UNIT IV – TOPIC 5

PRESERVATION THROUGH CANNING

The process of sealing food stuffs hermetically in containers and sterilizing them by heat for long storage is known as canning.

In 1804, Appert in France invented a process of sealing foods hermetically in containers and sterilizing them by heat. In honour of the inventor, canning is also known as appertizing. Saddington in England was the first to describe a method of canning of foods in 1807. In 1810, Peter Durand, another Englishman, obtained the first British Patent on canning of foods in tin containers. In 1817, William Underwood introduced canning of fruits on a commercial scale in U.S.A.

Fruits and vegetables are canned in the season when the raw material is available in plenty. The canned products are sold in the off-season and give better returns to the grower.

Principles and Process of Canning

Principle

Destruction of spoilage organisms within the sealed container by means of heat.

Process

Selection of fruits/vegetables → Grading → Washing →

Cooling → Blanching → Cutting → Peeling →

Filling and Syruping or Brining → Exhausting → Storage →

Cooling → Processing → Sealing

(1) Selection of fruits and vegetables

- Fruits and vegetables should be absolutely fresh.
- Fruits should be ripe, but firm, and uniformly mature. Over-ripe fruits should be rejected
- because they are infected with microorganisms and give a poor quality product. Unripe
- fruits should be rejected because they generally shrivel and toughen on canning.
- All vegetables except tomatoes should be tender.
- Tomatoes should be firm, fully ripe and of deep red colour.
- Fruits and vegetables should be free from dirt.
- They should be free from blemishes, insect damage or mechanical injury.

(2) Grading

The selected fruits and vegetables are graded according to size and colour to obtain uniform quality. This is done by hand or by machines such as screw grader and roller grader. Fruits like berries, plums and cherries are graded whole, while peaches, pears, apricots, mangoes, pineapple, etc., are generally graded after cutting into pieces or slices.

(3) Washing

It is important to remove pesticide spray residue and dust from fruits and vegetables. One gram of soil contains 10^{12} spores of microorganisms. Therefore, removal of microorganisms by washing with water is essential. Fruits and vegetables can be washed in different ways. Root crops that loosen in soil are washed by soaking in water containing 25 to 50 ppm chlorine (as detergent). Other methods of washing are spray washing, steam washing, etc.

(4) Peeling

The objective of peeling is to remove the outer layer. Peeling may be done in various ways.

Hand peeling

It is done mostly in case of fruits of irregular shape, e.g., mango and papaya, where mechanical peeling is not possible.

Steam peeling

Free-stone and clingstone peaches are steam peeled in different ways. The former are cut and steam washed. Potatoes and tomatoes are peeled by steam or boiling water.

Mechanical peeling

This is done in case of apples, peaches, pineapples and cherries and also for root vegetables like carrots, turnips and potatoes.

Lye peeling

Fruits like peaches, apricots, sweet oranges, mandarin oranges and vegetables like carrots and sweet potatoes are peeled by dipping them in 1 to 2 per cent boiling caustic soda solution (lye) for 30 seconds to 2 minutes depending on their nature and maturity. Hot lye loosens the skin from the flesh by dissolving the pectin. The peel is then removed easily by hand. Any trace of alkali is removed by washing the fruit or vegetable thoroughly in running cold water or dipping it for a few seconds in 0.5 per cent citric acid solution. This is a quick method where by cost and wastage in peeling is reduced.

Flame peeling

It is used only for garlic and onion which have a papery outer covering. This is just burnt off. Vegetables like peas are shelled, carrots are scarped, and beans are snipped or trimmed.

(5) Cutting

Pieces of the size required for canning are cut. Seed, stone and core are removed. Some fruits like plum from which the seeds cannot be taken out easily are canned whole.

(6) Blanching

It is also known as scalding, parboiling or precooking. It is usually done in case of vegetables by exposing them to boiling water or steam for 2 to 5 minutes, followed by cooling. The extent of blanching varies with the food. Generally fruits are not blanched. This brief heat treatment accomplishes the following:

- Inactivates most of the plant enzymes which cause toughness, discolouration (polyphenol oxidase), mustiness, off-flavour (peroxidase), softening and loss of nutritive value.
- Reduces the area of leafy vegetables such as spinach by shrinkage or wilting, making their packing easier.
- Removes tissue gases which reduce sulphides.
- Reduces the number of microorganisms by as much as 99%.
- Enhances the green colour of vegetables such as peas, broccoli and spinach.
- Removes saponin in peas.
- Removes undesirable acids and astringent taste of the peel, and thus improves flavour.
- Removes the skin of vegetable such as beetroot and tomatoes which helps in their peeling.

