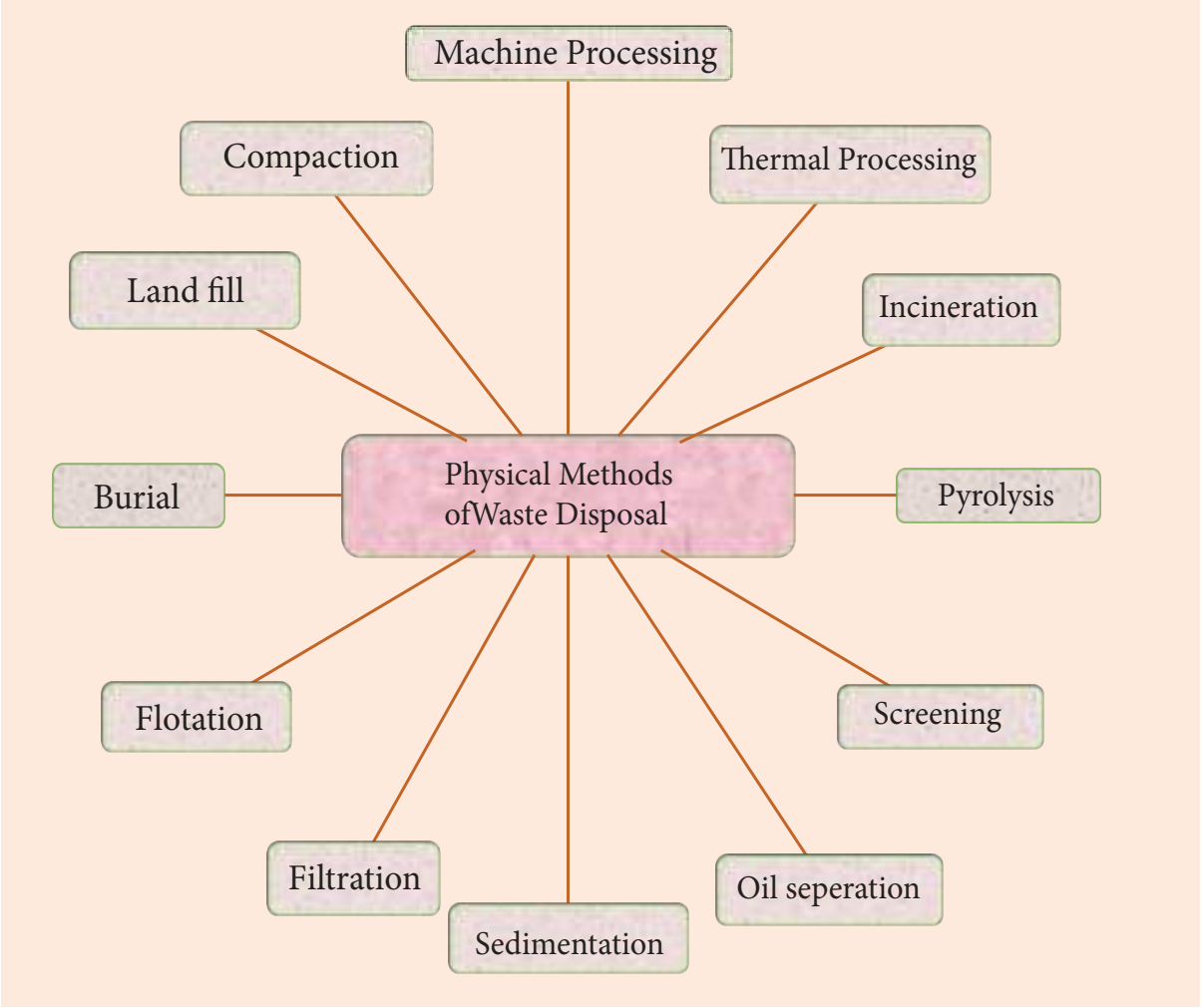
- Making animal feed
- Composting to create nutrient-rich fertilizer
- Anaerobic digestion to produce biogas
- Recycling / reusing waste for utilization by other industries
- Feeding surplus food to needy people.
- Recovery of food wastes
- Recovery of fruit and vegetable wastes
- Recovery of protein
- Fat extraction
- Silage production

- Uses of enzymes
- Treatment of dairy wastes
- Treatment of starch effluent
- Production of earthwarm proteins
- Utilisation of waste in animal feeds

5.3.1. Physical Methods of Waste Disposal

Wastes are generated during the extractions and processing of raw materials into intermediate and final products. These include collection, transport, treatment and disposal of waste together with monitoring and regulations.

Many different physical treatment processes are simple and low cost. Choice depends on physical form of waste and its characteristics. It is all the activities and actions required to manage waste from its inception to the final disposal.



Flowchart 5.7. Physical Methods of Waste Disposal

Figure 5.25. Machine Processing of Waste

1. Machine Processing of Waste

* Crushing: divide, mix and homogenize the waste
* Compaction: reduction of spaces or compression of waste at low cost
* Recovery: separation of materials that could be recycled.

2. Thermal Processing

* It is defined as the combination of temperatures and time required to eliminate waste products. It is an easy mechanism and thermal energy is produced by reducing the volume of waste and convert into heat, steam and electrical energy. In this method, disposal or breakdown of the wastes is carried out by using the heat energy.

3. Incineration

* Incineration is a waste treatment process that involves the combustion of solid waste at 1000°C in furnace.
* The ash is formed by the inorganic constituent of waste and gases due to organic waste.
* The heat generated by incineration is used to generate electric power.
* Incineration converts waste into ash, flue gas and heat.
* The weight of the waste is reduced to 25 percent of the initial value and gases are used to generate power.
* The chemicals released into the air could be strong pollutants and may destroy ozone layer.

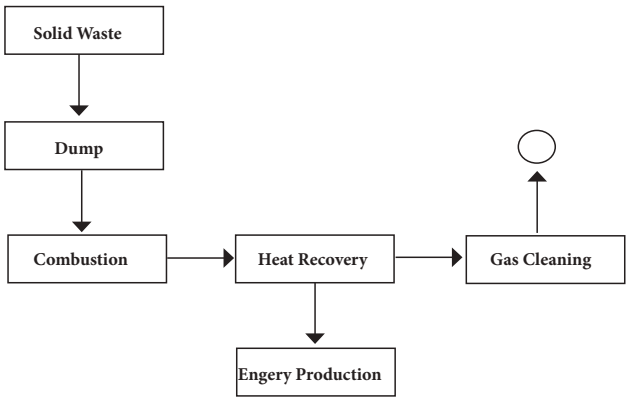


Figure 5.26. Incineration

Notes

4. Pyrolysis

Pyrolysis is the heating of an organic material, such as biomass, in the absence of oxygen. Because no oxygen is present the material does not combust but the chemical compounds (i.e. cellulose, hemicellulose and lignin) that make up that material thermally decompose into combustible gases and charcoal. Most of these combustible gases can be condensed into a combustible liquid, called pyrolysis oil (bio-oil), though there are some permanent gases (CO_2, CO, H_2, light hydrocarbons).

Thus pyrolysis of biomass produces three products: one liquid, bio-oil, one solid, bio-char and one gaseous (syngas).

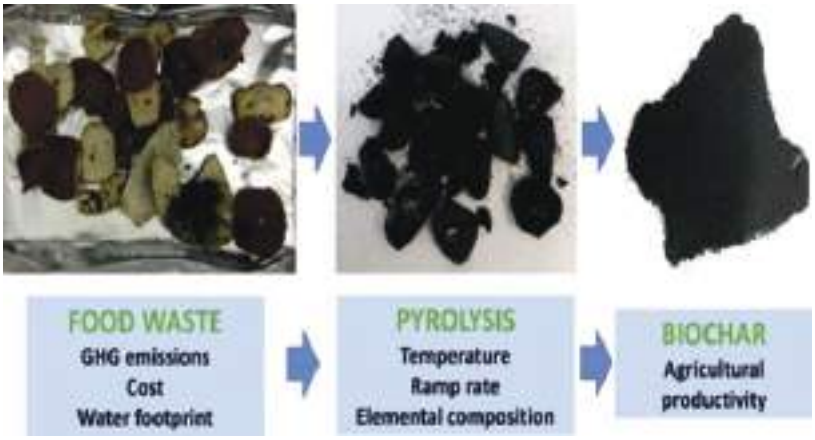


Figure 5.27. Pyrolysis

5. Screening

Figure 5.28. Screening

Notes

* A screen is a device with openings, uniform in size that is used to retain the coarse solids found in waste water.

* According to the size of openings, screens are designated as coarse or fine. Coarse screens have openings of ¼ inch or more and fine screens have less than ¼ inch.

6. Oil Separation

* It is a process in which floatables, namely non-emulsified oil and organics separates from waste water.

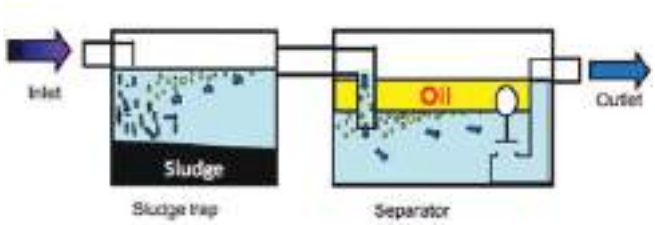


Figure 5.29.Oil Separation

7. Sedimentation

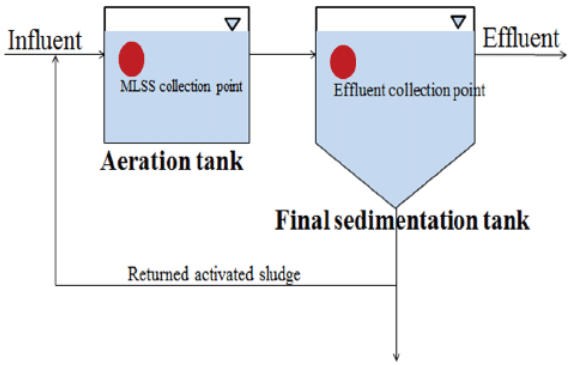


Figure 5.30. Sedimentation

* Sedimentation is the separation of undissolved substances from water, by gravitational settling of suspended particles that are heavier than water.

