

Principles and methods of preservation

Preservation: Preservation means just protect the foods against the spoilage, but scientifically it may be defined as a science which deals with the process for prevention of decay or spoilage of the food is called preservation.

Principles of preservation--- There are three main principles:

1. Prevention or delay the microbial decomposition of the food.
2. Prevention or delay the self decomposition of the food.
3. Prevention or damage by insects, animals, mechanical causes.

1. Prevention/delay the microbial decomposition of the food:

1. By keeping out the micro organisms ---Asepsis
2. By removal of micro organisms ---Filtration
3. By hindering the growth and activity of micro organisms ---Anaerobic condition
4. By killing the micro organisms ---Exposing at high temperature

A. Asepsis: It means preventing the entry of micro organisms by maintaining of general cleanliness, while picking, grading, packing and transporting of fruits and vegetables, increase their keeping quality and the product prepared from them will be superior quality.

B. Filtration: Fruit juice, bear, soft drinks, wines etc. enter through a bacteria proof filter which is made of asbestos pad or unglazed porcelain type of materials. These filters contain the micro organisms and allow the water or juice to percolate through with or without pressure.

C. Anaerobic conditions: It can be maintained by:

- Replacing the O₂ by CO₂ ----- Carbonation
- Evacuating the sealed container (fruit juice)
- Use of oils from top of the food (pickles)

Authour's affiliation:

Assistant Professor, Department of Horticulture, Shri. Shivaji Agriculture College, Amravati, M.S., India

Address for correspondence :- Assistant Professor, Shri. Shivaji Agriculture College, Morshi road ,Amravati, Maharashtra, India -444602. Mobile no- 9403063177, 9403178825 Email.: pb_sable@rediffmail.com, pbsable80@gmail.com

D. Exposing at high temperature: Fruits can be exposed to high temperature such as;

Canning: Food is exposed to a high temperature ($>100^{\circ}\text{C}$) which reduces spoilage and inactivate the enzyme present in the food. The process of sealing food stuffs hermitically (air tight, protecting from out side agencies) in containers and sealing them by heat for longer storage is called canning.

Irradiation: In case of irradiation, the food is exposed to the radiations to kill the surviving micro organisms by ionising and non-ionising radiation like α , β and γ rays. Here, food is exposed to electromagnetic or ionizing radiation or various frequencies ranging from low

frequency electromagnetic rays to high frequency i.e. gamma rays which destroy the micro organisms present in the food.

2. prevention/delay the self decomposition:

a. By destruction or inactivating the enzyme – Blanching.

b. Prevention / delay the non-enzymatic chemical reactions – Antioxidant

A. Blanching: Treatment of fruits and vegetables with boiling water or steam for short periods followed by cooling prior to canning is called” **blanching**”.

It is a primary treatment which has to soften the tissues to facilitate packaging.

To preserve the original colour and flavour.

To destroy certain enzymes which are undesirable.

Elimination of the air.

Mostly done for vegetables.

Remove micro organisms

Remove astringent taste and toxins.

B.Antioxidant: Anti-oxidants are substances which are used to protect the food against deterioration caused by exposure to the air.

BHA- Butylactic Hydroxy Anisole & BHT- Butylactic Hydroxy Toluene
(vegetable oils)

Gellales : Animal fat, Vegetable oil

Tocopherols: Animal fat

Ascorbic acid: Fruit juices, Citrus oil, Wine, Beer etc.

Lactic acid: Processed fruits and vegetables, canned fruits.

Phosphoric acid: Vegetable oil, Animal fat and Cola drinks.

3. Prevention or damage by insects, animals, mechanical causes: This principle of preservation deals with the prevention of damage caused by various external agencies other than micro-organisms and enzymes i.e. animals, man, insects, rodents etc. These agencies generally cause physical damage to the food material eg. rats may eat peels of oranges in a storage, animals may also eat the food if kept within their reach etc. But in none of these cases these damages are deleterious to human health. If you consume a half eaten apple or orange you are generally never going to die or experience any health risks, but if the food is spoilt by micro organisms, and you consume the spoilt food your health shall definitely be at risk. The damage of food by animals, man, insects, rodents etc. may later on give way for the initiation of microbial and self decomposition. Proper packing of the food is predominantly the effective solution for prevention

of damage caused by the agencies considered under this principle of preservation. Over all from the food processors point of view the three principles are to be considered in decreasing order of importance and emphasis. Highest emphasis is given on control of microbial decomposition followed by self decomposition, ultimately followed by damage caused by animals, insects, rodents etc.

