8 Techniques in Food Processing and Preservation

Contents

Food preservation is a group of methods that helps to preserve food. For thousands of years, humans have used methods of preserving food, so that they can store their food to eat it later. Food preservation helps to reduce the quantitative loss to maintain nutritional quality and to increase the availability of food.

What is Food Preservation?

"Food preservation can be defined as the science which deals with the methods of prevention of decay or spoilage of food, thus allowing it to be stored in a fit condition for future use".

8.1 Need of food preservation:

When food is available abundantly than our consumption, it should be preserved for future utilization. Thus, preservation activities ensure proper utilization of food. In the past, food was preserved to provide a store of food during winter, when there was no other source of food. Today, preservation of fresh produce is required for following reasons:

- To increase availability of certain foods which have a short and specific growing season such as fruits and vegetables, for availing its use throughout the year.
- To utilize surplus crops into value added products and prevent wastage.
- To save money by preserving foods when they are most abundant, cheaper and are of good quality.
- To produce such food items which are easy to store, distribute, transport and that can be made available at all places at all time.
- To meet the needs of people for food in secluded and difficult areas.
- To ensure constant supply of preserved food at homes, hotels and other such places.
- It helps in reducing the national food loss by saving the food and improving food availability significantly.

8.2 Principles of food preservation:

All food preservation methods are based upon three general principles of preventing or retarding the causes of spoilage. Those are as follows :

A. Prevention or delay of microbial decomposition

- By keeping out microorganisms (asepsis) e.g. fruit pulps in multilayer pack.
- By removal of microorganisms e.g. washing or filtration etc.
- By destruction of microorganisms e.g. by heat or radiation.

- By slow down the growth and activity of microorganisms e.g. by using low temperature, drying, anaerobic conditions, chemicals, etc.

B. Prevention or delay of self-decomposition of the food

- By destruction or inactivation of food enzymes e.g. by blanching
- By preventing or delay of chemical reactions e.g. prevention of oxidative rancidity with the use of antioxidant.

C. Prevention of damage due to insects, animals, mechanical causes, etc.

8.3 Methods of food preservation and processing:

To retain the nutritional profile alongwith natural taste and aroma of a product, it is necessary to preserve it soon after preparation. Various methods of food preservation are employed and each has its own merits and demerits. The methods generally used are as under:

1. Asepsis (Keeping out micro-organisms)

Asepsis means preventing the entry of microorganisms during processing, packaging and storage. The aseptic environment can be created by -

- Proper packaging of the product, which protects the internal product from the surroundings.
- Maintenance of general cleanliness, hygiene and sanitary conditions during processing and handling of product from raw material to finished stage.

2. Removal of micro-organisms

The dust and dirt adhering to the raw material contain microorganisms and by applying various pre-treatments such as cleaning, washing, blanching, etc. help to reduce them considerably. Filteration of water, juices etc. can remove microorganisms, thereby preserve it from microbial spoilage.

3. Preservation by high temperature

Application of heat to foods leads to the destruction of microorganisms. High temperatures used for preservation are usually:

(a) Pasteurization- temperature below 100^0C (Except UHT pasteurization)

(b) Boiling - at about 100^0C and

(c) Sterilization- temperature above 100^0C.

One of the most important modern applications of the heat preservation is the pasteurization of milk.

(a) Pasteurization

The process of pasteurization was first discovered by the French microbiologist Louis Pasteur in 1862. The process uses temperature less than 100^0C to eliminate pathogenic

Louis Pasteur

bacteria and extend shelf life of the food products. The heating may be achieved by means of steam, hot water, dry heat or electric currents and the products are cooled promptly after the heat treatments e.g. milk, wine, beer, fruit juices and aerated waters.

Table 8.1 : Methods of pasteurization

Sr. No.	Method of Pasteurization (for milk)	Tempera-ture	Time
1	Low Temperature Long Time (LTLT) or Batch type	62.8^{0}C	30 min
2	High Temperature Short Time (HTST)	71.7^{0}C	15 sec
3	Ultra High Temperature (UHT)	137.8^{0}C	2 sec

Do You Know ?

Ultra-high temperature processing (UHT), is a food processing technology that sterilizes liquid food, mainly milk, by heating it above 137.8 °C temperature required to kill microbial spores in milk for 2 seconds

Blanching

Blanching is a heat treatment at about 100^{0}C. The term is usually used in conjunction with vegetable processing, where the goals are inactivation of enzymes, reduce microflora and improve the colour. Blanching is usually performed by dipping the products in boiling water or steaming for 2-3 minutes.