* Sedimentation is used for separation of biological floc and chemical floc in the sludge.

8. Flotation

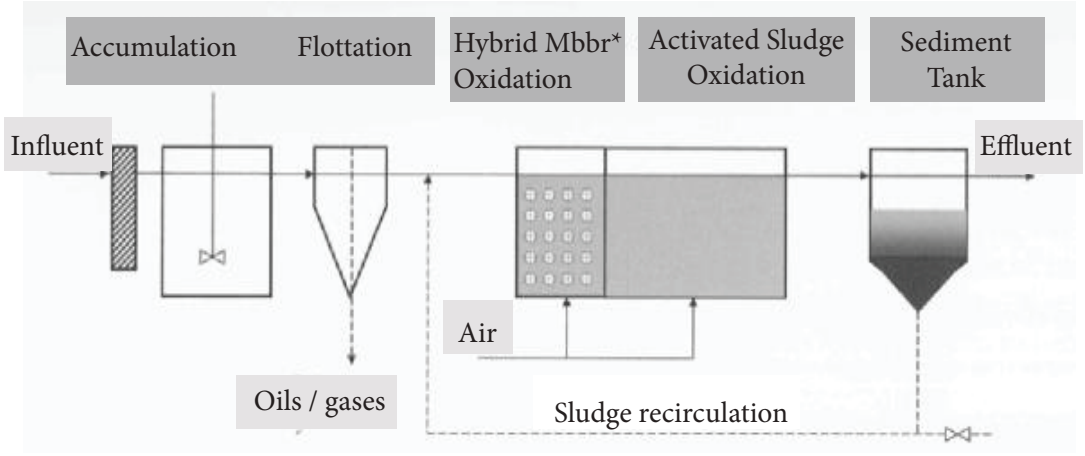
* Flotation is a unit operation used to separate solid or liquid particles from a liquid phase.

* Separation is brought by introducing fine gas (air bubbles) into the liquid phase.

* The bubbles attach to the particulate matter and the buoyant force of the combined particle and gas bubble is great enough

to cause the particle to rise to the surface to form a scum blanket, which is removed from a skimming mechanism.

* Even a very small or light particles that settle slowly can be removed more completely and in a shorter time.



*MBBR-Moving Bed Biofilm Reactor

Figure 5.31. Flotation

9. Land-Fill

* It is the most traditional method of waste disposal. Waste is directly dumped into mining voids or borrows pits.

* Disposed waste is compacted and covered with soil gases generated by the decomposing waste materials are often burnt to generate power.

* Landfill site is a cheap waste disposal and lots of different types of wastes can be disposed.

* Dangerous gases are released from landfill site that cause local air pollution. Local streams could become polluted with toxins seeping through the ground.

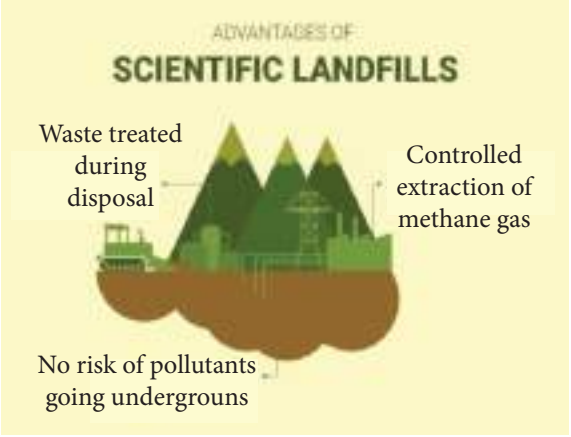


Figure 5.32. Landfill

10. Compaction

* The waste is compacted or compressed by external pressure

* It also breaks up large or fragile items of waste.

Figure 5.33. Compaction

11. Burial

Figure 5.34. Burial

* A trench of 1.5m wide and 2m deep is evacuated used for small amount of waste disposal.

* The refusal is covered with 20-30cm of earth.

* When the level in the trench is 40cm from ground level, the trench is filled with earth and compacted.

* It requires 4-6 months.

12. Dumping

* It is the practice of transfer of waste from one place to another.

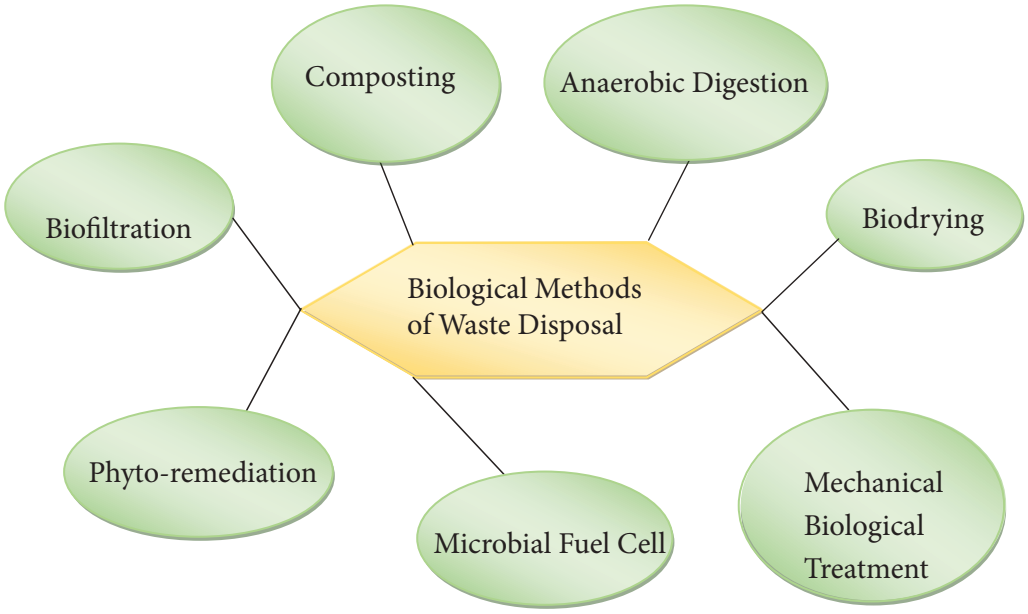
Figure 5.35. Dumping

Activity 7

Dig a manure pit in your school backyard to dump the lab food waste.

5.3.2. Biological Methods of Waste Disposal

Biological waste is a waste that is capable of undergoing anaerobic or aerobic decomposition. Biological treatment is a biological process (Anaerobic digestion and composting) that changes the properties of waste using microorganisms such as bacteria and fungi.



Flowchart 5.8. Biological Methods of Waste Disposal

1. Composting

Composting is transformation of organic material (plant matter) through decomposition into a soil-like material called compost. Invertebrates (insects and earthworms) and microorganisms (bacteria and fungai) help in this transformation.

Figure 5.36.Composting

- Making a heap of wetted organic matter known as green waste (leaves and food waste) and wait for the materials to breakdown into humus after a period of week or month.

- The decomposition process is aided by shedding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture.
- Worms and fungi further break up the material.
- Bacteria requiring oxygen to function (aerobic bacteria) and fungi manage the chemical process by converting the inputs into heat, carbondioxide and ammonium. The ammonium (NH_4) is the form of nitrogen used by plants.
- Compost is rich in nutrients. It is used in gardens, horticulture and agriculture as soil conditioner, fertilizer and a natural pesticide for soil.

2. Anaerobic Digestion

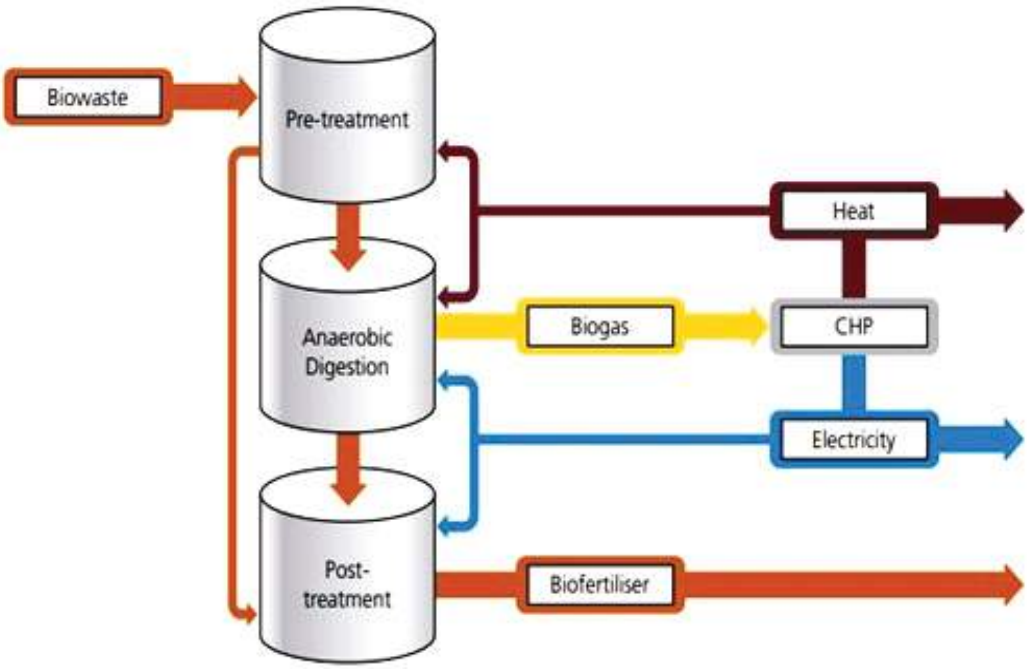


Figure 5.37. Anaerobic Digestion

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen.

- Anaerobic digestion is used to produce fermented food and drinks in industries.
- The digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates are broken down to soluble derivatives that become available for other bacteria.

- Acidogenic bacteria convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia and organic acids. Methogens convert these products to methane and carbon dioxide.
- This process helps in power generation, produce fertilizer, cooking and fuel production in waste disposal management.

