Principal and Traditional methods of food Protection in preservation ---(Part 1)

Physical methods
Chemical methods
Biological methods

In this chapter we deal with the following aspects

- ✓ Prevention of contamination:
- ✓ General principles for preventing food contaminations:
- ✓ Food preservation methods
- ✓ Removal/restriction of microbes
- ✓ Methods to control microorganism in food processing

1. Introduction:

Nature provides protective coverings around the food. It may be in the form of shells of nuts, dry skins of cereals or thick skins of fruits and vegetables. In animal based foods, the shells of eggs, the rubbery skin or fat layers on meat or fish provides the protection. These protective coverings also prevent or delays microbial colonisation and further decomposition.The aim of food protection and food preservation is to prevent contamination and spoilage of foods. A number of food preservation methods are used today has their origin dating back to ancient time.

Physical Methods of Food Preservation includes methods like Dehydration, Freezing, Cool Storage, and Heat Treatment.The standards for the number of microbes permitted in various food are specified in our country by Food Safety and Standards Authorities of India (FSSAI). Every company/person dealing with food commercially needs to take approval from FSSAI and adhere to the conditions laid by them.
This is mainly to prevent the spoilage of food and further to take care of the consumer's health. They also lay down the standards for the containers, preservatives nutritional conditions, contaminants and storage. The details of FSSAI Laws will be dealt in another chapter.

Prevention of contamination:

The food should be clean and neat with minimum contamination from the field. Food can be damaged either by insects, animals or by mishandling. The damaged portions are then exposed for microbial attack. Therefore, care should be taken to minimize any damage to the foods. This can be achieved by cleaning the food in the place it is grown or reared. The food material should be washed and dried before it is packed in appropriate containers. One of the important place for the spread of contamination is the packing material and market floor. Hence it is advised to wash

clean and separate the good material from the spoilt ones before it is taken inside our house or processing units.

Food handlers' hygiene:

One of the most important ways of preventing contamination is by adopting good **food handlers' hygiene**. This includes a set of practices that should be followed by all the personals involved in handling food at every stage of the food supply process. Food handlers' hygiene in both retail and commercial premises, where food and drink is sold to customers is of critical importance.

The same principles should also be practiced at the domestic premises. The importance of good food handlers' hygiene is:

- To prevent food contamination and spread of disease.
- To ensure the good health of people eating the food.
- To protect the health of the food handler.

All the food handlers should avoid bad habits such as scratching, touching the hair, nose or mouth, having unclean hair, unclean and long fingernails. Food handlers should refrain from smoking, coughing or sneezing in food handling and preparation areas. They should be healthy and should not be carrying any contagious diseases like skin infections, diarrhea or sore throats. They should always wash their hands before they enter the premises where food is prepared or handled and after using the toilet.

2. General principles for preventing food contaminations:

Some of the general principles for preventing food contaminations are:

- Water used in food preparation should be of good quality and adhere to the standards specified by FSSAI.
- All the utensils must be kept clean and covered.
- All surfaces that come in contact with food should be well cleaned.
- The areas used for storage, preparation and serving of food should be free of pets, rats and insects.
- All type of prepared food should be clearly labeled, covered.
- Food and the utensils should be kept separate from chemicals and poisons.
- Cloths and handling aids that come into contact with dishes and utensils, and that are used to cover food, need to be changed daily and washed in hot water before use.

During storing or preserving food, the conditions which are congeal for the spoilage systems has to be restricted. Like we humans, microorganisms also need food and water. Further, they also need a suitable pH and temperature to grow. Therefore, if we can target and limit these requirements food preservation can be achieved. Food preservation depends on the methods which effectively manage the microbial content of foods. They should also alter or delay the

activities of enzymes in the food. The techniques to achieve these may be applied separately or in combinations. Thus the aim of food preservation should be to first prevent contamination then to reduce the population of contaminants and to prevent microbial growth.

