Methods of Food Preservation

Food preservation methods can be classified as follows

I. Physical Methods

A. Preservation by low temperatures

1. Refrigeration
2. Freezing

B. Preservation by high temperature

1. Pasteurization
2. Canning

C. Preservation by drying

1. Sun drying
2. **Drying by mechanical driers**

- Spray drying
- Foam mat drying
- Drying by osmosis
- Freeze drying

D. Preservation by irradiation

II. Chemical Methods

A. High concentration of salt

B. High concentration of sugar

C. Using chemical preservatives

III. Fermentation

Preservation OF food

1. Physical Methods

A. Preservation by Low Temperatures

1. Refrigeration: The temperature maintained in the refrigerator is 0 to 5°C. Enzymatic and microbial changes in foods are slowed down considerably. Perishable foods like eggs, dairy products, meat, sea foods, fruits and vegetables are stored in refrigerators. Food can be stored safely for few days or a week.

2. Freezing: The temperature of freezer is –18 to –40°C. Microbial growth is prevented completely and the action of food enzymes greatly reduced. Frozen foods have better quality and needs uninterrupted supply of electricity while storing. Foods like poultry, meat, fish, peas, vegetables, juice concentrates can be preserved for several months by this method. In vegetables, enzyme action may still produce undesirable effects on flavour and texture during freezing. Various methods of freezing include slow freezing, quick freezing, cryogenic freezing and dehydro freezing.

Quick freezing is an ideal method of preserving nearly all baked products. Bread frozen at –22oC or below retains its freshness for many months. Cakes, cookies, short cakes, waffles and pancakes are also frozen and marketed frozen.

Many food products can have their shelf-life extended by storing them at 4°C or below. Fresh fruits and vegetables, eggs, dairy products, and meats are all commonly refrigerated foods. However, some items, such as tropical fruits (bananas, for example), are destroyed by low temperatures. Freezing is an excellent way to preserve the nutritional value of foods. It's done at a temperature of –18°C to –4°C. The majority of juices are kept by freezing.

B. Preservation by High Temperature

Food commodities in which pasteurization is employed include milk, beer, wines and fruit juices.

1. **Pasteurization:**

It is defined as heat treatment of food material at 72°C for 15 seconds, 63°C for 30 minutes, or 90°C for 0.5 seconds, followed by quick cooling to 7°C. High-temperature-short-time (HTST) treatments are favoured over low-temperature-long-time (LTLT) treatments because they cause less damage to the nutrient composition and sensory properties of meals.
There are three methods of pasteurization.

a. Bottle or Holding Pasteurization: This method is commonly used for the preservation of fruit juices. The extracted juice is strained and filled in bottles. The bottles are then sealed air tight and pasteurized.

b. Over Flow Method: Juice is heated to a temperature about 2.5oC higher than the pasteurization temperature and filled in hot sterilized bottles. The sealed bottles are sterilized at a temperature 2.5oC lower than filling sealing temperature and then cooled.

c. Flash Pasteurization: The juice is heated rapidly to a temperature of about 5.5oC higher than the pasteurization temperature and kept at this temperature for about a minute. This method has been developed specially for canning of natural orange juice, grape and apple juice. It has the advantages of minimizing the flavor loss and preserving the vitamins.

2. Canning: Canning is the process in which the foods are heated in hermetically sealed (airtight) jars or cans to a temperature that destroys microorganisms and inactivates enzymes that can cause food spoilage.
The general steps to be adopted for canning foods are cleaning, blanching, filling, exhausting, sealing, sterilizing, cooling and labeling.

i. Cleaning: It is the first step in canning. Thorough cleaning of the product to be canned helps to remove most of the spoilage organisms.

ii. Blanching: This process serves as an additional hot water wash. It inactivates the food enzymes and fixes the natural colour of the product. It also softens the fibrous plant tissues and facilitates removal of skin. In this process the raw food material is immersed in hot water or exposed to live steam for 2–5 minutes and immediately dipped into cold water to prevent further exposure to heat.

iii. Filling: Either manually or by using machinery the contents can be filled in the cans. A headspace of 6– 9mm depth above the level of food in the can must be left.

iv. Exhausting: Gases are expelled by passing the open can containing the food through an exhaust box in which hot water or steam is used. It expands the food and expels air and other gases from contents and also from the head space area of the can.

v. Sealing: The exhausted containers are immediately sealed to avoid re-contamination.

vi. Sterilization: To bring about complete sterilization, thermal process is carried out. This ensures the destruction of spoilage microorganisms. This is usually done by the application of steam under pressure.

vii. Cooling: The containers are cooled rapidly to check the action of heat and prevent unnecessary softening of the food or change in the colour of the contents. It can be done by means of air or water.

viii. Labelling: The containers are labelled with nutritional characteristics of the food inside.