3. Bio drying

Bio-drying is the process by which biodegradable waste is rapidly heated through initial stages of composting to remove moisture from a waste stream and reduce its overall weight.

Figure 5.38. Biodrying

- The major portion of biological heat is utilized to evaporate surface and bound water associated with the mixed sludge. This heat generation assists in reducing the moisture content of the biomass without the need for supplementary fossil fuels and with minimal electricity consumption.
- It can take only eight days to dry the waste. This enables reduced costs of disposal.

4. Mechanical Biological Treatment (MBT)

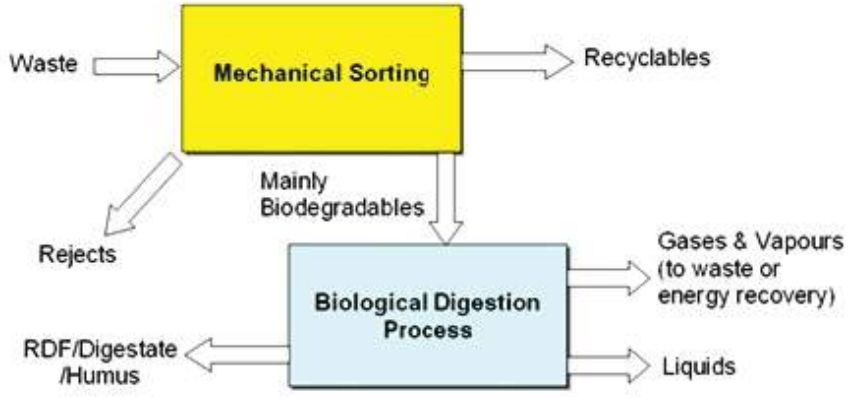


Figure 5.39. Mechanical Biological Treatment

It is a type of waste processing with a form of biological treatment such as composting or anaerobic digestion.

- MBT plants are designed to process mixed household wastes as well as commercial and industrial wastes.
- This system enables the recovery of materials contained within the mixed waste or produces a refuse-derived fuel that can be used for the generation of power.

Notes

- Recovered recyclable materials such as metals, paper, plastics and gases are used
- Biogas (power) and digestate (an organic fertilizer) are produced.

5. Microbial Fuel Cell (MFC)

A microbial fuel cell (MFC) or biological fuel cell is a bioelectrochemical system that derives on electric current by using bacterial interactions found in nature. MFC's are used in waste treatment to harvest energy utilizing anaerobic digestion.

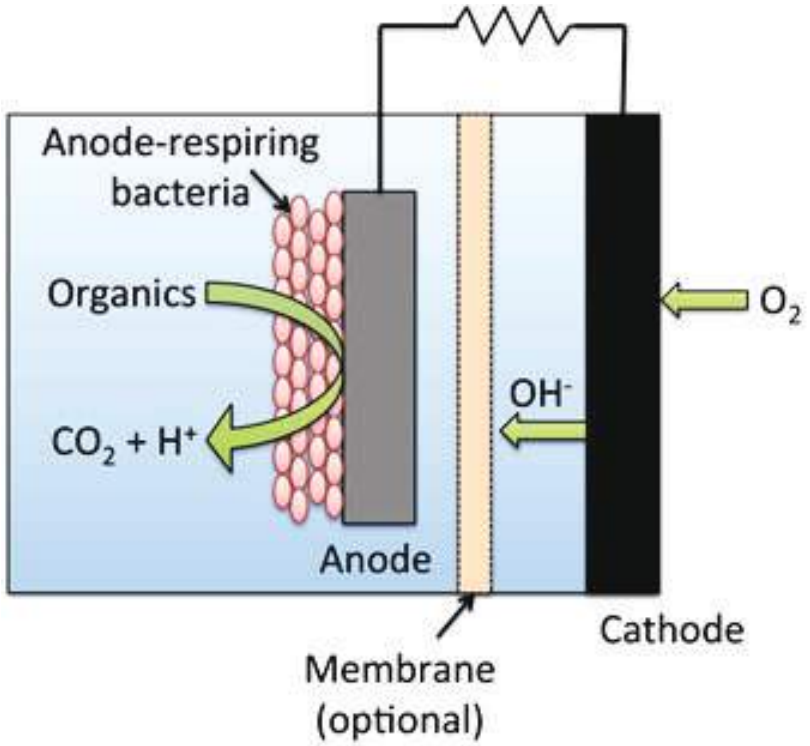


Figure 5.40. Microbial Fuel Cell

6. Phytoremediation

The process of removing contamination from soil or water using potential plants. The plant potential to uptake, accumulate and degradation of contaminants vary from plant to plant. This technology is inexpensive, natural, conserves soil resources and enhances the soil quality and productivity.

Notes

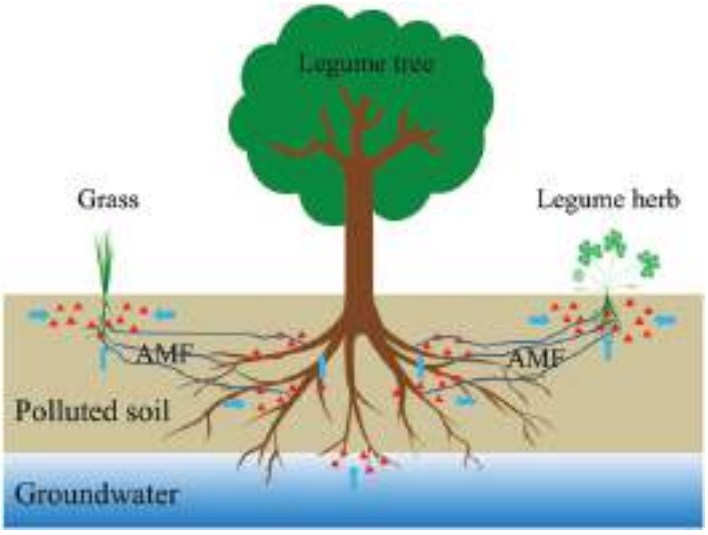


Figure 5.41. Phytoremediation

7. Biofiltration

Biofiltration is a pollution control technique using a bioreactor containing living material to capture and biologically degrade pollutants.

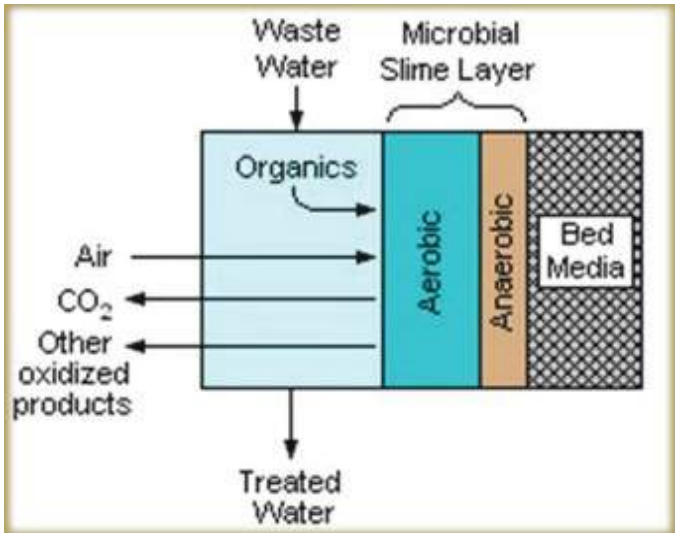


Figure 5.42 Biofiltration

- A biofilter is a bed of media on which microorganisms attach and grow to form a biological layer called biofilm. The biofilm is formed by a community of different microorganisms (bacteria, fungi and yeast), macro-organisms (protozoa, worms and insects larvae) and extracellular polymeric substances.
- Water to be treated can be applied continuously over the media, via up flow or down flow.

Notes

- Organic matter and other water components diffuse into the biofilm mostly by biodegradation. This process is aerobic, which means that microorganisms require oxygen for their metabolism. Oxygen can be supplied to the biofilm with water flow.

8. Aerated lagoon method:

In the aerated lagoon method, waste is agitated with air in large enclosures to increase oxygen-dependent biological oxidation. In treatment using trickling filters, wastes are allowed to trickle through a bed of rocks coated with micro-organisms that alter the waste components by using them as food.

- Waste stabilisation ponds are ponds in which wastes are allowed to decompose over long periods of time, aeration is provided only by wind action. Anaerobic digestion is a method for decomposing organic matter by using anaerobic organisms in closed vessels in the absence of air; methane may be produced in the process.

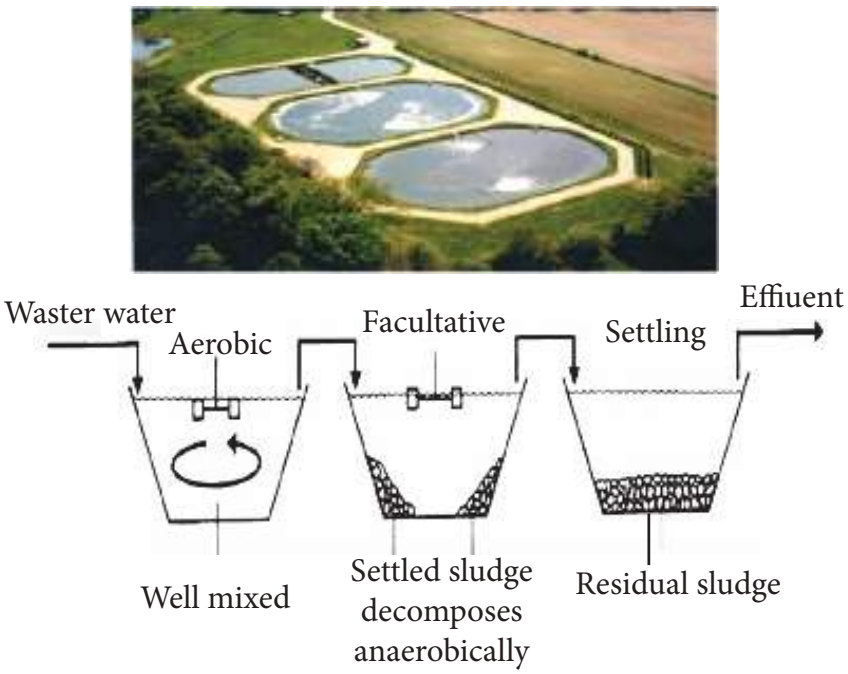


Figure 5.43 Aerated Lagoons.Biofiltration

Considering the challenges, food processing industries must provide a safe work place, optimize processing technologies to minimize the amount of waste, utilize by products, offer hazard reporting facilities and proper first aid training.