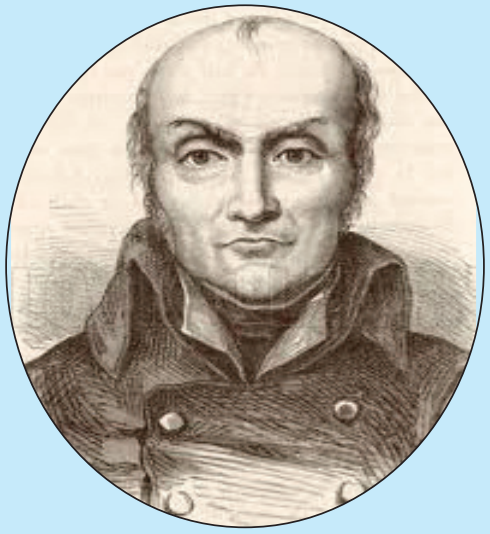
(b) Boiling

Cooking of rice, vegetables, meat, fish, etc. at home is usually done by boiling the food with water and involves a temperature around 100^0 C.

(c) Sterilization

Sterilization is a heating process (above 121^{0}C for 15 min) used to completely destroy all living micro-organisms in food. It can be achieved by moist heat, dry heat and irradiation heat source. Vegetables like green peas, okra, beans, etc. being non acidic and containing more starch than sugar, require higher temperature to kill the spore forming organisms.

(d) Canning is the method of preserving food from spoilage in which the foods are filled in cans heated to 115-125^{o}C tempreature and then sealed hermetically. Finally these cans are processed in boilling water for about 30 minutes and then cooled, removed and stored. They remain stable for about a year. It helps to destroy microorganisms and inactivates enzymes e.g. all kinds of canned foods such as soup, meat, beans, pulp, slices, legumes, nuts, etc.



Nicolas Appert
Father of Canning

In 1809, Nicolas Appert, a French confectioner and brewer, observed that food cooked inside a closed jar did not spoil unless the seals leaked, and developed a method of sealing food in glass jars or cans (Thermal method of canning). This method of canning is known as appertisation.

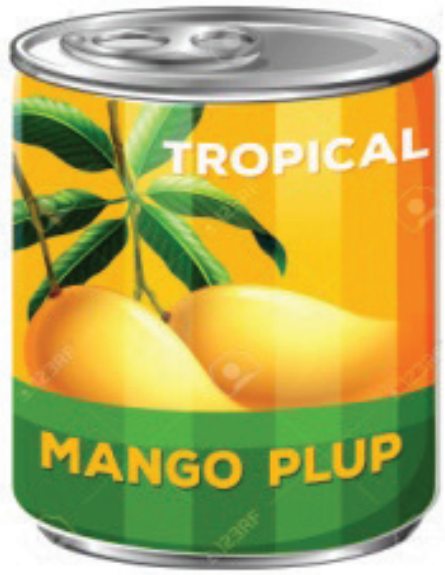


Fig. 8.1 : Canned Mango Pulp

Do You Know ?

In canning of food items, more than 88°C temperature kills most of the pathogenic organisms and retains most nutrients with other quality attributes.

Table 8.2 Difference between pasteurization and sterilization

Pasteurization	Sterilization
1. Partial destruction of microorganism	Complete destruction of microorganism
2. Temperature below 100^0C (generally except UHT).	Temperature above 100^0C
3. Require definite time	Require more time
4. Maximum nutrients are preserved	Heavy loss of nutrients

4. Preservation by irradiation

Foods are exposed to high-energy rays called gamma rays or by fast-moving electrons, which kill bacteria, fungi and insect by protecting the major nutrients. A major advantage of irradiation is that it can be done after the food is packaged and sealed. It has been used in pasteurizing or sterilizing perishable foods such as meat, fish, fruits, spices, ghee, etc. and extending their storage lives for long periods. It is also used for sprouting inhibition in onions, potatoes, garlic etc.

5. Preservation by low temperature

Low temperature preservation include following methods :

(i) Cellar storage (about 15^0C): It is used for the storage of surplus foods like root crops, potatoes, onions, apples, fresh fruits and vegetables, etc. for limited periods.

(ii) Refrigeration or chilling (0 to 5^0C): It is used for fruits, vegetables, meats, poultry, eggs, fish, fresh milk and milk products, etc. that can be preserved for 2-7 days by refrigeration.