Methods of preservation of fruits and vegetables

| A. TEMPORARY PRESERVATION | B. PERMANT PRESERVATION |
|----------------------------------|--------------------------------|
| 1. Ascepsis | 1. Sterilization |
| 2. Low temperature storage | 2. By chemical preservative |
| 3. Exclusion of moisture/drying | 3. By antiseptics |
| 4. Use of mild antiseptic | 4. By fermentation |
| 5. Pasteurization | 5. By irradiation |
| | 6. By carbonation |
| | 7. By filtration |
| | 8. By antibiotic |

The important methods of preservation of fruits and vegetables are:

A) Temporary preservation

a) Asepsis: prevention of microbial infection during handling processing and till sealing and during storage of cans by observing strict cleanliness throughout the entire process is kown as asepsis.

Precautions-

- 1 Take proper care during picking and packing of fruits and vegetables discarding the diseased and damaged produce.
- 2 Removed bruised or damaged fruits and vegetables select the material which is free from blemishes.

3 Remove the dirt and microorganisms present superficially on fruit and vegetables by through washing or cleaning for preservation.

4 maintain strict cleanliness and hygienic condition during preparation of produce and during sealing and processing of cans.

5 Store in cool and dry place. Storing in cool place help to maintain proper moisture content in product as well hamper microbial growth.

(2) Preservation by low temperature-- Low temperature retards the microbial growth and enzyme reaction because it retards the chemical reactions. This is not a permanent method because some micro organisms can also grow at low temperature.

1. Cellar storage: (Above 150C)

2. Refrigerated storage: (0 to 50C)

3. Freezing storage: (-18 to -400C)

1) **Cellar Storage:** Cellar Storage (about 150C). The temperature in cellar ((underground rooms) where surplus food is stored in many villages is usually not much below that of the outside air and is seldom lower than 150C. Root crops, potatoes, cabbage, apples, onions and similar foods can be stored for limited periods during the winter months.

2) **Refrigeration:** Refrigerated (or) chilling (0.to 50C). Chilling temperature are obtained and maintained by means of ice or mechanical refrigeration. Most perishable foods, including eggs, dairy products, meats, sea foods, vegetable and fruits may be held in chilling storage for a limited time with little change from their original condition. Enzymatic and microbial changes in the foods are not prevented but are slowed considerably. Fruits and vegetables can be stored for 2-7 days. Semi-perishable crops, such as potatoes, apples etc. can be stored, in the commercial cold storage with proper ventilation, automatic controlled temperature for one year.

3) **Freezing:** Freezing (-18 to -400C). At temperature below the freezing point of H₂O, growth of microorganisms and enzyme activity are reduced to minimum. But, sometimes enzymes are active even below the 00C. In this case before freezing, 'Blanching' is necessary for vegetable freezing. Most perishable foods can be preserved for several months. Fruits, vegetables, juices and fleshy foods (meat, poultry, fish and sea foods) can be preserved in this method.

(3) Preservation by drying --- Drying is just removal of moisture from the food to a certain level at which micro organisms cannot grow is called drying, It can be done by two methods:

(i) Application of heat : (a) Sun drying (b) Mechanical drying (c) Vacuum drying (d) Freeze drying, (ii) Binding the moisture in the food : (a) Use of Sugar & (b) Use of Salt, (i) Application of heat :

(a) Sun drying: Sun drying is the method in which food is directly exposed to sunlight. It is generally done in the places where plenty of sunshine is available for long period e.g. Rajasthan. The dried product in this method is inferior in quality.

(b) Mechanical drying: This is a method of drying where application of heat is applied by a mechanical dryer under the controlled conditions of temperature, humidity and air flow.

(c) Vacuum drying: The temperature of the food and the rate of water removal are controlled by regulating the degree of vacuum and intensity of heat input.

(d) Freeze drying: In this method, the food is dried by sublimation process, i.e., just converting the food into ice without passing through the liquid form of water by means of vacuum plus heat applied in the drying chamber. In this method, the product is first frozen, then water is removed by vacuum and application of heat which occurs simultaneously in same chamber.

(4) Use of mild antiseptic: The use of antiseptics in small quantities prevents growth of microbes either by osmosis or by poison or by both actions for a short time. Sugar, salt, vinegar. Oil etc are example of mild antiseptic.

