Food preservation:

It is known "as the science which deals with the process of prevention of decay or spoilage of food thus allowing it to be stored in a fit condition for future use". Preservation ensures that the quality, edibility and the nutritive value of the food remains intact.

The term food preservation refers to any one of a number of techniques used to prevent food from spoiling. It includes methods such as drying and freeze-drying, irradiation, pasteurization, smoking, canning, pickling, and the addition of chemical additives.

Principles of Food Preservation:

The principles of various methods for food preservation are as:

1) Prevention or delay of microbial decomposition:
   - By keeping out microorganisms (asepsis)
   - By removal of microorganisms
   - By hindering the growth and activity of microorganisms (e.g. by low temperatures, drying, anaerobic conditions, or chemicals).
   - By killing the microorganisms (e.g. by heat or radiation)

2) Prevention or delay of self decomposition of the food:
   - By destruction or inactivation of food enzymes (by blanching)
   - By prevention or delay of chemical reactions (By using antioxidant)

Methods of Food Preservation:

There are three methods to preservative food:

- ***Physical methods:***

•Cooling to

→ Low temperature refrigeration (0 to 7°C) - preserves for shorter period (days) → Freezing - preserves for several months

• Heating → pasteurization, cooking, sterilization etc.

• Exposure to ionizing radiation → U.V., γ, etc.

• Application of high pressure

• Drying → removal of water to a level which does not support the growth of microorganism

- ***Chemical methods:***

• Chemical food preservatives are applied to foods as direct additives during processing, include sodium chloride (common salt), sugar, acids, alcohols and components of smoke, which act as antimicrobial agents.

- ***Biological methods:***
- Souring (fermentation) lactic and acetic acid, e.g. cheese and milk.

Thermal treatment:

The term "thermal" refers to processes involving heat. Heating food is an effective way of preserving it because the great majority of harmful pathogens are killed at temperatures close to the boiling point of water. In this respect, heating foods is a form of food preservation comparable to that of freezing but much superior to it in its effectiveness.

This process prevents or retards spoilage because high temperatures kill or inactivate most kinds of pathogens.

Several measurements have been defined to quantify and killing power of heat.

1- ***Thermal Death Point (TDP)***: is the temperature that kills all the bacteria in a 24-hour-old broth culture at neutral pH in 10 minutes. Factor to be considered in sterilization is the length of time required.
2- ***Thermal Death Time (TDT or F value)***: is the time required to kill all the bacteria in a particular culture at a specified temperature. Both TDP and TDT are useful guidelines that indicate the severity of treatment required to kill a given population of bacteria.
3- ***Decimal reduction time (DRT or D value)***: is a third concept related to bacterial heat resistance. DRT is the time, in minutes, in which 90% of a population of bacteria at a given temperature will be killed.

Factors Important for Determination of Time and Temperature:

When determining the time and temperature for microbial destruction with heat, certain factors bear consideration:

1. Initial number of M.O.
2. Age of M.O.: Stationary phase is more resistance than log phase and spore is more resistance than vegetative cells because of the present of Ca^{++} deposition in their cell wall.
3. Type of M.O.: Thermophilic bacteria are more resistant than mesophilic and psychrophilic bacteria. Also bacteria are more resistance than fungi.
4. Type of Food: Dry food need long exposure to heat than moist food.
5. Presence of Organic, Acidic or Basic Material: Organic matter may prevent heat from reaching microorganisms, while acidity or alkalinity may encourage the lethal action of heat.

Procedure:

1. Inoculate 10ml of sterilized nutrient broth with 0.1 ml of actively grown bacteria.
2. Streak a loopful of the grown bacteria onto a nutrient agar plate.
3. Label the plate with the name of the organism and the word *Control* (zero time).
4. Place the "control" plate at 37°C incubator for 24 hours.
5. Divide one nutrient agar plate into 4 quadrants by marking the bottom of the plates with a wax pencil or ink marker.
6. Label the 4 quadrants on each plate as follows: 5, 10, 15, 30 minutes.
7. Place a tube in a water bath at 70^{o}C. Note the time.
8. Leave the broth culture in a water bath for 5 minutes. Remove the tube and streak a loopful of heated culture onto the quadrant of nutrient agar labelled 5 minutes.
9. Return the tube to the water bath for an additional 5 minutes and then streak a loopful of culture onto the quadrant of nutrient agar labeled 10 minutes.
10. Repeat step 9 twice more, streaking loopful of culture onto the quadrants of the plates labeled 15 and 30 minutes, respectively.
11. Incubate subcultures from heated tube at 37°C for 24 hours.
12. Record F-value and then D-value by using semi-log paper.