(iii) Freezing (-18^0C to -40^0C): Mostly processed foods like fruit and vegetable products, peas, juice concentrates, ice-creams, meats, poultry, fish, etc. can be preserved for several months at this temperature range.

6. Preservation by Drying

Drying is one of the oldest and simplest methods of food preservation which removes water from the food. The reduced moisture content does not allow microorganisms to grow and also controls the enzymatic activity. Drying can be accomplished by sun-drying, mechanical drying (dehydration unit) and freeze drying.

- **Sun dried products:** Raisin, figs, apricots, etc.
- **Mechanical dried products:** Potato chips, milk powder, etc.
- **Freeze dried products:** Fruits, vegetables, sea foods, enzyme, bacteria, etc.

Dried foods are compact and lightweight; (low moisture content), do not require refrigeration and kept for longer time than the fresh foods. Dried foods should be stored in airtight containers to prevent re-absorption of moisture and allowing microbial growth, there by maintaining the crispiness and quality attribute.

Figure 8.2 : Preservation by drying

7. Use of high sugar or salt content

Sugaring: A strong sugar (more than 68.5^0 brix) concentration prevents mould, yeast and bacterial growth e.g. fruits in heavy sugar syrup (preserve or *murraba*), jams, jellies, marmalades, candies and sweetened condensed milk, etc.

Salting: Salting is one of the oldest natural method of food preservation. Dry salting is used in India for the preparation of tamarind preserve, raw mango, Indian gooseberry (*amla*), fish, meat, etc. Salting preserves the food by removing moisture from food through osmosis and makes it unavailable for microbial growth and enzyme action. The chloride in salt has direct effect on the growth of microorganisms.

Fig. 8.3 : Preservation by Sugar

Fig. 8.4 : Preservation by Salt

8. Use of organic acids

Organic acids are used to inhibit growth of many spoilage microorganisms that helps in food preservation e.g. acetic acid, lactic acid, citric acid, malic acid are widely used for preservation in food products. Vinagar contains 4 % acetic acid which is used for pickling of vegetables like onion, red cabbage, garlic, chillies, etc.

9. Fermentation

The term fermentation is defined as breakdown of carbohydrates by micro-organisms under anaerobic conditions. This is one of the oldest methods of food preservation. The chemicals produced by the microorganisms such as alcohol, or acetic and lactic acids cause the preservative effect of fermentation by slowing down spoilage factors (checking the growth of microorganisms and thereby the spoilage of food). Some food preserved by fermentation are alcoholic products (fruit wine) and acid products (vinegar, pickled vegetables), yogurt, cheese, etc.

Fig. 8.5 : Preservation by Fermentation

10. Preservation by oil and spices

A layer of oil on the surface of any food creates anaerobic conditions which further prevent the growth of bacteria, moulds and yeasts. Thus pickles in which enough oil is added to form thick layer at the top of bottle can be preserved for long periods.

Spices like turmeric, chilli, clove, ginger pepper, and asafoetida have bacteriostatic effect and thus helps in preservation of the food. Their primary function is to impart their characteristic spicy flavour and taste to the food e.g. Oil in mango pickle, lime and chilli pickles.

Fig. 8.6 : Preservation by oils and spices (Pickles)

11. Use of chemical preservatives

Preservatives are classified into two groups like class I and class II preservatives. The class I preservatives are called as natural preservative whereas class II preservative are known as chemical preservative.

Class I Preservatives

The class I preservatives are generally preservatives that are found in common kitchen occuring naturally. It includes sugar, salt, spices, vinegar, honey, vegetable oil, smoke and gases. As class I preservatives are natural, there is no need to be cautious while using it.

Class II Preservatives

Class II preservative includes benzoic acid, sulphurous acid, propionic acid, sorbic acid and their salt, nitrates and nitrites of potassium and sodium. Class II preservatives are chemical preservatives therefore used within the permissible limits prescribed by the regulatory bodies of the country. (In India, FSSAI-2006)

Table 8.3 Class II preservatives

Name of chemical	Salt	Products
Benzoic acid	Sodium benzoate	Tomato sauce, fruit squash, syrup and jam, jelly, etc.
Sulphurous acid	Potassium / Sodium meta-bisulphite (KMS) / (NaMS)	Lime cordial, fruit pulp, fruit products like juice, syrups, squash, candies etc.
Propionic acid	Sodium and Calcium propionate	Bread, juices, dried fruits
Sorbic acid	Potassium / Calcium sorbate	Meat, sea food, confectionery, cheese, cereal products
Nitrates and nitrites	Sodium nitrate, potassium nitrate	Meat and meat products

12. Carbonation

Carbonation is the process of preservation of fruit juices in which carbon dioxide gas is dissolved under pressure. The principle behind this is that by eliminating oxygen and forming carbonic acid from carbon dioxide gas, inhibits bacterial growth e.g. carbonated beverages (soft drinks).