Glossary

Aerobic process	:	A process requiring the presence of oxygen.
Anaerobic digestion	:	Organic matter broken down to bacteria in the absence of air, producing a gas and solid.
Biogas	:	Contains methane and carbondioxide, which is produced by fermentation of organic waste, animal or plant origin ferments, human sewage or crop residues in airtight container.
Contaminant	:	Any biological or chemical agents, foreign matter or other substances not intentionally added to food which may compromise food safety and suitability.
Contamination	:	The introduction or occurrence of a contaminant in food or food environment.
Cytotoxic	:	Refers to substance or process which results in cell damage or cell death.
Disinfection	:	By means of chemical agents or physical methods, the number of microorganisms in the environment reduced to a level that does not compromise food safety or suitability.
Epi Pen	:	An epinephrine autoinjector is a medical device for injecting a measured dose of epinephrine. It acts quickly to improve breathing, stimulate the heart, raise a dropping blood pressure and reduce swelling of the face, lips and throat.
Food hygiene	:	All conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.
Food Safety	:	Assurance that food is not cause harm to the consumer when it is prepare and eaten according to its intended use.
HACCP	:	A system which identifies, evaluates and controls hazards which are significant for food safety.
Hazard	:	A biological, chemical or physical agent or condition of, food with the potential to cause an adverse health effect.
Near miss	:	"Near hit" or "Close call" is an incident in which no property was damaged and no personal injury was sustained, but where, given a slight shift in time or position, damage or injury easily could have occurred.
Syngas	:	A mixture of carbon monoxide and hydrogen may be used as a clear alternative to fossil fuels in generating electricity or for the production of liquid fuels such as synthetic diesel, dimethyl ether and ethanol.

Notes

Evaluation

I. Choose the best answer (1 mark)

1. _____is a hazard characterized by the contamination of food by microorganisms found in the air, water and food.

   a) Allergenic b) Biological

   c) Physical d) Chemical

2. _____ is a chemical hazard produced by fungi which grow on crops and foods under certain conditions.

   a) Marine toxins b) Pesticides

   c) Mycotoxins d) Natural toxins

3. _____ is the promotion and maintenance of the highest degree of physical, mental and social well-being of all kind of workers.

   a) Occupational health

   b) Public health

   c) Safety environment

   d) Food hygiene

4. Food Safety and Standards Regulations in India implemented in _____ year.

   a) 2010 b) 2007

   c) 2011 d) 2015

5. PPE stands for

   a) Personal Protective Equipment

   b) Personal Protective Employment

   c) Personal Protective Emergency

   d) Personal Preventive Equipment

6. Epi Pen is used to treat in _____ conditions.

   a) Burns b) Amputations

   c) Allergic reactions d) Cuts and grazes

7. State whether the following statements are true or false.

   a) Exposure to extreme cold can cause hypothermia.

   b) During electric shock fracture may occur.

8. Thermal processing is a _____ method of waste disposal.

   a) Biological b) Physical

   c) Chemical d) Flotation

Notes

9. Match the following:

1.	Pyrolysis	-	i	Separation of undissolved substances
2.	Sedimentation	-	ii	Compressed by external pressure
3.	Flotation	-	iii	Destructive distillation of waste in the absence of oxygen
4.	Compaction	-	iv	Introducing fine gas into the liquid phase

a) 1-(iii), 2-(i), 3-(iv),4-(ii) b) 1-(i), 2-(ii), 3-(iii), 4-(iv)

c) 1-(ii), 2-(iv), 3-(i), 4-(iii) d) 1-(iv), 2-(ii), 3-(i), 4-(iii)

10. _____ is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen.

a) Aerobic digestion b) Anaerobic digestion

c) Bio-drying d) Phytoremediation

II. Very Short Answer (2 Marks)

1. Define a food safety hazard.
2. Write few examples for physical hazards.
3. List the common hazards at food processing unit.
4. Give the reasons for hazards.
5. Write on HACCP.
6. What is the code of practice for the processing unit layout and facilities?
7. List the 5P's in first aid.
8. What is SDS?
9. How do you give first aid for insect bite?
10. What is a compost?

III. Short Answer (3 Marks)

1. Enumerate the objectives of occupational health.
2. List the step by step procedure for response to an injured employee in a processing unit.
3. Write the safety procedure for spillage cleaning.
4. List the steps to be taken to report any accident in a food industry.
5. How do you prepare a hazard analysis report?

6. Give the important first aid training orientation programme for the employees.
7. What are the general steps to administer immediate first aid to an injured employee?
8. Write on incineration.
9. How do you dispose biological waste through anaerobic digestion?
10. How bio-drying is helpful in biological method of waste disposal?

PRACTICAL EXERCISE

5.1. Equipment used in Processing Jams, Jellies and Ketchup

Aim:

To gain knowledge about equipment used in preparation of jam, jelly and ketchup.

Procedure:

Reading of the manuals of all the equipment in the lab.

Fruit washing, inspection and handling systems

- Incorporate gentle handling techniques for all kinds of fruits and vegetables
- Use of Dump and spray washers for effective washing and cleaning.
- Complete with drying systems as required.
- Inspection of preparation tables, gentle handling and packing tables for loading fresh fruits and vegetables

Figure 5.44. Fruit Roller Sorter

1. Fruit Roller Sorter

This roller conveyor is suitable for spherical or oblong fruit and vegetable (such as apple, pear, mango, tomato) sorting. It consists of frames, reducers, rollers, and other components.

Maximum speed: 600 fruits/min, Speed variable.

Function: Sorting by colour, diameter and weight (a combination of these parameters)

V belt pre-aligner Two load cell and weighing bridge

Solenoid tilting system

Laptop, operating software and collection tables. Software to program the machine for weight sorting of the fruits.

2. Fruit Bubble Washer Machine

The fruit bubble washer machine is also a surf washing machine, which is one type of fruit and vegetable washing machine. The machine consists of water tank, blower, up ender, blower, roller, spray water tube, hopper, etc. The production capacity of TICO fruit bubble washer machine is 5-20 tons per hour.

Figure 5.45. Fruit Bubble Washer Machine

Work principle of fruit bubble washer machine

The blower blows the air out and keeps the water spinning, so the water flows quickly, scours the surface of the fruit and washes the dirt. It adopts air stirring and does not destroy the integrity of the fruit. After cleaning the fruits, they are sent to the elevator. In order to avoid secondary pollution and get more sanitary fruits, the dirt and sand of the washing materials are sent to the receptive tank at the bottom of the fruit washing machine.

3. Fruit Pulper

Suitable for extracting the pulp and separating the seeds and skin from fruits like mango, tomato, guava and papaya.

Figure 5.46. Fruit Pulper

Process

The fruits and vegetables are fed in the coarse pulping chamber where due to blades and brushes the fruit is pressed against the sieve. The extracted pulp passes through the perforations in the sieve and stone and skin are pushed forward and discharged from the other end. The pulp is then passed through the fine sieve to refine the pulp and remove the fine skin. The refined pulp can be collected and processed further.

1. Body frame made of SS square pipes
2. The coarse pulping and fine pulping unit are mounted one below the other
3. The coarse pulping unit consists of a coarse sieve and blades and brushes
4. The fine pulping unit consists of fine sieve and brushes
5. Special openable design of sieve is provided for easy cleaning and maintenance of the machine

6. S.S. 304 feed and discharge hopper

7. S.S. 304 collection hopper

8. S.S. 304 covers

9. Appropriate drive system consisting of motor, pulleys, V belts and bearings.

Figure 5.47. Steam jacketed kettle

4. Steam jacketed kettle

A steam-jacketed kettle is similar to a double boiler and cooks large quantities of food by using steam heat. It is designed with both an inner and outer steel wall that cooks the contents inside by releasing steam into the space between the walls.

Process: Thermal Processing, with anchor type mixer, thermometer and pressure gauge.

Power Source	:	Electric
Certification	:	CE, ISO9001
Automatic Grade	:	Automatic
Application	:	Ketchup, Jam and Jelly
Customized	:	Customized
Capacity	:	200-600 litres

Figure 5.48. Bottle Filling Machine

5. Bottle Filling machine

An automatic filler machine is made of corrosion-resistant stainless steel. The perfect can and bottle filling machines for the beverage industry.

- Model: LPE-LFM006
- This liquid filling machine features 6 volumetric nozzles for efficient & precise packing.
- Suitable for filling beverage and other free-flowing non-carbonated liquid into the tin, aluminium and PET round cans.
- Adopting automation technology, importing PLC, sensor, pneumatic components, and machine is efficient, intelligent, wide adaptability and good stability.

Figure 5.49. Bottle Sealing Machine

6. Bottle Sealing Machine

The main parts of an induction sealing machine include:

i. Digital touch screen

The touch screen has a human machine interface that allows you to monitor all the sealing operations

ii. PLC control system

This is the interface that is used in programming and setting the machine to specific sealing requirements.

iii. Induction Head and Sealing System

This is the main part of the machine that does the actual placement and sealing of the bottles.

iv. Electric Power Supply System

This is the main source of electric power that initiates performance of the other parts of the induction sealing machine. For instance, it provides enough power that can heat the coil for sealing purposes.

v. Power Inverters

Power inverters regulate and transform power to the suitable power range for use by the sealing machine.

vi. Inductor sealing Coil

This is the main heating mechanism of the machine that provides the induction head with enough heat.

vii. Cooling System

The cooling system consists of cooling fans that takes away excess heat from the machine and the seals.

