Canning

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

Principle and Process of Canning: Destruction of spoilage organisms within the sealed container by means of heat.

Process

(1) Selection of fruits and vegetables

(i) Fruits and vegetables should be absolutely fresh.

(ii) 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.

(iii) All vegetables except tomatoes should be tender.

(iv)Tomatoes should be firm, fully ripe and of deep red colour.

(v) Fruits and vegetables should be free from dirt.

(vi) 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, pineapples, 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 1012 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.

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

(ii) 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.

(iii) Mechanical peeling: This is done in case of apples, peaches, pineapples and cherries and also for root vegetables like carrots, turnips and potatoes.

(iv) 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.

(v) 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 scraped, 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. Fruits are generally not blanched leaving the oxidizing enzyme system active. Sometimes fruit is plunged for a given time-from half to, say, five minutes, according to variety-into water at from 180°F to200^{o}F, and then immediately cooled by immersion in cold water. The object is to soften the texture and so enable a greater weight to be pressed into the container without damage to the individual fruit. Blanching is usually done in case of vegetables by exposing them to boiling water or steam for 2 to 5 minutes, followed by cooling. This brief heat treatment accomplishes the following:

(i) Inactivates most of the plant enzymes which cause toughness, discolouration (polyphenol oxidase). Mustiness, off-flavour (peroxidase), softening and loss of nutritive value.

(ii) Reduces the area of leafy vegetables such as spinach by shrinkage or wilting, making their packing easier.

(iii) Removes tissue gases which reduce sulphides.

(iv) Reduces the number of microorganisms by as much as 99%.

(v) Enhances the green colour of vegetables such as peas, broccoli and spinach.

(vi) Removes saponin in peas.

(vii) Removes undesirable acids and astringent taste of the peel, and thus improves flavour.

(viii) Removes the skin of vegetables such as beetroot and tomatoes which helps in their peeling.

Disadvantages

(i) Water-soluble materials like sugar and anthocyanin pigments are leached by boiling water.

(ii) 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.

(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:

(i) Corrosion of the tinplate and pin holing during storage is avoided.

(ii) Minimizes discolouration by preventing oxidation.

(iii) Helps in better retention of vitamins particularly vitamin C.

(iv) Prevents building of cans when stored in hot climate or at high altitude.

(v) Reduces chemical reaction between the container and the contents.

(vi) Prevents development of excessive pressure and strain during sterilization.

(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°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 very 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 add vegetables can be processed satisfactorily at a temperature of 100°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 may infect them with spore-bearing organisms are processed at higher temperatures of 115 to 121^0C.

(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 become 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. Containers for packing of canned products both tin and glass containers are used in the canning industry, but tin containers are preferred.

(1) Tin containers

Tin cans are made of thin steel plate of low carbon content, lightly coated on both sides with tin metal. It is difficult to coat the steel plate uniformly and during the process of manufacture small microscopic spots are always left uncoated, although the coating may appear perfect to the eye. The contents of the can may react with these uncoated spots resulting in discolouration of the product or corrosion of the tin plate. When the corrosion is severe, black stains of iron sulphide are produced. It is necessary, therefore, to coat the inside of the can with some material (lacquer) which prevents discolouration but does not affect the flavour or wholesomeness of the contents. This process is known as "lacquering".

Two types of lacquers are used:

(i) Acid-resistant: Acid-resistant lacquer is a golden coloured enamel and cans coated with it are called R-enamel or A.R cans. These cans are used for packing acid fruits which are of two kinds: (a) those whose colouring matter is insoluble in water, e.g., peach, pineapple, apricot, grapefruit, and (b) those in which it is water-soluble, e.g., raspberry, strawberry, red plum and coloured grape. Fruits of group (a) are packed in plain cans and those of group (b) in lacquered cans.

(ii) Sulphur-resistant: This lacquer is also of a golden colour and cans coated with it are called C-enamel or S.R. cans. They are meant for non-acid foods only and should not be used for any highly acid product as acid eats into the lacquer. These cans are used for pea, corn, lima bean, red kidney bean, etc.

Tin containers are preferred to glass containers because of certain advantages:

(i) Ease of fabrication,

(ii) Strength to withstand processing,

(iii) light weight,

(iv) Ease in handling,

(v) Cheapness, and

(vi) Can be handled by high speed machines.

Causes of spoilage of canned foods

Spoilage of canned products may be due to two reasons:

(A) Physical and chemical changes, and

(B) Microorganisms.

(A) Spoilage due to physical and chemical changes

(1) Swell: When the ends of an apparently normal and perfect can with good vacuum become bulged it is termed as 'Swell' or 'Blower'. The bulge is due to the positive internal pressure of gases formed by microbial or chemical action.