Fig. 8.7 : Preservation by carbonation

13. Preservation by antibiotics

Certain metabolic products of microorganisms have been found to have germicidal effect and are termed as antibiotics. Some antibiotics are used to preserve fruits, vegetables and their products.

Nisin is an antibiotic produced by *Streptococcus lactis,* an organism commonly found in milk, curd, cheese and other fermented milk products. It is non- toxic and has no

adverse effect on the sensory qualities of food. It is widely used in the food industry especially for preservation of acid foods in which it is more stable.

14. Hurdle technology

Combination of two or more of the above methods are called as Hurdle Technology.

15. Advanced methods of food preservation or non-thermal processing techniques

1. High Pressure Processing (HPP)

High pressure processing (HPP) is a way to modify and preserve food without using heat.

2. Pulsed Electric Field (PEF) Processing

Pulsed electric field (PEF) is a non thermal food preservation technology suitable for preserving liquid and semi-liquid food products. It involves application of short, high voltage pulses of electricity to food for microbial inactivation.

Some other methods of non-thermal food processing

- Ultrasound Processing
- Ultra-violet (UV) light
- Electron Beam (E-beam) irradiation
- Gamma irradiation
- Cold Plasma

Points to remember

- Food preservation is process of slowing down the food deterioration activities.
- Thermal food processing involves heating food in an effective way to preserve the food.
- Food additives, preservatives also play important role in food preservation by checking the food spoilage at critical level.
- Non-thermal food processing and preservation method exert minimal impact on nutritional and sensory properties of foods and extend shelf life by killing microorganisms.

Activity

Look at the table. It shows a variety of foods with their water content. Lower the water content in food product better shelflife.

Draw a bar chart to show the water content of each food product in the table.

Using the information from your bar graph answer the following questions.

1. Which two foods are the most difficult for microbes to grow in?
2. Which two foods are the easiest for microbes to grow in?

Food Products in packed form	Water Content (%)	Shelf-life at ambient temp (Approx)
Macaroni	10	2 Months
Fresh meat	70	1 day
Bread	40	4 days
Biscuits	5	>4 Months
Boiled sweets	3	>4 Months
Dried vegetable	5	>4 Months
Rice	16	> one year

Exercise

Q.1 (a) Select the most appropriate option:

i. Keeping micro-organisms out from entering into the food is termed as _____.
(Spoilage, Asepsis, Canning)

ii. Nicholas Appert is the father of _____.
(Boiling, Fermentation, Canning)

iii. _____ is the non thermal method of food preservation.
(HPP, Drying, Pasteurization)

(b) Match the following:

A	B
i. Pasteurization	a. Keeping out microorganisms
ii. Asepsis	b. Father of canning
iii. Nicholas Appert	c. Oldest method of preservation
iv. Salting	d. Louis Pasture
v. Benzoic Acid	e. Use of chemical preservatives
	f. Sterlization

(c) State whether the following statements are true or false:

i. Combination of two or more preservation method is known as hurdle technology.

ii. Salt and sugar are class II preservatives.

iii. Pasteurization leads to the complete destruction of micro-organisms.

iv. HPP processing is a non-thermal method of preservation.

Q.2 Answer in brief

i. Asepsis

ii. Food preservation

iii. High pressure processing

iv. Pulsed electric field processing

v. Canning

Q.3 Short answer questions

(a) Write in short

i. What is the need for food preservation?

ii. Discuss the principles involved in food preservation.

(b) Give the full form of following:

i. HTST

ii. UHT

iii. PEF

iv. HPP

v. LTLT

Q.4 Long answer questions

i. Describe the method of high temperature preservation.

ii. Explain in detail the method of low temperature preservation.

iii. Discuss non-thermal method of preservation

❖ **Project :**

Identify the method of preservation done for value added products. (sauce, pickle, jam, jelly, etc.)