Note: Students can be instructed to collect information on the different types of machines used for preparing jam, jelly and ketchup by a market survey or visiting to a food processing industry.

Table 5.7. Details of Machines

S.No.	Name of the machine	Usage	Brand	Price	Availability / durability

Result and Discussion:

Notes

5.2. Demonstration of the correct and safe use of Equipment

Aim:

To obtain the skill of using the equipment correctly

Apparatus: Fruit sorter, Fruit Bubble Washer Machine, Pulper, Bottle sealer.

Procedure:

- Demonstration of instruction manual to understand the working of the above equipment.
- Demonstration of the safety measures to be followed while operating the equipment
- Provide an opportunity to operate the machines under the guidance of the instructor.

Result and discussion:

5.3. Safe storage of Equipment

Aim: To obtain the skill of keeping the equipment safe and in working condition.

Procedure:

1. Buy from trusted suppliers
2. Know the error codes
3. Follow the instructions on the manual correctly.
4. Listen to unusual sounds
5. Work with professionals
6. Call the manufacturer if there is a problem
7. Install the equipment with professionals
8. Never use substandard parts.
9. Keep the equipment in working condition by using it when needed only. Do not over use it.
10. Use all safety measures in the factory.

Result and Discussion:

Notes

5.4. Reporting an accident

Aim: To gain knowledge and skill of reporting an accident in a food processing unit.

Procedure:

The Need for Reporting and Compiling Accident Data

The primary purpose of assembling and analysing occupational accident data is to provide knowledge for use in the prevention of occupational injuries, fatalities and other forms of harm such as toxic exposures with long-term effects. These data are also useful in assessing needs for compensating victims for injuries previously incurred. Additional, more specific purposes for the compilation of accident statistics include the following:

- to estimate the causes and magnitude of accident problems
- to identify and prioritize the need for preventive measures
- to evaluate the effectiveness of preventive measures
- to monitor risks, issue warnings and conduct awareness campaigns
- to provide feedback for those involved in prevention.

The need for accident information pertains to the following three levels of function that make use of it:

- At the workplace level within the individual unit, accident data are used in local safety activities.
- At the level of authority responsible for legislation, accident data are used to regulate the working environment and to promote safety at the workplace.
- At the level of authority responsible for payments of compensation to accident victims, accident data are used to help determine rates.

Reporting Accident Information to Safety Authorities

Legislation requiring the reporting of occupational accidents varies widely from country to country. Common to most legislation is the fact that reporting is linked with some sort of penalty or compensation for the consequences of accidents.

Notes

What Information is to be compiled?

There are three basic classes of information obtainable by means of accident recording:

- Identifying where the accidents occur - that is, sectors, trades, work processes and so on.
- Showing how the accidents occur, the situations in which they occur and the ways in which the injuries come about. and
- Describing the nature and seriousness of the injuries - for example, the parts of the body affected and the health consequences of the injuries. Such knowledge is to be used for prioritizing preventive action in order to ensure that action is taken where the risk is highest.

It is necessary to compile a certain basic complement of data to properly document when, where and analyse how an accident occurs.

Information to be recorded in Table to describe the individual Accident

Actions	Items
Step 1:	
Activity of the victim: e,g., Operating a machine, performing maintenance, driving, walking etc.,	Component related to the activity of the victim: e.g., Power press, tool, vehicle, floor, etc.
Step 2:	
Deviant action: e.g., explosion, structural failure, trip, lost control of, etc.	Component related to deviant action: e.g., pressure vessel, wall, cable, vehicle, machine, tool, etc.
Step 3:	
Action leading to injury: e.g., struck by, crushed, trapped, in contact with, bitten by, etc.	Agent of injury: e.g., brick, ground, machine, etc.

Accident identification number.

All occupational accidents must be assigned a unique identifying number. It is especially advantageous to use a numerical identifier for the purpose of computerized filing and subsequent processing.

Notes

Personal identification number and date.

Registration of the victim is an essential part of accident identification. The number can be the worker's date of birth, employment number, social security number or some other unique identifier. Recording both a personal identification number and the date of the accident will prevent duplicated registration of the same accident event.

Nationality.

The nationality of the victim may be an especially important item of information in countries with a significantly large foreign labour force. A double-digit code number can be selected from among those listed in the DS/ISO Standard 3166.

Occupation.

An occupation registration number can be chosen from the list of four-digit international occupation codes supplied by the International Standard Classification of Occupations (ISCO).

Enterprise.

The name, address and identification number of the enterprise are used in the recording of accidents with the registration of its workforce.

The work processes.

A vital component of information relating to occupational accidents is a description of the work process carried out at the time the accident occurred.

The accident event.

An accident event normally comprises a chain of events. A description of that part helps to know what the victim was doing when the event occurred.

The consequences of the accident.

After the injured part of the body is specified and the type of injury described (this is done partly by coding from a checklist and partly from the description in the event cycle), information is recorded describing the seriousness of the injury, whether it resulted in absence from work (and for how long), or whether it was fatal or involved invalidity.

For recording purposes, the examination of accident events is therefore divided into the following three information components:

- **The activity** associated with an accident is that which was being carried out by the victim at the time of the accident. It is recorded by means of an action code and a technology code.
- **The injury event** is the deviant event which led to the accident. This is recorded by means of a code for the deviation and by one or two codes for the technology which formed part of the deviation.
- **The mode of injury** is recorded by using a code for the manner in which the victim came into contact with the injury-causing factor and another code for the technology which caused the injury.

Filling an accident report form

Procedure: Fill the form given below to report an accident.

Serial No

State date of resumption of work	Year	Month	Day
Name of injured person : Date of birth			
Address of injured person : Postal Code			
Please send to the address overleaf			

OCCUPATIONAL ACCIDENT REPORT

Serial No.
Injured Person

Name:	Date of Birth		•
Address	Post Code	Nationality	•
Occupation	Time of Year Month Day Hour		•Self employed •Trainee •Family Member

Employer Information

Name of business	Company Registration No.		
Address	Postal Code	Number of Staff	
Economic Activity	Length of service:	Year:	Months:

If the accident did not occur at the enterprise address state where	Address	Postal code

Type of work and work environment

What type of work was the injured person doing at the time of the accident? (e.g. iron founding, harvesting, slaughtering)
Where was the injured person at the time of the accident? (inside buildings, underground, etc.)

Circumstances of the accident

Describe what the injured person was doing at the time of the accident and what item (tool, machine, etc.) was associated with the acitivity
Describe the action of deviation from normal including the item (tool, machine, etc.) associated with the deviation
Describe the action leading to injury including the agent (tool, machine, etc.) that caused the injury

Circumstances of the accident

Type of injury • Cotrusion, bruise • Concussion and internal injuries • Open wound • Amputation • Open fracture • Closed fracture • Luxation, dislocation • Distortion, sprain, torn ligaments	• Asphyxiation, gassing, drawning • Poisoning • Heat injury or frostbite • Chemical burns • Effect of radiation • Electric shock • Injury not ascertained • Other	Injured part of the body • Head except eyes • Eyes • Neck • Back, spine • Chest • Abdomen • Shoulder, upper arm, elbow • Lower arm, wrist	• Hand • Fingers one or more • Hip joint, thigh, knee cap • knee joint, lower leg, • Foot • Toes, one or more • Large parts of the body • Other injury
Describe fully the nature of the injury and the injured part of the body			

Consequences of the accident

** No absence / absence less than 1 day * Absence 1-3 days * Absence 4-14 days * Absence expected to exceed 14 days * Permanent Disability * Death*

Date

Signature of person reporting the claim

Result and Discussion:

Notes

5.5 First Aid

Aim:

To gain knowledge about first aid in different accidents in food processing unit.

Apparatus:

First aid kit

Procedure:

First aid is the first and immediate assistance given to any person suffering from either a minor or serious illness or injury, with care provided to preserve life, prevent the condition from worsening, or to promote recovery. It includes initial intervention in a serious condition prior to professional medical help.

The following first aid practices should be demonstrated by the teacher.

First aid in cuts and scrapes

- Washing a cut or scrape with soap, and water and keeping it clean and dry is required to care for most wounds.
- Cleaning the wound with hydrogen peroxide and iodine is acceptable initially, but can delay healing and should be avoided long-term.
- Apply antibiotic ointment and keep the wound covered.
- Seek medical care within 6 hours if the bleeding does not stop, as the wound might need stitches.
- Avoid delay since a delay can increase the rate of wound infection.
- Requires medical care if any redness, swelling, increased pain, fever, red streaking, or pus draining from the wound may indicate an infection

First aid in punctured wounds

- Puncture wounds do not usually bleed much, but treatment is necessary to prevent infection. A puncture wound can cause infection because it forces bacteria and debris deep into the tissue and the wound closes quickly forming an ideal place for bacteria to grow.

Notes

- First aid for puncture wounds includes cleaning the area thoroughly with soap and water. These wounds are very difficult to clean out. If the area is swollen, ice can be applied and the area punctured should be elevated.
- Apply antibiotic ointments (Bacitracin, Polysporin, Neosporin) to prevent infection.
- Cover the wound with a bandage to keep out harmful bacteria and dirt.
- Cleanse the puncture wound and change the bandage three times a day, and monitor for signs of infection. Change the bandage any time it becomes wet or dirty.

Doctors attention required for the following if

- People with suppressed immune systems or any particularly deep puncture wounds should be seen by a doctor. If it is difficult to remove the puncturing object, it may have penetrated the bone and requires medical care.
- Most puncture wounds do not become infected, but if redness, swelling or bleeding persists, see a doctor.
- Puncture wounds to the feet are a particular concern. Wear shoes to minimize the risk of a puncture wound from a nail or glass, especially if the affected person has diabetes or loss of sensation in the feet for any reason.
- Additional common causes of puncture wounds can include animal or human bites, or splinters from wood or other plant material, which carry a high risk of infection and should be treated by a physician.

