Unit III - Topic 2

Canning: Definition, processing steps and equipment, cans and containers

Introduction

In the present scenario, preservation of foods has become a part of common man life. Foods such as fruits and vegetables are existing in particular seasons. In some places there is a excess production of a food product, whereas in other places there is an poor supply. Man adopted certain techniques to preserve seasonal foods together for later use. Today, preservation of food is essential to fulfil the food supply needs of a developing country like India. It also ensures that the food is available and its supply is maintained at all times.

Objectives

After going through this session you will be able to understand the,

- Containers used for canning operation.
- Process involved in canning operation.
- Effects of canning on different parameters of foods.
- Different Spoilage of canned foods.

5.1 Canning

The process of sealing foodstuffs hermetically in containers(of metal, glass, thermo stable plastic, or a multi-layered flexible pouch) and sterilizating them by heat for long storage is known as canning. It enhance the shelf life of the products ranging from 1to5years, although under specific conditions it can be much longer. Heating is the principle factor to demolish the microorganisms and the everlasting sealing is to prevent re-infection.

5.2 History of canning

In 1804,Appert in France invented a process of sealing foods hermetically in containers and sterilizing by heat. He is known as"Father of Canning". This work created the establishment for modern canning method. In respect of the inventor, canning is also known as appertizing. During the first years of the Napoleonic wars, the French government offered a bulky cash award of12,000 francs to any inventor who could work out a cheap and effective method of preserving large amounts of food.

5.3 Importance of canning

The fresh foods are highly perishable and spoil/lose their quality due to high levels of water content. Microorganisms can grow or multiply rapidly on the surface of foods. The parameters such as moisture, oxygen and enzymes are present throughout

fresh food tissues, that influences the growth of microorganism that spoil the food stuffs. To minimize the effect of microorganism proper cnning practice to be followed.Main purpose of this method is to preserve the foods by thermal treatment so that it can be safely consumed at a later time. Consumer safety is the primary goal when food is canned.

5.4 Nutritional value of canned food

Many vegetables begin to lose vitamins when harvested. almost half of the vitamins may be lost within a few days if not the fresh produce is cooled or preserved. Within one to two Refrigerated produce may lose half of its vitamins within one or two weeks. Canning destroys from 1/3 to 1/2 of vitamins A and C, thiamin, and riboflavin when subjected to heat treatment. Each year on storage the canned foods accounts for a loss of sensitive vitamins from 5 to 20 percentage. The amounts of other vitamins are slightly lower in canned foods compared with fresh foods. Vegetables that are handled properly and canned quickly after harvest may be more nutritious than fresh produce held many days after harvest. The heating process in canning appears to make dietary fiber more soluble and more readily fermented in the colon into gases and physiologically active byproducts.

5.5 Canning preservation of foods

Fresh foods spoil or lose their quality for several reasons:

- growth of undesirable microorganisms-bacteria,
- molds, and yeasts
- activity of food enzymes
- reactions with oxygen
- moisture loss
- Destroys microorganisms
- Inactivates enzymes
- Containers are sealed to avoid recontamination

5.6 Containers for canned foods:

The container plays essential role in food canning, it must be:

1-) Capable of being hermetically sealed to avoid access of microorganisms.

2-) Resistant to liquids and gases, including water vapour

3-) Retain the condition of biological stability (*i.e*, commercial sterility) that was induced by thermal treatment alone or combined with other chemical and physical process.

4-) It defend the contents against damage during transportation and storage.

5.6.1 Can materials:

Broad varieties of materials are used for manufacture of cans for preservation of foods andare mostly packed in metal containers.

(a) Steel:

Materials commonly used to make metal food cans are tinplate, tin-free steel, and nickel-plated steel. The amount of tin used is about 1.5% of the can's weight and be supposed to contain less than 1% lead and is commonly used to prevent rusting . To avoid contact between foods and metal, organic material are usually coated on the inside of the can.

The commonly used organic coatings in food industry are,

(i) acid-resistant

(ii) sulfur-resistant

Acid-resistant coated cans are primarily used for fruit products whereas meat products are usually packed in cans that have been lined with sulfur-resistant materials.

(b) Glass containers and metal closures

Although the ample range of glass containers and metal closures for canned foods are used.It has a high conductivity of heat and cannot be broken easily. Being dense, any probable bad effects of light on food stuffs are avoided.It can endure the stresses forced during thermal processing and cooling.