(2) Overfilling: Spoilage due to overfilling is common. During retorting, overfilled cans become strained due to expansion of the contents, and in the absence of vacuum in them swelling takes place. If the cans are properly heat exhausted, the excess material overflows from it due to expansion and thus spoilage because of overfilling is "avoided.

(3) Faulty retort operation: When the steam pressure is reduced rapidly at the end of processing, high pressure develops inside the cans resulting in their distortion and the cans when cooled look like "swells". Cans of very thin tin plate should not be used as they cannot withstand the pressure which develops in the cans while processing.

(4) Under-exhausting: Cans are exhausted to remove most of the air. This helps in the" proper filling of fruits and vegetables and also creates a good vacuum, which is necessary to accommodate any pressure that might develop inside the can as a result of production of hydrogen due to corrosion. Improperly exhausted cans may suffer severe strain during heat processing due to the large internal pressure of the gas present in it.

(5) Panelling: It is generally seen in large sized cans that the body is pushed inward due to the high vacuum inside. This also occurs when the tin plate is thin or the cans are pressure cooled at very high pressure. In very severe cases, seam leakage may occur but normally this is not regarded as spoilage.

(6) Rust: Cans having external rust must be thoroughly examined after removing the rust and, if the walls show a pitted appearance, should be rejected as spoiled. Cans slightly" affected by rust if not used immediately should be rejected. Rust is mostly seen under the label and subsequently affects the label as well. Rust formation can be checked if the cans are externally lacquered.

(7) Foreign flavours: During preparation, filling, storage or even transportation, conditions may become unhygienic and the products may develop foreign or "off-flavours". If unsuitable metallic containers are used, a "metallic flavour" develops. Flavour is an important characteristic for maintaining which packages must be examined at regular intervals.

(8) Damage: Rough handling of cans due to carelessness or ignorance may damage them. If any cans show signs of leakage or severe distortion they must be rejected.

(9) Undesirable texture: Texture is another important characteristic, like flavour and colour, which is detected easily by a consumer. In order to maintain the standard of a product its texture should be tested periodically. Although there are no precise parameters for measuring texture, an instrument like "Tenderometer", which measures the resistance
to shearing and relative tenderness, can be used for peas and beans

(10) Corrosion of cans: Cans become corroded or perforated due to the acidity of the contents, specially highly acid fruits. In recent years, attempts have been made to reduce the spoilage by using improved lacquers for internal coating of cans.

(11) Leakage: A leaking can is known as a "Leaker". This may be due to: (i) defective seaming, (ii) nail holes caused by faulty nailing of cases while packing, (iii) excessive internal pressure due to microbial spoilage sufficient to burst the can, (iv) internal or external corrosion, and (v) mechanical dam- age during handling.

(12) Breathing: There may be a very tiny leak in the can through which air can pass in and destroy the vacuum. In such cases the food is damaged due to rusting of the can caused by oxygen in the air but still remains fit for consumption.

(13) Bursting: This may be caused by the excess pressure of gases produced by decomposition of the food by microorganisms, or by hydrogen gas formed by the chemical action of food acids on the tin plate. In such cases the canned product cannot be used.

(14) Buckling: Sometimes due to improper cooling, distortion of the can takes place resembling 'swell'. Although the distortion can be corrected by pressing, the cans are often badly strained and the contents become spoiled due to entry of microorganisms through the strained seams. This type of spoilage is known as "Buckling" Sometimes a peak or small ridge forms on the can which is known as "Peaking".

(15) Discolouration : This can be detected by visual examination of the can and its contents. Discolouration may be due to biological causes like enzymatic and nonenzymatic browning or metallic contamination.

(16) Stack burning: If processed cans are not allowed to cool "own sufficiently before storing, the contents remain hot for a long time. This is known as "stack burning" which results in

discolouration, cooked flavour and very soft or pulpy product. Therefore, it is necessary to cool the cans quickly to about 39°C before storage.

(B) Microbial spoilage

(1) Pre-processing spoilage: This type of spoilage occurs because of the time gap between filling and heat processing of the containers. Although processing checks the growth of organisms the gas already present in the can causes swelling and flipping, so delay between filling and processing must be avoided, and also at all stages in the preparation of raw materials for canning.

(2) Under-processing spoilage: Under-processing of canned foods result in their spoilage by thermophilic bacteria and mesophilic organisms and this is termed as "underprocessed" spoilage.

(3) Infection due to leakage through seams: A large number of cans after processing show signs of microbial spoilage due to leakage of 'Can seams. Cans which are water-cooled are more likely to leak than air- cooled ones. In such cases the cans mayor may not swell depending upon the type of organism and if there is a defect in the seam it permits free passage of the gas formed in the can. For reducing this type of spoilage the bacterial level of the cooling water should be low and the cans should be properly exhausted to reduce seam strain. Moreover, buckling also allows the entry of microorganisms.