First aid for burns

- Stop the burning process as soon as possible. This may mean removing the person from the area, dousing flames with water or smothering flames with a blanket. Do not put yourself at risk of getting burnt as well.
- Remove any clothing or jewellery near the burnt area of skin. But do not try to remove anything that's stuck to the burnt skin, as this could cause more damage.
- Cool the burn with cool or lukewarm running water for 20 minutes as soon as possible after the injury. Never use ice, iced water, or any creams or greasy substances like butter.

Notes

- Keep the person warm. Use a blanket or layers of clothing, but avoid putting them on the injured area. Keeping warm will prevent hypothermia, where a person's body temperature drops below 35°C (95°F).
- Cover the burn with cling film. Put the cling film in a layer over the burn, rather than wrapping it around a limb. A clean clear plastic bag can be used for burns on your hand.
- Treat the pain from a burn with paracetamol . Always check the manufacturer's instructions when using over-the-counter medication.
- Sit upright as much as possible if the face or eyes are burnt. Avoid lying down for as long as possible, as this will help reduce swelling.

Electrical burns

Electrical burns may not look serious, but they can be very damaging and the victim should seek immediate medical attention at an Accident and Emergency department.

If the person has been injured by a low-voltage source (up to 220 to 240 volts) such as a domestic electricity supply, safely switch off the power supply or remove the person from the electrical source using a material such as a wooden stick or a wooden chair that doesn't conduct electricity.

Do not approach a person who is connected to a high-voltage source (1,000 volts or more).

Acid and chemical burns

Acid and chemical burns can be very damaging and require immediate medical attention at an Accident and Emergency department.

The first aider should put on appropriate protective clothing and then:

- find out what chemical caused the burn
- remove any contaminated clothing on the person
- if the chemical is dry, brush it off their skin
- use running water to remove any traces of the chemical from the burnt area

Notes

Sunburn

In cases of sunburn, adhere the following:

- If there are any signs of sunburn, such as hot, red and painful skin, move into the shade or preferably inside.
- Take a cool bath or shower to cool down the burnt area of skin.
- Apply after sun lotion to the affected area to moisturise, cool and soothe it. Do not use greasy or oily products.
- If there is any pain, paracetamol should help relieve it. Always read the manufacturer's instructions.
- Stay hydrated by drinking plenty of water.
- Watch out for signs of heat exhaustion or heatstroke, where the temperature inside your body rises to 37 to 40°C (98.6 to 104°F) or above. Symptoms include dizziness, a rapid pulse or vomiting.

If a person with heat exhaustion is taken to a cool place quickly, given water to drink and has their clothing loosened, they should start to feel better within half an hour.

First Aid for Snakebites

- Call medical help immediately if possible.
- Remain calm; remember most snake bites are not fatal.
- Minimise movement if possible. If you are hiking alone you may have to hike out for help.
- If you are bitten on the arm or finger remove any rings, bracelets or watches. Loosen any tight clothing in case swelling occurs.
- Apply a pressure bandage to the bitten limb. If the bite is to the trunk, head or neck, apply firm pressure to the bitten area. Do not restrict chest movement as breathing will be affected by this.
- Splint or use a sling on the bitten limb to restrict movement.
- If there is no bandage or equivalent to apply a pressure bandage make note of any inflammation by tracing the edge of the swelling with a pen or the like near/around the bite and mark the time clearly next to it.

Notes

- If possible, lie down and keep the bitten extremity at body level. Raising it can cause venom to travel through the body quicker. Holding it down, can increase swelling.
- Arrange for transport to the nearest hospital emergency room, where anti-venom for snakes common to the area will often be available and given if required.

Some definite No No's for Snake Bite First Aid

- NO aspirin or other pain relievers.
- NO tourniquets. This cuts blood flow completely and may result in loss of the affected limb.
- DO NOT try to suck the venom out of the wound or cut into the bite with a knife. Such measures have not been proven useful and may cause further injury.
- DO NOT apply a cold compress or ice on the bite. Research has shown this to be potentially harmful.
- DO NOT use electric shock or a stun gun on the bite area. This method is under study and has yet to be proven effective. It could harm the victim.
- DO NOT wash the snake bite area.
- DO NOT try and capture the snake. If it's safe you can try to take a photo with a camera or with your phone. This is the best way in aiding snake identification.

First aid for Bee stings

To take care of an insect bite or sting that causes a mild reaction:

- Move to a safe area to avoid more bites or stings.
- If needed, remove the stinger.
- Wash the area with soap and water.
- Apply a cool compress. Use a cloth dampened with cold water or filled with ice. This helps reduce pain and swelling. If the injury is on an arm or leg, elevate it.
- Apply 0.5 or 1 percent hydrocortisone cream, calamine lotion or a baking soda paste to the bite or sting several times daily until the symptoms go away.

- Take an antihistamine to reduce itching.

Result and Discussion:

5.6 First aid in an obstructive airway

Aim:

To obtain the skill of saving victims with obstructive airway.

Procedure:

When the victim is conscious

- Encourage the victim to cough - some victims are in so much panic they require encouragement to cough.
- Deliver up to 5 hard blows with the heel of your hand to the centre of the victims back between the shoulder blades.
- If the object has still not been removed, and the victim is still choking, you should perform up to five abdominal thrusts.
- The rescuer stands behind and to the side of the victim and wraps their arms around the victim's sides, underneath the victim's arms.
- One hand is made into a fist and placed, thumb side in, flat against the victim's upper abdomen, below the ribs but above the navel.
- The other hand grabs the fist and directs it in a series of upward thrusts until the object obstructing the airway is expelled.
- The thrusts should not compress or restrict the ribcage in any way.
- If you're not able to compress the victim's diaphragm due to their size, then perform the thrusts at the chest.
- Continue a cycle of back blows and abdominal thrusts until the blockage is removed, or the victim becomes unconscious.

Abdominal thrusts are performed only on conscious adult with a severe airway obstruction

Note:

Even when first aid procedures performed correctly, abdominal thrusts can injure the person they are performed on, and so should always be used as a last resort after encouragement

to cough and back blows. Abdominal thrusts should never be performed on someone who can still cough, breathe, or speak or encourage them to cough instead.

If the victim is unconscious

1. Call for an ambulance.
    - o Quickly check the mouth - Use your fingers to remove any visible solid obstruction.
    - o Begin CPR - Begin CPR and continue until the ambulance arrives.

There may be some resistance to inflations at first until the object has been dislodged.

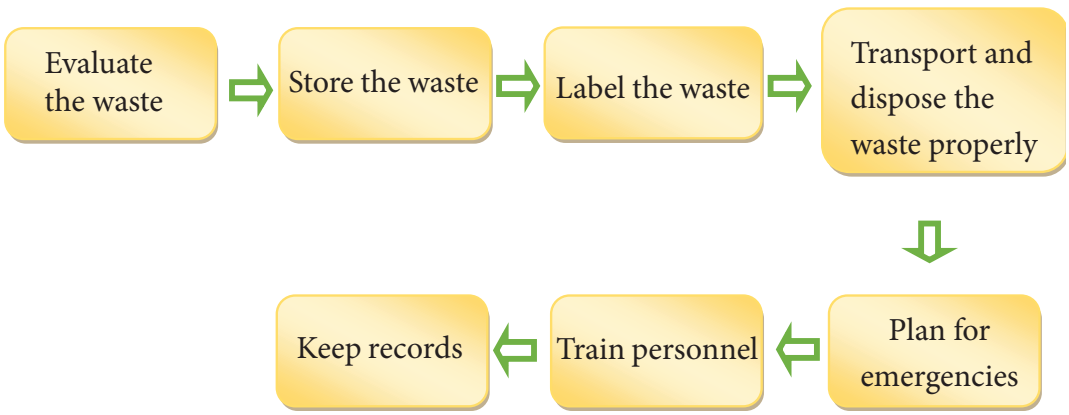
Result and Discussion:

5.7 Waste Disposal

Aim:

To know about proper waste disposal in processing unit

Procedure:



Flowchart 5.9. Waste Disposal Process

Waste management is the process of treating wastes, and it offers a variety of solutions for recycling items that do not belong in the trash. Waste management disposes of the products and substances that have been used in a safe and efficient manner. Common steps in the waste disposal process are as follows:

1. Evaluate the waste

To be able to handle the waste properly, the company first needs to determine whether the waste is hazardous or not,

and whether handling of that particular waste is regulated by legislation. This step is often called classification or categorization of the waste.

Bio- degradable

waste from fruits

Non Bio- degradable

Plastic sheets

2. Store the waste

Depending on the type of waste, there will be different requirements in terms of storage facilities. Waste can be in solid or liquid form, so it is important to store it according to its characteristics. Hazardous waste must be stored in a sturdy, leak-proof container that is kept closed when not adding or removing waste. Different kinds of waste may require different types of storage containers. The container must be labelled with the words "Hazardous Waste", a clear description of the contents, and the date when the waste is first placed in the container.

3. Label the waste

Non-hazardous waste does not have to be labelled in any special way. On the other hand, hazardous waste labelling is often prescribed by law and in most countries the company must obtain a license for even generating some kinds of hazardous waste. The label for marking packed hazardous waste usually contains the following information:

- Warning: HAZARDOUS WASTE
- Information about the waste owner who packed the waste: name, address, telephone, date of packaging, name and surname of the person qualified to be responsible for that job
- Physical characteristics of the waste: powder, solid, viscous substances, pastes, sludge, liquid substance, gaseous substances

4. Transport and dispose the waste properly

If the waste has to be recycled in another company, send it in proper containers If the waste has to be treated and sent out, then

Notes

it should be treated properly in a treatment plant. The company is responsible for its hazardous waste forever. To help ensure that hazardous waste is transported and disposed of properly, and to reduce liability, choose a transporter that fulfils the following requirements:

- Has a hazardous waste identification number
- Is currently licensed or permitted as a hazardous waste transporter
- Has fulfilled specific training requirements
- Maintains adequate liability insurance
- Carries credentials in the vehicle
- Transports the waste to a permitted hazardous waste facility

5. Plan for emergencies

Handling hazardous waste leaves room for emergency situations caused by mistreatment of the waste or any other cause. Plan for emergencies in the following ways:

- Maintain spill and appropriate emergency response equipment in an accessible area.
- Train employees in the emergency response procedures that are appropriate for your site.