5.7 Important food groups

Group	pH	Foods
Low acid	5.0 to 6.8.	Dairy products, vegetables, meats, seafood and poultry.
Acid food	4.5 and 3.7.	Fruits for example oranges, pear, tomato and apricots
High acid	3.7 to 2.3	fermented foods, Jam, Jellies, pickles

Packing the Jar Plays a large role in heat transfer through the product
Can be completed by using one of the following packing processes: raw or cold pack hot pack

Raw or Cold Pack:

- Places raw food directly in the jar and then hot, boiling liquid is poured over the contents

Hot Pack:

- Involves cooking foods in liquid before packing and then the cooking liquid is pouredover the food in the jar

Headspace

- It is the area in the jar between the inside of the lid and the top of the food or itsliquid Is usually the following for certain foods:
- jellies- ¼ inch fruits
- tomatoes and pickles- ½ inch
- low acid foods- 1 inch to 1 ¼ inches
    - If too little, can result in the following: food bubbling out during processing proper seal may not occur because deposits can form on the rim
    - If too much, can result in the following: food at the top of the jar can become discolored proper seal may not occur because not all of the air may be forcedfrom the jar

5.8 CANNING METHODS

Canning can be done by two methods **boiling water bath method** and the **pressurecanner method**

Water bath canning

Pressure canning

processing of foods. Place six inches of water in the canner for hot packed jars, the water should be simmering at 180°F for raw or cold packed jars, the water should be

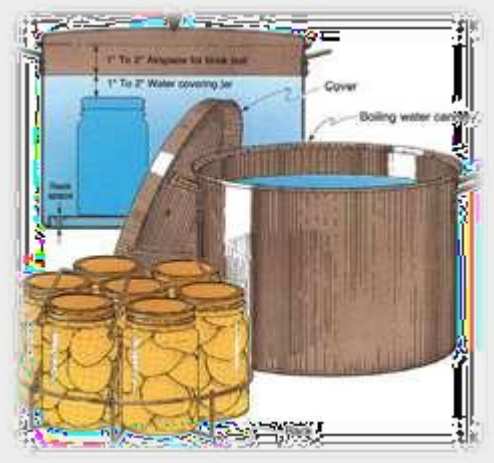
heated to 140°F and the jars are placed on a rack so that they do not touch the bottom of the canner. The water should rise to one to two inches above the tops of the jars, more hot or boiling water can be added if necessary. After processing time, canner is turned off, the lid is removed. Remove jars straight out of canner and let it cool for 12 to 24 hours.The seals are checked and the rings are removed.Jars are then stored in a cool, dry, dark place.

Advantages of Boiling Water Canning

It include: easy for beginners to learn best method for fruits, high acid and pickled foods inexpensive to start

Disadvantages of Boiling Water Canning

Include: temperature does not get high enough to ensure the destruction of microorganisms in food without high sugar or acid content longer time period to complete canning process



5.8.1 PRESSURE CANNING

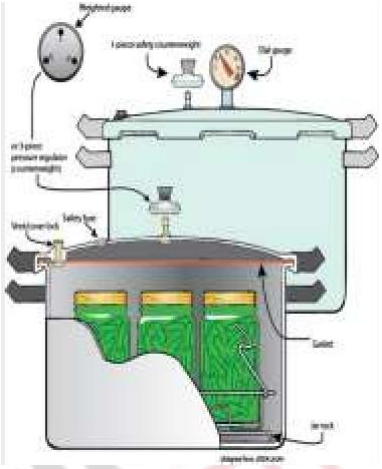
In this method the food products are exposed to 240° F, reduce the risk of food borne bacteria. Low acid foods such as vegetables, meats, poultry and seafood are canned by this method to remain foods fresh and safe to eat. Combination of high-acid and low-acid foods can be conserved for a longer period.A spore forming microorganism called Clostridium botulinum are killed at boiling temperatures, can withstand these temperatures. In low acid foods the spores will germinate in the absence of air, which forms the toxic botulinum. These spores can only be destroyed by pressure cooking method at a temperature of 240°F, or above, for a particular amount of time depending on the type of food and altitude. Clostridium botulinum spores can not grow at high acidic conditions that is pH of 4.6 or less and this type of foods can be safely canned using the boiling water bath method. Foods that have a pH value near to 4.6 need to have acid added to them in order to use the water bath method. This is accomplished by adding lemon juice of citric acid. Place two to three inches of water simmering or hot in a canner and lid is placed on canner with weight off.Allow a steady stream of steam to escape for 10 minutes,close vent or petcock Count time when correct pressure is reached Turn off heat at end of processing time and let pressure drop to zero. Wait two minutes after pressure is at zero remove weight or petcock and wait ten minutes. Open canner and remove jars, cool the jars for 12 to 24 hours and then check that the jars are properly sealed.