C. Preservation by Drying

Microorganisms need moisture to grow. When exposed to sunlight or subjected to dehydration, the moisture in the food is removed and the concentration of water is brought below a certain level. This prevents the growth of microorganisms and thereby spoilage of food. Food preservation by drying is one of the oldest meth-ods practiced from ancient times. This method consists of exposing food to sun-light and air until the product is dry. It is a very useful and economical process.
Both the terms ‘drying’ and ‘dehydration’ mean the removal of water. Drying is used to remove moisture by the application of unconventional energy sources like sun and wind. Dehydration

means the process of removal of moisture by the application of artificial heat under controlled conditions of temperature, humidity and air flow.

Treatment of Foods Before Drying

a. Selection and sorting for size, maturity and wholesomeness
b. Washing, especially fruits and vegetables
c. Peeling of fruits and vegetables by hand, machine or knife
d. Subdivision into halves, slices, shreds or cubes
e. Blanching or scalding of vegetables and some fruits like tomatoes and peaches
f. Sulphuring of light coloured fruits and vegetables by exposure to sul-phur-di-oxide gas.

i. Sun Drying: It is limited to regions with hot climates and dry atmosphere and to certain fruits such as raisins, prunes, figs, apricots, pears and peaches. It is a slow process. Many Indian foods are preserved by sun drying. Papads, vadams and vathals are made using this principle. Vegetables like sundaikai, cluster beans, bitter gourd and green chillies are preserved by this method. Fish and meat are also sun dried. The common dried fish or karuvadu (local name) is a good example for sun drying.

ii. Drying by Mechanical Driers: Artificial drying involves the passage of hot air with controlled relative humidity over the food to be dried or the passage of the food through such air. Fruits, vegetables, nuts, fish and meat can be successfully preserved by this method. In the dehydration process, artificial drying methods like spray drying, vacuum drying, drum drying and freeze drying are used for drying foods.

Although it is expensive when compared to natural sun-drying process, it is very hygienic, rapid and the products obtained are uniform in colour because the temperature and relative humidity can be maintained.

i. Spray drying: Milk and eggs are dried to a powder in spray driers in which the liquid is atomized and sprayed into hot air steam or almost instant drying.

ii. Foam mat drying: Foam mat drying may be used commercially to preserve orange and tomato juice. In this pro-cess a small amount of edible foam stabilizer is used. The foam is spread in a thin layer and dried in a steam of hot air. The product gets separated easily into small particles on cooling.

iii. Drying by osmosis: Drying by osmo-sis results when fish is heavily salted. In this case, the moisture is drawn out from all the cell tissues. The water is then bound with the solute making it unavailable to the microorganisms. In osmotic dehydration of fruits, the method involves the partial dehydration of fruits by osmosis in a concentrated sugar solution or syrup.

iv. Freeze drying: Removal of water from a frozen product by sublimation is called freeze drying. Freeze dried foods will be of superior quality with light and porous texture.

D. Preservation by Irradiation

Food irradiation also known as cold sterilization is another preservation technique. The foods are bombarded by high energy rays called gamma rays or by fast moving electrons to kill bacteria, fungi and insects and in some cases to delay fruit ripening or prevent sprouting in onions and potatoes. The goal of irradiation is to kill the microorganisms and inactivate the enzymes without altering the food.

2. Chemical Methods

A. Salt or Brine

It is an ancient preservation technique. Food is treated with salt or strong salt solution. Salt causes high osmotic pressure and shrinking of cell, dehydrates foods and microbes by drawing out moisture.

B. High Concentration of Sugar

Sugar has the ability to bind water and make it unavailable for microbial growth. It reduces the solubility of oxygen in moisture, which is essential for the growth and multiplication of microorganisms. Apples, oranges, guavas, grapes and pineapples are suitable for making jams and jellies. The fruits should be just ripe because the pectin content is high in such fruits.

C. Using chemical preservatives

The chemicals when added interfere with the cell membrane of the microorganisms, their enzyme activity or their genetic mechanisms. They also act as antioxidants. The common chemical preservatives permitted are

1. Benzoic acid (including benzoates) Sodium benzoate is a salt of benzoic acid and is used in preservation of coloured fruit juices and squashes.
2. Sulphur dioxide (including sulphites): Potassium meta-bi-sulphite is used as a source of sulphur dioxide when it is added to the juice or squash. When used in fruits with deep colours like blue grapes, jamun, watermelon it bleaches the colour and hence in such cases benzoic acid is desirable.
3. Organic acids and their salts:

Foods can be preserved by adding lactic, acetic, propionic, citric acids and their salts. Nitrates and nitrite compounds are used to preserve meat and fish prod-ucts. It gives desirable colour, flavor and discourages the growth of micro-organ-isms. It also prevents toxin formation by the microorganisms in food.