Disadvantages

- Water-soluble materials like sugar and anthocyanin pigments are leached by boiling water.
- Fruits lose their colour, flavour and sugar.

(7) Cooling

After blanching, the vegetables are dipped in cold water for better handling and keeping them in good condition.

(8) Filling

Before filling, cans are washed with hot water and sterilized but in developing countries these are subjected to a jet of steam to remove dust and foreign material. Automatic, large can-filling machines are used in advanced countries but choice grades of fruits are normally filled by

hand to prevent bruising. In India, hand filling is the common practice. After filling, covering with syrup or brine is done and this process is called syruping or brining.

A 1-b butter size can should hold 230 285 g of fruit slices and a A 2 ½ size can 510 to 565 g.

The blanched vegetables are packed in sterilized cans which should hold the drained weight of vegetables as specified below:

1 lb butter size can	-	269-283 g
A 2 ½ size can	-	538-566 g
Pint size glass jar	-	283-311 g

(i) Syruping

A solution of sugar in water is called a syrup. Normally sucrose syrup is used in canning. Syrup is added to improve the flavour and to serve as a heat transfer medium for facilitating processing. Syruping is done only for fruits.

Strained, hot syrup of concentration 20 to 55^{o} Brix is poured on the fruit. Fruits rich in acid require a more concentrated syrup than less acid ones. The syrup should be filled at about 79 to 82^{o}C, leaving a head space of 0.3 to 0.5 cm. Sometimes citric acid and ascorbic acid are also mixed with the syrup to improve flavour and nutritional value, respectively.

(ii) Brining

A solution of salt in water is called brine. The objective of brining is similar to that of syruping. Only vegetables are brined. Common salt of good quality free from iron should be used. Hot brine of 1 to 3 per cent concentration is used for covering vegetables and is filled at 79 to 82^{o}C, leaving a head space of 0.3 to 0.5 cm. The brine should be filtered through a thick cloth before filling.

After syruping or brining the cans are loosely covered with lids and exhausted. Lidding has certain disadvantages such as spilling of the contents and toppling of the lids. Hence lidding has now been modernized by 'clinching' process in which the lid is partially seamed. The lid remains sufficiently loose to permit the escape of dissolved as well as free air from the can and also the vapour formed during the exhausting process.

(9) Exhausting

The process of removal of air from cans is known as exhausting. After filling and lidding or clinching, exhausting is essential. The major advantages of exhausting are as under:

a) Corrosion of the tinplate and pinholing during storage is avoided.

b) Minimizes discolouration by preventing oxidation.

c) Helps in better retention of vitamins particularly vitamin C.

d) Prevents bulging of cans when stored in a hot climate or at high altitude.

e) Reduces chemical reaction between the container and the contents.

f) Prevents development of excessive pressure and strain during sterilization.

Containers are exhausted either by heating or mechanically. The heat treatment method is generally used. The cans are passed through a tank of hot water at 82 to 87^{o}C or move on a belt through a covered steam box. In the water exhaust box, the cans are placed in such a manner that the level of water is 4-5 cm below their tops. The exhaust box is heated till the temperature of water reaches 82 to 100^{o}C and the centre of the can shows a temperature of about 79^{o}C. The time of exhausting varies from 6 to 10 minutes, depending on the nature of the product. In the case of glass jars or bottles, vacuum closing machines are generally used. The bottles or jars are placed in a closed chamber in which a high vacuum is maintained.

It is preferable to exhaust the cans at a lower temperature for a longer period to ensure uniform heating of the contents without softening them into pulp. Exhausting at high temperature should be avoided because the higher the temperature, the more is the volume of water vapour formed, and consequently the greater the vacuum produced in the can.

(10) Sealing

Immediately after exhausting the cans are sealed airtight by means of a can sealer. In case of glass jars a rubber ring should be placed between the mouth of the jar and the lid, so that it can be sealed airtight. During sealing the temperature should not fall below 74^{o}C.