Advantages of Pressure Canning

Include: best method for low acid foods, such as vegetables foods reach a higher temperature process is completed in a short period of time.

Disadvantages of Pressure Canning

Include: start-up cost is higher than boiling water method as a pressure cooker is required can be dangerous if pressure is not monitored and released some soft fruits can be damaged by high heat

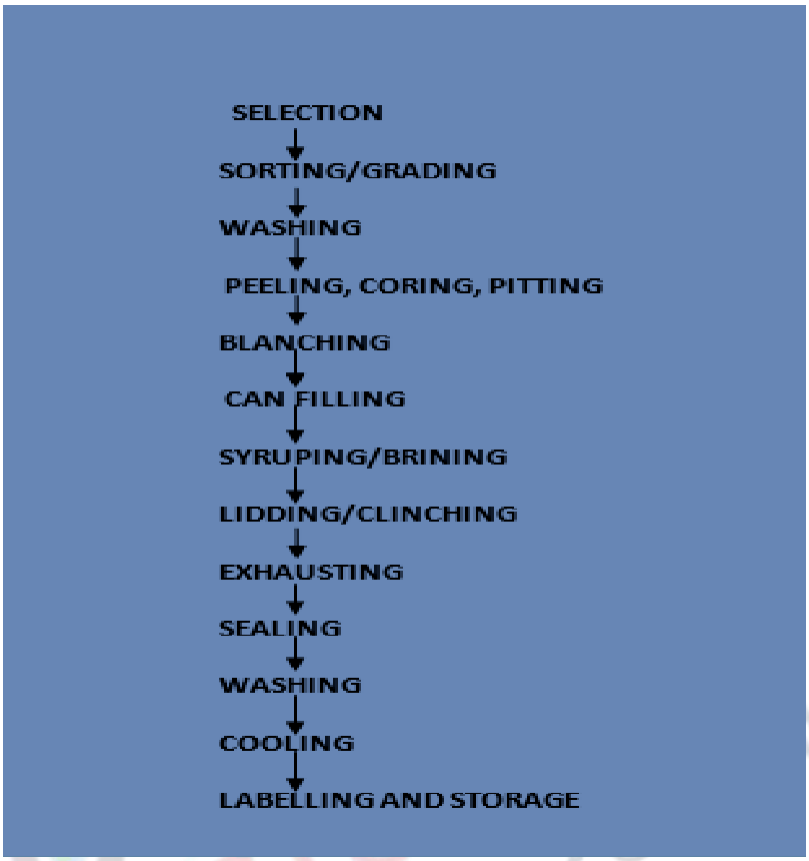


Canning time & temperature depends on,

- The physical state of the food
- Size of Pieces
- Fullness of pack
- Container size and material
- Initial temperature of food
- The heat resistance of microorganisms or enzymes likely to be present in the food

General process flow chart of Canning

5.9 PROCESSING:



5.9.1 Selection :

The fresh fruits and vegetables were used for canning. The selected fruit should be firm, mature and uniformly ripened. It should be free from all unpleasant blemishes, insect damage and malformation. Over-ripe fruit is normally infected with microorganisms and results in poor quality.

5.9.2 Sorting and Grading:

After the preliminary sorting, the fruits and vegetables are graded. according to their size, color etc. It is usually done by manual or by mechanical grading (screen graders, roller graders, rope or cable graders etc.).

Mechanical Grader

5.9.3 Washing:

The graded fruits and vegetables are washed to remove the foreign matter, dirt, dust with water in diverse ways such as soaking or agitation in water, washing with cold or hot water sprays , etc. Among all the methods spray washing is more efficient. Vegetables may first be soaked in potassium permanganate solution to disinfect them.

5.9.4 Peeling, Coring, Pitting:

After washing the fruits and vegetables are peeled to remove the outer layer.Thereare 3 common methods of peeling.

1. Mechanical peeler
2. Hand peeling by machine
3. Lye peeler(dipping the fruits and vegetables in a solution of boiling causticsoda or lye solution of strength 1-2%for 30 seconds to 2 minutes).