(5) Pasteurization: It is a mild heat treatment. By pasteurization milk is pasteurized by HTST at 72°C for 15 sec. Fruit juices are pasteurized at such temperature and for such periods as would render them sterile, without impairing their flavor. Usually, the juices are pasteurized at about 85°C for 25-30 min., according to the nature of the juice and the size of container. Acid fruit juices require lower temperature and less time for pasteurization than the less acid ones. Juices can be pasteurized in two ways

- (1) By heating the juice at a low temperature for a High time (LTHT) and
- (2) By heating the juice at high temperature for a short time only (HTST).

B) Permanent preservation

1.1. Preservation by high temperature

Sterilization: Process of killing of all the form of microbial life is called as sterilization. Sterilization products are sealed to prevent entry of live microbes from outside. The temperature and time required for sterilization varies with the types of product. The various methods of sterilization are as follow.

- a) Sterilization below 100°C- eg used for fruit juices.
- b) One time heating at 100°C –for long period
- c) Intermitted processing- at 100°C.

eg Canning: Canning is done at or above 100°C. In case of fruits which are acidic, they are canned at 100°C, while in case of vegetables those are non-acidic; they are canned at above 100°C. Here, high temperature can be obtained by using steam pressure; time varies according to the type of foods. Due to anaerobic condition any survivable organism would not grow.

(2) Preservation by use of chemical preservatives-- Chemical preservatives are substances which are added to food just to retard, inhibit or arrest the activity of micro organisms such as fermentation, pacification and decomposition of the food.

Chemical preservatives are of two types:

Class-1 preservatives: common salt, sugar, dextrose, spices, vinegar, Ascorbic acid etc.

Class-2 preservatives : Benzoic acid and its salt, SO₂ and the salts of sulphuric acid, nitrates, ascorbic acid and its salts, propeonic acid and its salts, lactic acid and its salts. Among the class-2 preservatives, only two chemical preservatives are used in fruits and vegetables preservation:

(i) KMS(Potassium Meta bisulphate) :

- (1) It releases the SO₂ and it is unstable.
- (2) It is used for the fruit which have non water solvent pigment (colourless).
- (3) It can not be used in naturally coloured juices such as phalsa, jamun because they have the Anthocynin pigment.
- (4) It can not be used in the product which is packed in container because it acts on the tin containers and oil, Hydrogen Sulphide (H₂S) which has an unpleasant smell and also form a black compound with the base plate of containers.
- (5) Best to control moulds than bacteria.
- (6) 350 ppm KMS is mostly used in fruit juice products.

(ii) Sodium Benzoate :

- (1) It is a salt of benzoic acid and soluble in water.
- (2) It delays the fermentation in the juices.
- (3) It is commonly used in the product which are having natural colour such as anthocynin pigment.
- (4) It is more effective against the yeast.
- (5) 750 ppm Sodium benzoate is mostly used in fruit juices, squashes and cordials.

(3) Preservation by use of antiseptics (Sugar, Salt, acids and vinegar):

Food additives are substances or mixture of substances other than basic foodstuffs, which are present in the foods as reagent of any aspects of production, processing, storage, packaging etc. Food additives are (i) **sugar**, (ii) **salt**, (iii) **acids**, (iv) **spices**.

In case of sugar and salts, they exert osmotic pressure and water diffuses from the product through a semi-permeable membrane until the concentration reached equilibrium. They kills the micro organisms or do not allow them to multiply.

(i) Sugar: The concentration of 68-70% is used for preparation of jam, jelly, marmalades etc. Sugar act as a preservative by osmosis and not as a true poison for micro organisms. It absorbs most of the available water, so little water available for the growth of micro organisms.

(II) Salt: The concentration of 15-20% is used for the preparation such as pickles. Salt inhibits enzymatic browning and discolouration and also acts as an anti-oxidant. It exerts its preservative action by:

- (i) Causing high osmotic pressure resulting in the plasmolysis of microbial cells.
- (ii) Dehydrating food and micro organisms by tying up the moisture.
- (iii) Ionizing to yield the chloride ion which is harmful to micro organisms, and
- (iv) Reducing the solubility of oxygen in water, sensitizing, and the cells against CO₂.