The pre-processing of food preservation can be divided into three parts:

i. Proper packaging

ii. Quick and effective transportation

iii. Providing good storage facilities (silos for grains and cold storages for fruits and vegetables).

Once the food ingredients/raw materials are properly handled and managed the next step is Food preservation.

Food preservation methods: Methods that allow food to be kept for a specified period of time without losing its nutritional quality. The method should also prevent the growth of unwanted microorganisms which leads to spoilage.

The three basic objectives of food preservation are

- Prevention of contamination of food from external damaging agents.
- Prevention or delay of growth of spoilage microorganisms.
- Delay of enzymatic spoilage by the naturally occurring enzymes within the food (self-decomposition).

Food industry adopts several aseptic methods to prevent the contamination of foods during processing. Industries based on their requirement,determine the process of food preservation. For example in the canning industry, the microbial load determines the temperature required to process. This is known as aseptic canning. In the dairy industry, the quality of milk is judged by its bacterial content.

Some of the methods adopted to achieve good processed foods are:

Removal/restriction of microbes

For liquid foods filtration is a method used for the complete removal of microorganisms. This method can be successfully applied only to clear liquidseg. Water, fruit juices, beer, soft drinks and wine. The filters are sterilised and made “bacteria proof” before they are used. The liquid is filtered by passing through the filters under pressure.

Inhibiting the growth and/or activity of micro-organisms

This may be achieved by storing at low temperature or drying or by providing anaerobic conditions or using chemicals. Holding the food material at Low temperature in cold storage slows down and sometimes prevents microbial activity. All microorganisms need moisture and

they cannot flourish in the absence of moisture. Hence, drying of foods is a very effective method for avoiding spoilage of food. When anaerobic (absence of oxygen) conditions are created, most of the aerobic organisms die. The spores may survive but will be unable to multiply in the absence of oxygen. This principle is used in canning and in packaged foods.

Certain chemicals like sodium benzoate and potassium meta-bisulphite are used as preservatives. However, they should be used within the prescribed limits as any excess usage may result in poisoning.

The most common and ancient method used is heat processing. In irradiation gamma rays or high speed electrons are used to destroy the micro-organisms. Such radiations are known as ionized radiations. This topic will be dealt in part 2 of this chapter.

Prevention or delay of self decomposition of food

Blanchingis commonly carried out for destruction or inactivation of food enzymes. Blanching is a process of dipping the whole food material in boiling water or steam for a short period of time. The time duration of treatment applied varies with the kind of food. This process inactivatesplant and microbial enzymes. Most of the plant and animal tissues contain enzymes which are active at room temperatures. An increase of temperature by 10°C doubles the rate of the chemical change. Eg. Rancidity of fats, which leads to the deterioration in flavour of food. Oxidation also leads to a loss of ascorbic acid an important vitamin for human beings.These enzymes may soften the tissueand change colour. Eg. Cut Apple and Banana.

Short heat treatment can reduce the number of micro-organisms on the food, enhance of the colour of vegetables such as peas and spinach. They also prevent secondary contamination due to damagescaused byhandling, insects and animals.

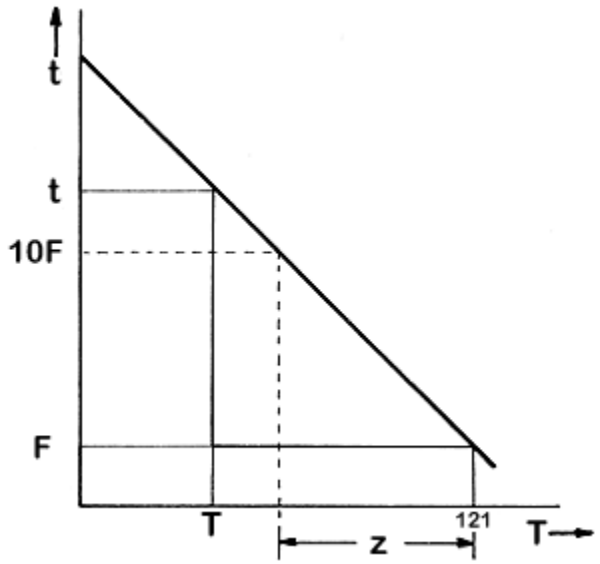
Aseptic processing following of HACCP, GMP, ISO 9000,and Total Quality Management (TQM) need to be a part of food production.