Cores and pits in fruits are removed by manual or by mechanical means.

Hand Peeling

Lye peeling

Mechanical peeler

5.9.5 Blanching:

Treatment of fruits and vegetables with boiling water or steam for shorter period of time followed by cooling prior to canning, is called ‘blanching’.It is commonly done to remove or loosen the outer covering(skin).This process can reduce the microbial growth and contamination.It helps to inactivate the reaction of enzymes which inturn prevent the discoloration in fruits and vegetables.It improves the flavor by reducing the astringency in food products.

5.9.6 Can Filling:

The cans used for filling of food products are washed and exposed to steam jet which helps to get rid of any adhering dust or foreign matter in it.Prior to filling of contents(fruits and vegetables) a small amount of syrup(for fruits) or brine(for vegetables) is transfer to the cans which serves as a medium to contents.This filling operation can be done by machine or byhand filling.

5.9.7 Syruping and Brining:

The hot sugar syrup for fruits of concentration of 35-40% and hot brine solution for vegetables of concentration 1-2% normally used to fill the cans. The syrup or brine should be added to the can at a temperature of 79°C to 82°C, leavinga headspace in the can so that when the filled can is closed on the double seaming machine, the headspace left inside ranges from o.32 cm to 0.47 cm.This step is doneto progress the taste of the canned product and to fill up the inter space between fruits and vegetables.

5.9.8 Lidding or Clinching

Cans after being filled, are covered loosely with lid and passed through the exhaust box. Now,lidding is replaced by clinching process where the lid is partly seamed to the can by a single first roller action of double seamer.

5.9.9 Exhausting:

This operation reduces the risk of corrosion of tin plate and pin holing during the storage and staining of the product is minimized as the oxidation process is prevented. the exhausted cans are then passed into trough containing 82-87°C of water or it can be sent to a steam box by a moving conveyor belt. The time taken for

this process usually varies between 5-25 minutes depending on the nature of the substance.The spoilage of the canned products are prevented product by stopping the chemical reactions which results in bulging of can.

5.9.10 Sealing:

After exhausting,special closing machines are used to seal the cans which is known as double seamers. It may be hand operated or semi-automatic/fully automatic seamers.

5.9.11 Processing/Sterilization:

Sterilization is done to reduce the growth of microorganisms that causes spoilage.The temperature required for processing of fruits is 100°C whereas for vegetables is 116-120°C.The overall time required to sterilize canned food is mainly depends on the size of can, the processing temperature, the rate of heat penetration at the center of the can,pH of the food product,the type and number of organisms present in it.

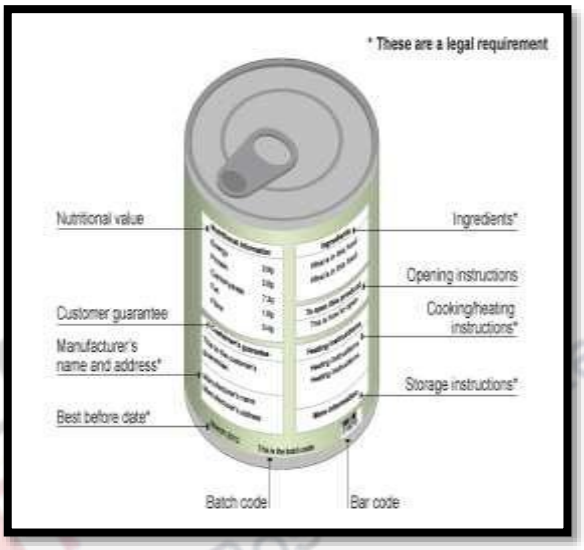
5.9.12 Washing and Cooling:

After the cans are closed, they pass through a detergent spray washer to get rid of grease and other material. The washing should consist of hot water (66°C) then

by appropriate pre-rinse by detergent spray wash. It is then followed by a fresh warm water rinse (66°C).Instantly after processing, the cans are cooled in water to a temperature of 36°C to 42°C. to avoid thermophilic spoilage or can rust. If the cans are cooled much below 36°C, they may not dry thoroughly and results in rusting. If the cans are cased at temperatures much over 42°C, thermophilic spoilage may occur.

5.9.13 Labeling and Storage:

The cans are labeled, packaged and stored at a clean and dry place. Storage temperatures of sterile canned meat products should not be above 21.1°C, because higher temperatures obviously speed up deterioration during storage, thus limiting shelf life.