Salting and Pickling

Salting

Salt is added to enhance taste and extend shelf life in foods such as butter, cheese, vegetables, bread and meat products. Dry salting is used for meat, mango, amla and fish.

Pickling

It is also an ancient preservation technique. The preservation of fruits and vegetables using common salt, vinegar, oil and spices are referred to as pickling. The layer of oil that floats on the top of pickles prevents the entry and growth of microorganisms like moulds and yeast. Spices like turmeric, pepper, chilli powder and asafoetida retard the growth of bacteria. Vinegar provides an unfavorable acidic environment for microbial growth. The salt added absorbs water and prevents the growth of micro-organisms.

Fermentation

Fermentation is one of the age-old methods of food preservation techniques. Fermentation is a metabolic process in which substances undergo decaying in presence of microorganisms to produce desired compounds that can be utilized for improving food quality and safety. Preservation of food by the fermentation process is a great method to preserve foodstuffs even in industrial level. Fermentation not just prolong the shelf life of food but also has many added advantages like it improves the sensory properties of food and even improves the nutritional value of that food itemFermentation means the process of the reaction between microorganisms and organic compounds in natural conditions. Apart from carbohydrate, microorganisms and enzymes react on protein and fat by releasing carbon-di-oxide and other gases.

Fermented foods can be defined as the food which has been subjected to desirable physical and biological changes by the action of microbes (yeast, molds, etc) or enzymes that provides the food with significant modification of the food as a whole

Sterilization

Microbes are completely eliminated during sterilisation. Fruits and acidic vegetables, such as tomatoes, can be sterilised at 100°C for 30 minutes; however, non-acidic veggies must be sterilised at 116°C for 30 minutes.

Smoking process

Smoking is one of the oldest of food preservation methods. The smoking process allows cured meats, poultry, game and seafood to be subjected to smoke in a controlled environment. The

smoke is produced by smoldering hardwood chips, vines, herbs, fruit skins, or spices. This smoke influences the flavor, aroma, texture, appearance and shelf life of foods.

Dehydration

Dehydration is the process of removing moisture from food materials in order to preserve them. The temperature of dehydration starts at 43°C and gradually rises to 60–66°C (for vegetables) and 66–71°C (for meat) (for fruits).

Curing process

Curing may be defined as the addition of salt (Sodium chloride), sugar and nitrate or nitrite to the meat, which results in conversion of the meat pigments into the characteristic cured meat pigments imparting the characteristic cured meat colour and production of characteristic meat flavour.

The process of meat curing is currently valued as a means of imparting organoleptic qualities to the cured products, though it originally was introduced as a means of preserving meat.
Due to the advent of efficient and widespread refrigeration the need for preserving meat by curing alone has reduced.
Apart from chacteristic colour and flavour, the meat packing industry is concerned with the following attributes also:

- Preservation,
- Tenderness and
- Yield.

Curing Ingredients

- Sodium chloride
- Sodium or potassium nitrate
- Sodium nitrite
- Monosodium glutamate
- Sugar
- Acetic acid
- Vinegar and
- Spices

Action of Curing Ingredients

Salt

- Salt acts by dehydration and alteration of osmotic pressure so that it inhibits bacterial growth and subsequent spoilage.
- It ionizes to yield the chlorine, which is harmful to the organisms.
- It sensitizes the cells against CO_2.
- It interferes with the proteolytic enzyme action.
- The effectiveness of sodium chloride varies directly with its concentration and storage temperature.
- An acceptable level of salts in hams has been reported to be about 3% and about 2% for bacon.

Sugar

- Sugar softens the products by counteracting the harsh and hardening effects of salt.
- It interacts with amino groups of the proteins and upon cooking, forms browning of the products, which enhances the flavour of the cured meats.
- Sugar substitutes have been used in bacon cures to prevent excessive browning during cooking.
- It acts as a preservative by dehydration.

Nitrates and Nitrites

- Nitrates and nitrites bring about the desired pink colour development – nitrosyl hemochromes.
- Both nitrates and nitrites are used where nitrates act as a reservoir for nitrites.
- Nitrate raise the oxidation-reduction potential and therefore are more favourable to aerobic than anaerobic organisms.
- They inhibit the growth of food poisoning and spoilage organisms. It has been clearly demonstrated that nitrite is effective in preventing the growth of the *Clostridium botulinum* organism.
- They retard the development of rancidity.
- Nitrate or nitrite alone or in combination of both shall not be more than 200 ppm in finished products as it is toxic.
- The European Directive 95/2/CE (1995) allows 150 ppm of nitrite (if alone) or 300 ppm when combined (nitrite plus Nitrate), and the residual values should be less than 50 ppm (if alone) or 250 ppm (if combined).
- There are more stringent limits for curing agents in bacon to reduce the formation of nitrosamines. For this reason, Nitrate is no longer permitted in any bacon (pumped and/or massaged, dry cured, or immersion cured).