3. Methods to control microorganism in food processing

Canning: Microorganisms are destroyed by heat. But the amount of heat required for the killing different organisms varies. Microorganisms can exist in two forms, the vegetative or growing form and the spore or dormant form. The spores are much harder to destroy by heat treatment than are the vegetative forms. Canning is a process in which temperatures of over 100°Cand sealing in sterile airtight containers is used. Such treatments kill all spoilage organisms and their spores it also in activates the enzymes. The packaging materials for canning can be tin or glass. In this process the food is sterilized ie. the food is free from all microorganisms and its spores. This also prevents decomposition of the food, making it unattractive or inedible. Sterilization also prevents pathogenic (disease-producing) organisms from contaminating the food.

It has been found that all microorganisms, including *C. botulinum*, are destroyed by heat. Higher temperatures kill spores more quickly. At any given temperature, the spores are killed based on time of exposure. Some spores are more resistant to heat than other spores. If a graph is drawn, the number of surviving spores against time of holding at any chosen temperature; it is found that the number of surviving spores fall almost to zero.

Experimentally, it has been found that if the logarithm of *t*, the thermal death time, is plotted against the temperature, a straight-line relationship is obtained.



Thermal Death time/temperature Relationships

We can then write from the graph

$$\log t - \log F = m(121 - T) = \log t/F$$

Where*t* is the thermal death time at temperature *T, F* is the thermal death time at temperature 121°C and *m* is the slope of the graph.

The D-value of an organism is the time required in a given medium, at a given temperature, for a ten-fold reduction in the number of organisms. The z-value is a measure of the change of the D-value with varying temperatures.

It is possible to choose values of *F* and of *z*- valuesto suit specific requirements based on the contaminating organism.

Basically, heat treatment can be classified into three categories:

(i) Pasteurisation:Pasteurisation is a heat treatment that kills part of the micro-organisms present in food using a temperature under 100°C. The temperature used ranges from 65-75°C. There are two types of pasteurisation:

❖ HTST (High temperature-short time) Food product is heated at high temperature for a short time. For example, milk is heated to 72°C and held for 15 seconds.

❖ LTLH (Low temperature-long time) Food product is heated at a lower temperature for longer period of time. Eg. milk is heated to 62.8°C and held for 30 minutes.

(ii) Boiling or heating at about 100°C. Most fruits and vegetables can be preserved for a longer time by applying heat at about 100°C. Inherent enzymes which initiate self-decomposition can be destroyed after boiling at 100°C. This process is called blanching.

(iii) Sterilisation (temperature 100 or above) It is a process in which all micro-organisms are killed at high temperature or radiation. The time and temperature necessary for sterilisation vary with the type of food. Few examples are listed.

Time and temperature required for sterilization of various food

Type of food	**Temperature**	**Duration**
Fruit and tomato	**100°C**	**30 minutes**
Vegetables	**116°C**	**30-70 minutes**
Milk (ultra Heat Treatment (UHT))	**135°C**	**not less than 1 second**

However the type of food determines the type of treatment and not the type of contaminating organism for eg. If food is overcooked,major changes occur in texture, flavor and nutritional quality making them unpalatable.

4. Use of low temperature and cold preservation:

Low temperature can lower the rate of chemical reactions and the action of enzymes. Generally, freezing can prevent the growth of most food-borne micro-organisms and the usual temperature for cold storage is 4.5-7°C. Refrigeration temperature lowers the growth rate of micro-organisms and chilling can slow down the enzymatic and microbial changes in food. For frozen food, it should be stored at or below -18°C where the enzymatic and microbial changes may be stopped or extremely slow.