5.10 Effects of canning on foods

Colour

The time–temperature combinations used in canning have effect on naturally occurring pigments in foods. In fruits and vegetables, chlorophyll is converted to pheophytin, carotenoids carotenoids are isomerised isomerised from 5, 6-epoxides epoxides to less intensely intensely coloured 5, 8-epoxides, and anthocyanins are degraded to brown pigments. Discolouration of canned foods during storage occurs,for example, when iron or tin react with anthocyanins to form a purple pigment, or whencolourless leucoanthocyanins form pink anthocyani n complexes in some varieties of pears and quinces.

Flavour and Aroma

In canned meats there are complex changes, for example pyrolysis, deamination and decarboxylation of amino acids, degradation. In fruits and vegetables, changes are due to complex reactions which involve the degradation, recombination and volatilisation of aldehydes, ketones, sugars, lactones, amino acids and organic acids.

Texture or Viscosity

In canned meats, changes in texture are caused by coagulation and a loss of water holding capacity of proteins, which produces shrinkage and stiffening of proteins, which produces shrinkage and stiffening of muscle tissues. The texture of solid fruit and vegetable pieces is softer than the unprocessed food due to solubilisation of pectic materials but is considerably firmer than canned products.

5.11 Advantages of Canning:

- ✓ It modify the foods by varying the moisture, pH, or salinity levels to shield against microbes, bacteria, mold, and yeast.
- ✓ The activity of enzymes are limited to certain levels.
- ✓ The shelf life of the canned foods can be kept for 1-2 years or longer.
- ✓ It is an excellent way to decrease the environmental impact**.**

5.12 Limitations of canning process:

- ✓ Glass jars can be broken easily.
- ✓ Seals can be broken and it caused spoilage.
- ✓ It is a time consuming method.
- ✓ It does not taste as good as fresh foods.
- ✓ It also requires a major investment of time and equipment.

5.13 Spoilage of Canned Foods

(A) Spoilage of canned foods according to the condition and content of the can:

Swell: It is the bulging of both sides of can by positive internal pressure due to generationof gas by microorganisms or by chemical action. It may be hard or soft swell.

Flipper: The appearance of the can will be normal but there may be flip at any one end, when the can is struck next to a solid object but snaps back to the ordinary condition under light pressure.

Springer: It is a defect that a can bulged from one end which if forced back into normal position, the opposite end bulges.

overfilled can: It has convex ends due to overcapacity and not regarded as spoiled.

(B) Spoilage of canned food according to the causes:

(i) Microbial spoilage:

This type of result from inadequate processing or leakage.

There are 3 types of spore forming bacteria:

- Gas producing aerobes and anaerobes with optimum growth temperature 37 ˚C.
- Gas producing anaerobes with optimum temperature 55˚C.
- Non-gas producing aerobes or facultative anaerobes with optimum temperature 55˚Cgenerate flat souring bacteria.

  Leak can be detected by the bubbles when compress under water.There is a loss of vacuum (concavity) when heated to 38˚C followed by slow cooling.

  Flat souring :

  It results in high acid formation without gas production.It has a sour odour, bitter taste.It is caused by thermophilic bacteria such as,
- Bacillus coagulans.
- Bacillus stearothermophilus.

- Bacillus circulans.

These bacteria attack carbohydrate producing acid without gas.It is common intropical and subtropical countries. The affected cans should be destined.

(ii) Chemical spoilage:Hydrogen swell:

Creation of hydrogen gas in can due to internal corrosion or scratch.It happen mainly in acidic foods (canned fruits).It is not related to fermentation or bacterial spoilage.There is a unreliable degree of bulging,when opened there is a release of odorless burnable gas. It is risk-free but undifferentiated from swell of spoiled can.

Sulphiding (Sulphur stinker spoilage):

It leads to staining of inside of can with pink to dark purple. This happens due to the reaction of sulphur-containing proteins (liver, kidney, tongue) with liberated hydrogen sulphide from bacterial spoilage (*Cl. nigrificans* (sulphur stinker)) with the odor of rotted egg. It may be accompanied with blackening when hydrogen sulphide react with steel base of tin forming iron sulphide and it may direct to pitting. Sulphiding can be prohibited by sulphur-resistant lacquer.

epathshala पाठशाला A Gateway to All Post Graduate Courses