(11) Processing

Heating of foods for preserving is known as processing, however, in canning technology processing means heating or cooling of canned foods to inactivate bacteria. Many bacterial spores can be killed by either high or every low temperature. Such drastic treatment, however affects the quality of food. Processing time and temperature should be adequate to eliminate all bacterial growth. Moreover, over-cooking should be avoided as it spoils the flavour as well as the appearance of the product.

Almost all fruits and acid vegetables can be processed satisfactorily at a temperature of 100^{o}C, i.e., in boiling water. The presence of acid retards the growth of bacteria and their spores. Further, they do not thrive in heavy sugar syrup which is normally used for canning of fruits. Vegetables (except the more acid ones like tomato and rhubarb) which are non-acid in nature, have a hard texture, and proximity to soil which many infect them with spore-bearing organisms processed at higher temperatures of 115 to 121^{o}C.

The sourness of fruits and vegetables is due to their acid content (measured in pH) which has a great influence upon the destruction of microorganisms. The lower the pH the greater is the ease with which a product can be processed or sterilized. Fruits and vegetables can be classified into the following four groups according to their pH value.

Class	pH	Product
acid (called non-acid)	e 5.0	tables such as peas, lima bean, asparagus, cauliflower, potato, spinach, corn, french bean
um acid	.0	p, carrot, okra, cabbage, pumpkin, green bean, etc., and products like soups and sauces
	.5	to, pear, banana, mango, jackfruit, pineapple, sweet cherry, , apple and other fruits
acid	w 3.7	s juice, rhubarb, prune, sauerkraut, e, chutney, etc.

Bacterial spores can be more easily destroyed at pH 3.0 (fruits) than at pH 5.0 to 6.0 (vegetables, except tomato and rhubarb). Bacterial spores do not grow or germinate below pH 4.5. Thus, a canned product having pH less than 4.5 can be processed in boiling water but a product with pH above 4.5 requires processing at 115 to 121^{o}C under a pressure of 0.70 to 1.05 kg/cm^{2} (10 to 15 lb/sq inch). It is essential that the centre of the can should attain these high temperatures.

The temperature and time of processing vary with the size of the can and the nature of the food: the larger the can, the greater is the processing time. Fruits and acid vegetables are generally processed in open type cooker, continuous non-agitating cookers, while vegetables (non-acid) are processed under steam pressure in closed retorts known as automatic pressure cookers and continuous agitating cookers. In India, small vertical stationary retorts (frontispiece) are generally used for canned vegetable processing. The sealed cans are placed in the cookers, keeping the level of water 2.5 to 5.0 cm above the top of the cans. The cover of the cooker is then screwed down tightly and the cooker heated to the desired temperature. The period of sterilization (process) should be counted from the time the water starts boiling. After heating for the required period the cooker is removed from the fire and the petcock is opened. When the pressure comes down to zero the cover is removed and the cans are taken out.

(12) Cooling

After processing, the cans are cooled rapidly to about 39°C to stop the cooking process and to prevent stack-burning. Cooling is done by the following methods.

(i) Dipping or immersing the hot cans in tanks containing cold water.

(ii) Letting cold water into the pressure cooker specially in case of vegetables.

(iii) Spraying cans with jets of cold water; and

(iv) Exposing the cans to air.

Generally the first method, i.e. dipping the cans in cold water, is used. If canned products are not cooled immediately after processing, peaches and pears becomes dark in colour, tomatoes turn brownish and bitter in taste, peas become pulpy with cooked taste and many vegetables develop flat sour (become sour).

(13) Storage

After labelling the cans, they should be packed in strong wooden cases or corrugated cardboard cartons and stored in a cool and dry place. The outer surface of the cans should be dry as even small traces of moisture sometimes induce rusting. Storage of cans at high temperature should be avoided, as it shortens the shelf-life of the product and often leads to the formation of hydrogen swell.

The marketable life of canned products varies according to the type of raw materials used. Canned peach, grapefruit, pineapple, beans, spinach, pea, celery, etc. can be stored for about two years, while pear, apricot, carrot, beetroot, tomato, etc. can be stored for a comparatively long period.