Dehydration:

Drying or dehydration of foods as a method of preservation which has a long history. In olden days oriental countries would dry mushrooms, dried shrimps and salted fish. Both “drying” and “dehydration” mean the removal of water. “Drying” usually describes the process of drying under sunshine or open air. The other term, dehydration, usually describes the removal of moisture by applying artificial heat current under controlled conditions. Some of the differences of drying and dehydration are listed.

Differences between drying and dehydration.

Dehydration	Sun-drying
A faster process **Under controlled hygienic conditions** **Not dependent on the weather** **Investment on machinery and processing cost is needed**	**A slower process** **Under open-air conditions with little hygienic control** **Not possible in cloudy weather or rainy days** **No machinery and processing cost is needed**

Use of preservatives:

Preservatives serve as antimicrobials which prevent or slow down the growth of moulds, yeasts and bacteria. By preventing the growth of moulds, yeasts and bacteria, preservatives can improve the safety of food as well as prevent the wastage of seasonal surplus by making it last longer on the shelf or in the fridge. An ideal preservative should meet the following criteria: (i) they should inhibit the growth of a wide range of micro-organisms (ii) they should be non-toxic to humans (iii) should not be expensive (iv) should not affect the flavour, taste or aroma of the food product (v) should not be inactivated by the food (vi) should not promote the development of resistant micro-organisms (vii) should kill rather than inhibit the micro-organisms. Some of the common preservatives used in food are listed .

Some Common Preservatives

Preservatives	Target Organism(s)	Application(s) in Food
Sulfites	**Yeasts and bacteria**	**Dehydrated fruits and vegetables, wine, juice, sausages**
Sodium nitrate	**Bacteria**	**Meat and meat products**
Propionic acid	**Moulds**	**Bread, cakes, cheese**
Sorbic acid	**Moulds**	**Cheeses, cakes, salad dressing, wines**

Brining and sugar solution preservation: It means the use of salt and sugar for food preservation. Sugar binds to moisture and thus can preserve food by preventing the growth of microorganisms. However, sugar needs to be used in high concentration (65% or above). Products such as jams and jellies are preserved by using sugar. Most of the candies (both hard and soft) are preserved using sugar.

Salt in high concentration (15-20%):It can prevent the water being available for bacterial growth. This process is known as reducing the water activity (aw). It can slow down the growth rate of bacteria and thus the food is preserved. Salt can be used in brine (salt water) or applied to food directly. Most common salt used for such preservations is sodium chloride or common salt. This

technology even though old is slowly losing its importance due to the excess salt that is used. Hence, considered not healthy.

Pickling: Is a process in which use of acids (vinegar or citric acid) Acids spices and brine are in combination .This treatment lowers the pH and thus inhibits the growth of many micro-organisms. It is more effective against yeast and bacteria than moulds. About 20% vinegar (acetic acid) prevents the spoilage of most products. It is used in the preservation of pickles, sauces and chutney. Citric acid, is also used in the preservation of certain fruits and vegetables. Products of jams, jellies and squashes may contain citric acid. It lowers the pH of the food products and can prevent the growth of moulds. Today this technology has many ramifications as a number of food like Gerkins are exported from our country using this technology.

5. Conclusion:

In this chapter we tried to understand the commonly used process of food preservation. Many of these techniques are widely used in home or cottage industries level with minimum machineries. The main intentions are to see that the uncooked foods (raw materials) are handled carefully. Further the basic principles of hygiene are to be practiced. Methods like cooking at high temperature and keeping them in closed containers, storing the cooked food at low temperatures are common practices at home levels. Understanding the D and Z values required for preventing the contamination and the temperatures to which the food can be taken without losing its organoleptic characters is important. Many of the foods that we use in our common day to day life are processed in these manners eg. Milk, papad, pickle, jam etc.

Dear viewers the more modern technologies that the industries adopt to handle large quantity of foods will be taken up in the part 2 of food preservation.