6. Train personnel

Training all employees who have any role in handling, storing, or otherwise managing waste is a necessary step for ensuring compliance with hazardous waste rules. Personnel must be familiar with each waste's hazards, appropriate safety procedures, and all aspects of compliance.

The training should include an introduction to:

- basic procedures for waste management;
- human and environmental risks;
- measures of precaution in waste management; and

responsibilities and authorities.

Notes

7. Keep records

The purpose of keeping records is to provide evidence that the waste is stored according to the procedures. The usual records to be kept are the generated waste by type and amount, and records of waste deployed to an authorized organization.

Note:

When jam, jelly and ketchup preparation students can find edible portions and wastes (peel, skin, seeds etc.) of fruits. It can be weighed and recorded. They can find the right method of disposing the waste by digging a manure or compost pit.

Table 5.8. Amount of Waste

S.No.	Fruits	Edible portion (in kg)	Waste in (Kg)		
			Skin / Peel	Seed	Total
1.	Apple				
2.	Mango				
3.	Grapes				
4.	Pineapple				
5.	Tomato				
6.	Guava				
7.	Strawberry				

Result and Discussion:

Project

1. Prepare a first aid kit. Check to see if the following are there in the box.

1. Adhesive tape
2. Anaesthetic spray (Bactine) or lotion (Calamine, Campho-Phenique) - for itching rashes and insect bites
3. 4" x 4" sterile gauze pads - for covering and cleaning wounds, as a soft eye patch
4. 2", 3", and 4" Ace bandages - for wrapping sprained or strained joints, for wrapping gauze on to wounds, for wrapping on splints

Notes

5. Adhesive bandages (all sizes)
6. Diphenhydramine (Benadryl) - oral antihistamine for allergic reactions, itching rashes. Avoid topical antihistamine creams because they may worsen the rash in some people.
7. Exam gloves - for infection protection, and can be made into ice packs if filled with water and frozen
8. Polysporin antibiotic cream - to apply to simple wounds
9. Non adhesive pads - for covering wounds and burns
10. Pocket mask for CPR
11. Re sealable oven bag - as a container for contaminated articles, can become an ice pack
12. Safety pins (large and small) - for splinter removal and for securing triangular bandage sling
13. Scissors
14. Triangular bandage - as a sling, towel, tourniquet
15. Tweezers - for splinter or stinger or tick removal
16. Paracetamol tablets
17. Anti-inflammatory painkillers such as ibuprofen, naproxen or other NSAIDs can be used as part of treating sprains and strains
18. Burn gel - a water-based gel that acts as a cooling agent and often includes a mild anaesthetic such as lidocaine and sometimes, an antiseptic such as tea tree oil
19. Anti-diarrhoea medication such as loperamide
20. Oral rehydration salts
21. Antihistamine, such as diphenhydramine
22. Smelling salts (Ammonium Carbonate)
23. In case of a medical or trauma related emergency, a list of family member's medical history, medications, doctors, insurance company, and contact persons should be readily available.

2. Prepare a compost pit.

3. Visit a food processing industry and observe waste disposal method.

4. Conduct a certificate course from St. John's Ambulance for first aid.

Notes

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Notes

Model Question Paper

Marks:60 **Time:**

I. Choose the best answer (10X1=10)

1. …… are generally low in both acid and pectin.

   a) Strawberries b) Peaches

   c) Apples d) Apricots

2. The objective of …….. is to remove unwanted or inedible material from vegetable raw materials.

   a) Washing b) Sorting

   c) Blanching d) Peeling

3. ……were first used during World War II as an efficient way to move goods.

   a) Pellet bins b) Cardboards

   c) Pallets d) Paperboards

4. Glass jars with non hermetic closures made of metal, glass or rigid plastic caps are used for……..

   a) Jellies and jams b) tomatoes

   c) meats d) fish

5. A delivery note can also be known as a ……..

   a) Invoice b) Stock record

   c) Dispatch note d) Purchase order

6. Find out the first stage of production scheduling

   a) Routing b) Scheduling

   c) Execution d) Production Planning

7. _____ are an integral part of quality control.

   a. GMPs b.GLP c. CCP d. FIFO

8. Standards for achievement in all areas are provided by the nodal institution for standards in India, called the1. _____

   a.Bureau of Indian Standards

   b. Indian standards Institution

   c. International standards organization

   d. Export inspection council

Notes

9. Food Safety and Standards Regulations in India implemented in _____ year.

   a) 2010 b) 2007 c) 2011 d) 2015

10. Thermal processing is a _____ method of waste disposal.

   a) Biological b) Physical

   c) Chemical d) Flotation

II. Answer any 10 in two lines (10X2=20)

1. What are types of marmalades?
2. Mention the methods of determining pectin content.
3. What are the profitable waste management methods?
4. Give the AIDA formula for packaging
5. Why Tin can / tinplate is suitable for sterile products. give reasons.
6. List some generally used packaging materials.
7. Draw the production module flowchart
8. Enlist the advantages of inventory control
9. How does supply chain module helps to maintain finished goods records for future reference?
10. Write a short note on examples for food quality attribute.
11. What is international trade?
12. Expand – FSSAI, PFO, FDA, BIS, CAC
13. Write few examples for physical hazards.
14. Write on HACCP
15. List the 5P's in first aid.

III. Answer any 10 in three lines (10x3=30)

1. Explain the different pulping equipment.
2. What are the problems in jam preparation?
3. Differentiate Jam and Jelly
4. Write the Qualities of Good Packaging?
5. Write a note on deaeration in Food Preservation.
6. The can has distinct advantages over glass. Give reasons

Notes

7. Describe 3 Ps' of procurement process.
8. Give an account on Stores or Material Requisition Note.
9. What is GMPs? Write about the purpose of GMPs.
10. Write the importance of food quality.
11. Enlist the principles of HACCP
12. Arrange the types of food additives.
13. List the steps to be taken to report any accident in a food industry.
14. Write on incineration
15. How do you prepare a hazard analysis report?

AVENUES AVAILABLE FOR VOCATIONAL ASPIRANTS...

Institutional Support for MSMEs

Ministry of Micro, Small and Medium Enterprises- A branch of the Government of India and the apex executive body for the formation and administration of rules, regulations and laws relating to micro, small and medium enterprises in India.

Micro enterprise:

A business operation on a very small scale, especially one in the developing world that is supported by microcredit. (Ex. i. Trading, merchandising and retail, ii.Food business, iii. Agriculture and aquatics, Rice farming, iv. Graphic and Design, v. Arts and Craft, Furniture making, vi, Licensed Professional services, etc).

Small enterprise:

A small enterprise is an enterprise where the investment in plant and machinery is more than Rs. 25 lakh but does not exceed Rs. 5 crore.

Medium enterprise:

A Medium enterprise is an enterprise where the investment in plant and machinery is more than Rs. 5.

1. Commissionerate of Industries & Commerce

Formulate policies for MSME sector in Tamil Nadu

2. MSME Trade & Investment Promotion Bureau

To promote export and Investment in MSME sector

3. District Industries Centre

Implement the state policies at district level

4. Indcoserve and Sagoserve

Industrial Cooperative Societies to improve the socioeconomic conditions by providing gainful employment to the economically weaker sections and in ensuring remunerative prices to the growers like small tea growers and tapioca cultivators

5. Entrepreneurship Development & Innovation Institute

Training and Support for startup ecosystem

6. TN Small Industries Development Corporation

Provide Infrastructure for MSMEs - developed plots/shed

7. Tamil Nadu Industrial Investment and Corporation(TIIC) and Tamil Nadu Industrial Co-operative Bank (TAICO)

Provides -Strong financial support to MSMEs for securing loans and working capital needs

8. Tamil Nadu Small Industries Corporation Limited

Manages small scale units set up by the Government. They manufacture wooden, steel and engineering products

Schemes for MSMEs

1. MSME Subsidy Schemes

The micro, small and medium enterprises (MSMEs) have been accepted as the engine of economic growth and for promoting equitable development. The labour intensity of this sector is much higher than that of the large enterprises. The MSMEs play a pivotal role in the overall industrial economy of the country. With

its agility and dynamism, the sector has shown admirable innovativeness and adaptability.

Taking cognizance of the contribution made by the micro, small and medium enterprises to the economy of the state, the Government of Tamil Nadu has introduced various incentives and concessions to catalyse the growth of this sector.

The following incentives and concessions are being extended to the MSMEs in the state:

A. Capital Subsidy

25% capital subsidy on the value of eligible plant and machinery, subject to a maximum of Rs. 50.00 lakhs.

Eligibility:

- All new micro manufacturing enterprises established anywhere in the state.
- All new small and medium enterprises under the following 15 thrust sectors established anywhere in the state excluding additional capital subsidy and employment generation subsidy:

Electrical and electronic industry	Pollution control equipments
Leather and leather goods	Sports goods and accessories
Auto Parts and Components	Cost effective building materials
Drugs and pharmaceuticals	Readymade garments
Solar energy equipment	Food processing
Gold and diamond jewellery for exports	Plastic (Except "One time use and throw away plastics")
Alternate products to one time use and throw away plastics	Rubber, Electric Vehicle Components, Charging infrastructure and its Components

- All new small and medium manufacturing enterprises established in the 251 industrially backward blocks.
- All new agro based small and medium manufacturing enterprises established in the 385 blocks of the state.
- Existing manufacturing enterprises of the above categories which have taken up substantial expansion/diversification of the existing activities.

Additional Capital Subsidy:

- Additional capital subsidy for enterprises set up by women/scheduled caste/scheduled tribe/differently abled and transgender entrepreneurs at the rate of 5% on the value of eligible plant and machinery, subject to a maximum of Rs. 2 lakhs.
- Additional capital subsidy for promotion of cleaner and environment friendly technologies at the rate of 25% on the value of eligible plant and machinery / equipment meant for environment improvement or sustenance subject to a maximum of Rs. 3lakhs.
- Employment Intensive Subsidy at the rate of 5% on the value of eligible plant and machinery, subject to a maximum of Rs. 5 lakhs.