(III) Acids: Many processed foods and beverages need the addition of acids to impart their characteristic flavor and taste in the final product because acids provide desired flavour and taste. They adjust the sugar and acid ratio in the food .proper balance of flavor of the food. They are also playing the role for controlling the pectin-gel formation.

Main acids are the following: Acetic acid (Vinegar), Citric acid (Lime juice).

1. Acetic acid: It is commonly used for pickles, chutney, sauce and ketchup, just to inhibit the growth of micro organisms.

2. Citric acid: It is used for the preparation of jam, jelly, squash, nectar etc. just to increase the acidity.

(IV) Oil A layer of oil on the surface of any food produces anaerobic conditions which prevent the growth of moulds and yeasts. Eg., pickles

(4) Preservation by fermentation -- Decomposition of carbohydrates by microorganisms or enzymes is called fermentation. Foods are preserved by the alcohol or organic acid formed by microbial action. The keeping quality of alcoholic beverages, vinegars, and fermented pickles

depends upon the presence of alcohol, acetic acid and lactic acid respectively. Wines, beers, vinegar, fermented drinks, fermented pickles etc., are prepared by these processes. In wines – 14% alcohol acts as a preservative. About 2% acetic acid prevents spoilage in many products.

(5) Preservation by irradiation-- Sterilization of food by ionizing radiations is a recently developed method of preservation. The unacceptable flavor of some irradiated foods and the fear that radioactivity might be induced in such food has come in the way of its greater use. When gamma rays (or) electron beams pass through foods there are collisions between the ionizing radiation and food particles at atomic and molecular levels, resulting in the production of ion pairs and free radicals. The reactions of these products among themselves and with other molecules results in physical and chemical phenomena which inactivate microorganism in the food. Thus irradiation of food can be considered to be a method of “Cold Sterilization” i.e. food is free of microorganism without high temperature treatment. Radiation dose of up to 1 *Mrad* is not hazardous. Ionizing radiations can be used For sterilization of foods in hermetically sealed packs, Reduction of the spoilage organisms in the perishable foods, delays ripening of fruits, Inhibits sprouting of root vegetables and controls infestation (insects) in stored cereals

(6)Preservation by Carbonation -Carbonation is the process of dissolving sufficient CO₂ in water or beverage so that the product when served gives off the gas as fine bubbles and has a characteristic taste. Fruit juice beverages are generally bottled with CO₂ content varying from 1 to 8 g/ l, it is sufficient for supplementing that effect of acidity on pathogenic bacteria. For complete inhibition of microbial activity (14.6 g CO₂/ l) creating an anaerobic condition, which reduces the oxidation of ascorbic acid and prevents browning. Although carbonated beverages contain sugar much below 66%, the absence of air and the presence of CO₂ in them help to prevent the growth of moulds and yeasts. The keeping quality of carbonated fruit beverages is enhanced by adding about 0.005% sodium benzoate. The level of carbonation required varies according to the type of fruit juice and type of flavor.

(7)Preservation by filtration -- Filtration is the only successful method for the complete removal of organisms and its use is limited to clear liquids. The liquid is filtered through a previously sterilized ‘bacteria proof’ filter made of sintered glass, diatomaceous earth, unglazed porcelain, membrane pads, (or) similar material and the liquid is forced through by positive or negative pressure. This method has been used successfully with fruit juices, beer, soft drinks, wine and water.

(8) Preservation by Antibiotics--- Certain metabolic products of microorganisms have been found to have germicidal effect and are termed as antibiotics.

Nisin is an antibiotic produced by *Streptococcus lactis*. Commonly found in milk, curd, cheese and other fermented milk products. It is non-toxic. Used in the food industry especially for preservation of acid foods in which it is more stable. Used in canning of mushrooms, tomatoes and milk products.

Subtilin - an antibiotic obtained from certain strains of *Bacillus subtilis* is used in preservation of asparagus, corn, and peas. It is most effective against *gram*positive bacteria and spore-forming organisms.

Pimaricin- an antifungal antibiotic can be used for treating fruits and fruits juices .

References:

1. Preservation for fruits and vegetables. Principle and practices. By Shrivastava & Sanjeev Kumar.
2. Post harvest physiology, handling, utilization of tropical and subtropical fruits and vegetables. By Pantastico, E.R
3. Post harvest biotechnology of vegetables. By Salunke, D.K.
4. Fruits and vegetables preservation. By Girdharilal, Sidhappa and Tandon.
