Food Preservation & Principle

The basic principles of food preservation primarily involves the process of

- Inhibiting the growth and activity of micro-organisms
- Inhibiting activity of endogenous enzymes
- Inhibiting chemical reactions which may deteriorate the quality of food
- Inhibiting invasion and spoilage by insects and rodents.

How to prevent deterioration of quality of food

Several methods are available for preservation of food based on food principles. The methods include:

- Preventing the accessibility of food to micro-organisms by asepsis and packaging.
- Physical removal of micro-organisms from food by filtration or centrifugation.
- Hindering the growth and activity of micro-organisms by use of preservatives, use of low temperature etc.
- Killing the micro-organisms by use of high temperatures and ionizing radiation.
- Inactivation of endogenous enzymes by moderate heating
- Inhibition of chemical reactions through the use of chemical additives.
- Fermentation of foods to yield more stable or less perishable food products.

Factors affecting heat resistance of micro-organisms

Cells and spores differ widely in their ability to resist high temperatures. The various factors influencing the thermal death time (heat resistance) of micro-organisms include the following:

(a) Temperature-time relationship
(b) Initial concentration of spores and cells
(c) Previous history of the vegetative cells or spores
(d) Composition of the substrate.

(a) Temperature-time relationship:

The time required for killing cells or spores under a given set of conditions decreases as temperature is increased. For example, the time required to kill the spores of ***C. botulinum*** at an initial population of 6 × 1010 in medium at p^H 7.0 has been estimated to be 260 minutes at 100^0C, 120 minutes at 105^0C, 36 minutes at 110^0C and 5 minutes at 120^0C.

(b) Initial concentration of spores and cells:

The more the number of spores or cells present, greater is the heat treatment required to kill them. For example, the time required to kill spores of a thermophilic organism in spoiled canned corn juice with a p^H of 6.0 at a temperature of 120^0C has been found to be 14 minutes for an initial concentration of 50000/ml, 10 minutes for 5000/ml and 9 minutes for 500/ml.

(c) Previous history of the vegetative cells or spores:

The parameters of importance include:

- Culture medium
- Temperature of incubation
- Phase of growth or age
- Desiccation

The better the medium for growth, the more the resistance of cells or spores. For example, ***E. coli*** is more heat resistant when grown at 38^0C which is near its optimum temperature for growth than at 25^0C.

(d) Composition of the substrate:

The composition of the substrate or food in which the cells or spores are heated has a profound influence on the heat resistance of the organization.

- **Moisture content:** Moist heat is more effective as a killing agent than dry heat.
- **p^H of the medium:**
    - High acid foods: p^H < 3.7; e.g. berries, sauerkraut.
    - Acid foods: p^H 3.7- 4.5; e.g. tomato, pear, pineapple.
    - Medium acid foods: p^H 4.5- 5.3; e.g. beet, spinach.
    - Low acid foods: p^H > 5.3; e.g. corn, peas, beans, meat, fish, poultry and milk.

- Other constituents in food, particularly, Sodium Chloride in low concentration has a protective effect on some species. Sugars mat protect some spores, glucose protects ***E. coli***. Glucose is harmful to ***Staphyllococcus aureus***, whereas sodium chloride is very protective.
- The concentration of solutes may affect the heat process necessary for sterilization.
- Antiseptic or germicidal substances in the substrate aid heat in the destruction of micro-organisms.

Thermal death time of bacterial cells & their spores

Thermal death time of bacterial cells		
Name of the bacterium	**Time (min.)**	**Temperature (^{0}C)**
Gonococcus	2-3	50
Salmonela typhosa	4	60
Staphyllococcus aureus	19	60
E. coli	30	57
Streptococcus thermophilus	15	75
Lactobacillus bulgaricus	30	71

Factors affecting thermal process time:

A variety of factors influence the time required for thermal processing for a food. These include:

- **The material of the container:** Glass having a slower rate compared to that of a metal.
- **The size and shape of the container:** Smaller and slim cylindrical cans attain the desired temperature faster.
- **Initial temperature of the food:** A higher initial temperature provides the lethal range for the micro-organisms. A higher initial temperature is necessary for foods which heat slowly, e.g. meat, pumpkin etc.
- **Retort temperature:** A higher retort temperature heats the foods rapidly.

- **Consistency of the food:** Nature, sizes and shapes of pieces decide the rate heat penetration.

Commercial heat preservation method:

Commercial heat preservation methods may be classified into three (3) types:

(i) Blanching
(ii) Pasteurization &
(iii) Sterilization

➢ **Blanching:**

Blanching is generally applied to fruits and vegetables, primarily to inactivate natural food enzymes. This is a kind of small heat treatment. Blanching, depending upon its severity, also destroys some micro-organisms. Blanching is done by immersing the raw foods in boiling water for about 2-3 minutes or by using steam.

➢ **Pasteurization:** This is comparatively low order of heat treatment generally done at temperature below the boiling point of water. Two primary objectives are achieved by pasteurization.
  - ✓ **(i)** Destruction of majority of but not necessarily all pathogenic and other spoilage micro-organisms in liquid foods such as milk and liquid egg. In the case of milk used cheese making, pasteurization destroys all micro-organisms that would compete with the desired fermentation process at a later stage.
  - ✓ **(ii)** Extending the product shelf life from a microbial and enzymatic point of view.

➢ **Sterilization:** The aim is to complete destruction of micro-organisms. Because of the resistance of certain bacterial spores to heat, a treatment at 121^0C (250^0F) of wet heat for 15 minutes or its equivalent is necessary for sterilization. Commercially, sterile canned foods have a shelf life of 2 years or more. Even after longer periods, deterioration in the quality of such foods is generally due to texture or flavor changes rather than to growth of micro-organisms.

- **Canning:** A variety of foods are canned. These include whole fruits and vegetables, sliced or dried fruits and vegetables, meat and meat products, fish and fish products and soups. Two general methods of sterilization are commonly used in industry.
  - ✓ **(i)** In-pack sterilization (sterilization inside containers)
  - ✓ **(ii)** Sterilization of the food before placing in the containers.

(i) **In-pack sterilization:** The in-pack sterilization involves several steps. These include:

- ✓ Cleaning and grading of food raw materials
- ✓ Blanching to inactivate native enzymes (particularly in vegetables and fruits)
- ✓ Filling or placing the cleaned raw food in a sealable container, with added brine in the case of vegetables, meat and fish, or sugar syrup in the case of fruits
- ✓ Deaeration (to prevent bulging or bursting of can during heating) followed by closing and sealing the container.
- ✓ Heating the container in a retort at specified temperature for a specific holding time.
- ✓ Cooling particularly under pressure in the retort followed by cooling in a cooling tank &
- ✓ Labeling, storing and/or marketing.

Asceptic canning:

Asceptic canning involves:

- ✓ Sterilizing the food separately outside the containers
- ✓ Placing the food in previously sterilized cans under asceptic conditions &
- ✓ Sealing the containers.

THANK YOU