B. Low Tension Power Tariff Subsidy

Eligible MSME units are provided 20% low tension power tariff subsidy for 36 months from the date of commencement of production or from the date of power connection obtained, whichever is later.

Eligibility:

- All new micro manufacturing enterprises established anywhere in the state.
- All new agro based micro, small and medium manufacturing uring enterprises established in the 385 blocks of the state.

- All new small and medium manufacturing enterprises established in the 251 industrially backward blocks.
- Existing manufacturing enterprises of the above categories which have taken up substantial expansion/diversification of the existing activities.

C. Generator Subsidy

Micro, small and medium manufacturing enterprises established anywhere in the state are eligible for a subsidy of 25% on the cost of generator set purchased (upto 320 KVA capacity), subject to a maximum of Rs. 5 lakhs.

D. Back-Ended Interest Subsidy

Back-ended interest subsidy at the rate of 5 % subject to a maximum of Rs.10 Iakhs for a period of 5 years is being provided to micro, small and medium manufacturing enterprises for term loans upto Rs.100.00 Iakhs obtained for technology upgradation/ modernization and Credit Guarantee Fund Trust Scheme(CGFTS).

2. Scheme for promotion of Energy Audit and Conservation of Energy

The Government have introduced Promotion of Energy Audit and Conservation of Energy (PEACE) scheme for promoting energy efficiency in MSME units. Under this scheme, the Government would reimburse 50% of the cost of conducting energy audit and 25% of the cost of machinery &equipments replaced, retrofitted and technology acquired for the purpose of improving energy efficiency, based on the recommendations of the energy audit.

Objectives of the Scheme:

i. Creating awareness & educating MSMEs about benefits / advantages of the new techniques/ technologies for saving energy.

ii. Undertaking in-depth studies of high energy consuming MSME clusters and identify gaps and potential barriers for energy conservation and promoting adoption of suitable techniques/ technologies to achieve energy efficiency.

iii. Encouraging MSMEs for adopting energy audits to improve energy efficiency and fuel substitution, and monitoring the impIementation of recommendations.

Incentive for Conducting Detailed Energy Audit:

a. Main objective is to identify the major sources of energy in use, identify the lapses in energy usage and areas to improve energy usage, determine the level of consumption of the energy sources and recommend measures that will enhance energy savings in the industry.

b. 50% of the energy audit cost subject to a maximum of Rs.0.75 lakh per energy audit per unit.

c. Eligible MSMEs shall file their claims within one year from the date of completion of energy audit.

d. Incentive for Implementing Energy Audit Recommendations:

   a. The objective is to incentivise MSMEs to implement the recommendations of the Energy Audit Report and to optimize the energy consumption leading to energy saving and moneysaving in electricity bills.

   b. Eligibility - all manufacturing MSMEs in the state which have undertaken energy audit and have achieved at least 15% energy savings in terms of number of units of energy consumed per unit of product manufactured.

   c. 25% of the cost of the eligible components, subject to a maximum Iimit of Rs.2,00,000.

3. Scheme for acquiring quality certification

To encourage MSMEs to acquire quality standard certifications for process and product

such as ISO 9000/ ISO 14001 / ISO 22000 / Hazard Analysis and critical point (HACCP) / Good Hygienic Practices (GHP) / Good Manufacturing Practice (GMP) certifications, BIS certification, Zero defect and Zero Effect (ZED), Rating etc., the Government is providing reimbursement subsidy at the rate of 100% on the charge incurred by the MSMEs for acquiring such quality certifications subject to a maximum of Rs. 1.00 lakh

4. Business Facilitation Act

Tamil Nadu Business Facilitation Act, 2018 was enacted to ensure single point receipt of applications for securing clearances that are required to establish or expand an enterprise and for clearances required during normal course of business including renewals in a time-bound manner. The Act also provides for an effective grievance redressal mechanism in case of failure of Competent Authorities to act within the time limit and for matters connected therewith or incidental thereto.

The Act covers 54 clearances covering pre-establishment, pre-operation, renewals, incentives, etc. District Industries Centres and Guidance Bureau are designated as Nodal Agencies for MSMEs and large industries respectively for operating the single window mechanism.

The Act provides for a 3 tier institutional structure:

1. MSME District Single Window Committee
2. MSME State Single Window Committee, and
3. MSME Investment Promotion and Monitoring Board to monitor and review the progress of the single window mechanism.

5. Single Window Facilitation for MSMEs

The MSME Department supports the entrepreneurs who come forward to set up an enterprise. The entrepreneurs can get all licenses/approvals from various departments under the single window mechanism.

The Government of Tamil Nadu takes cognizance of the need for continuously improving the ease of doing business in the state. In order to demonstrate the state's interest in creating an investor friendly climate, conducive to the domestic and global business community, the MSME Department has implemented the online Single Window Portal to deliver requisite services to the investors in a time-bound and transparent manner through online mechanism from 11 departments such as the Directorate of Town and Country Planning (DTCP), Tamil Nadu Pollution Control Board (TNPCB), Fire, Directorate of Industrial Safety and Health (DISH), etc. during the pre-establishment, pre-operation and renewal stages.

The Single Window Portal for MSMEs is available at https://www.easybusiness.tn.gov.in/msme.

6. Micro and Small Enterprises Facilitation council

In the MSMED Act 2000, one of the objectives is to facilitate settlement of delayed payments to micro and small enterprises for the goods supplied by them to major industrial undertakings. Accordingly, the Government has constituted four regional Micro and Small Enterprises Facilitation Councils at Chennai, Tiruchirappalli, Madurai and Coimbatore. Applicants, who intend to file applications under this, can file applications online at https://samadhaan.msme.gov.in.

7. New Entrepreneur cum Enterprise Development Scheme

"New Entrepreneur—cum-Enterprise Development Scheme (NEEDS)" has been introduced by the Government to assist educated youth to become first generation entrepreneurs.

Objective:

To assist first generation entrepreneurs to set up their manufacturing / service enterprises with financial assistance for a maximum project cost of Rs 5 crores from banks or state financial agency.

Eligibility:

Age should be between 21 years to 35 years for General Category and not exceeding 45 years for Special Category (SC / ST / BC / MBC / Minority / Women / Ex-Servicemen / Differently Abled / Transgender).

Should possess educational qualification of any degree / diploma / ITI / vocational training from a recognized institution.

Highlights of the Scheme:

Promoter's contribution is 10% of the project cost for General Category and 5% for Special Category of entrepreneurs.

Individual based subsidy @25% of project cost (not exceeding Rs 30 lakhs).

3% interest subvention for the entire term loan period.

50%earmarked for women beneficiaries.

15 days training on entrepreneurship by EDll-Chennai.

No income ceiling.

Selection of beneficiaries by district level Task Force chaired by the District Collector.

Subject to availability, reservation upto 25% for allotment of plots/sheds in SIDCO Industrial Estates.

8. AMMA Skill Training and Employment Scheme

The Amma Skill Training and Employment Scheme aims at promotion of the MSME sector by providing them with necessary skilled human resources. The scheme aims to train unemployed youth in enhancing their skill for employment with 30% reservation for women. The MSME units providing training to the candidates selected by them will have to pay a stipend of 5000/- per month/candidate upto six months. Out of this, 2,000/- per month will be reimbursed by the Government of Tamil Nadu to the MSMEs after completion of the training programme. The trained candidates will be issued with a certificate by the Tamil Nadu Skill Development Corporation(TNSDC).

The objective of the scheme is to fuIfiII the requirement of skilled human resources in the manufacturing sector through on the job training of candidates fulfilling the norms of NSDC / NSDA / Sector Skill Council / MES / other agencies and possessing required educational qualification and age limit (18 years to 45 years) prescribed for each trade. Disbursement of stipend is done by the TNSDC.

9. UYGEP

The Unemployed Youth Employment Generation Programme (UYEGP) has been introduced to create employment opportunities for the marginalized sections of the society.

Objective:

To create employment opportunities to for the marginalized sections of the society with financial assistance for a maximum project cost of Rs. 10 lakhs for manufacturing activities, Rs. 5 lakhs for service and business activities.

Eligibility:

Age should be between 18 years to 35 years for General Category and upto 45 years for Special Category comprising SC/ ST/ BC/ MBC/ Minority/ Women / Ex-Servicemen / Differently Abled / Transgender.

Pass in VIII Standard.

Family income not exceeding Rs. 5 lakhs per annum.

Highlights of the Scheme:

Promoter's contribution is 10% of the project cost for General Category and 5% for Special Category of entrepreneurs.

Subsidy @ 25 % of project cost (not exceeding Rs 1.25 lakhs).

7 days EDP training.

Selection of beneficiaries by district level Task Force chaired by the General Manager, District Industries Centre.

10. PMEGP

The **Prime Minister's Employment Generation** have been accepted as the engine of economic Programme (PMEGP) is being implemented with effectfrom2008-09.

Objective:

Creation of self employment opportunities in both rural and urban areas with financial assistance for a maximum project cost of Rs. 25 lakhs for manufacturing sector and Rs. 10 Iakhs under service sector.

Eligibility:

Age should be minimum of 18 years.

Beneficiaries should have passed minimum 8th Std. to avail loan above Rs. 10 lakhs in manufacturing sector and above Rs. 5 lakhs in service sector.

No income ceiling.

Highlights of the Scheme:

Promoter's contribution is 10% for General Category and 5% for Special Category (SC/ST/OBC/ Minorities/Women/ Ex-Servicemen/DA).

Subsidiaries from 15% to 35% as detailed below:

Category of Beneficiary	Rate of Subsidy	
	Urban	Rural
General Category	15% of the Project Cost	25% of the Project Cost
Special Category	25% of the Project Cost	35% of the Project Cost

Higher Secondary – Second Year – Food Processing (Vocational Skills)

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