Food preservation

The dictionary meaning of the word "preserve" is to keep safe, retain quality, and prevent decomposition or fermentation. When we apply this meaning to food preservation:

Food preservation refers to the process of treating and handling food to stop or slow down spoilage to prevent food-borne illness and extend its shelf-life. Changing raw products into more stable forms that can be stored for longer periods of time. Allows any food to be available any time of the year in any area of the world.

Principles of food preservation:

Foods are readily decomposed unless special methods are used for their preservation. All methods of food preservation are based upon one or more of the following principles:

1. Prevention or removal of contamination.
2. Inhibition of microbial growth and their metabolism.
3. Killing of microorganisms.

All of the food preservation processes work by slowing down the activity and growth of disease causing bacteria, or by killing the bacteria all together. They also slow down or stop the action of enzymes which can degrade the quality of the food.

Methods of Food Preservation

Various practices are used for food preservation now the days. These practices can be summarized as:

- Heat treatment
- Removal of water

- Osmotic pressure treatment
- Removal of air
- Alteration of pH
- Treatment by radiation

1. Heat Treatment:

For each 10 °C rise in temperature, the activity of micro-organisms and enzymes increases by at least 2x, in the range 0-60 °C. Above this, heat quickly destroys enzymes and stops living cells from working.

- ***Increased temp. :***

  Can have a more permanent preservative effect, and only require a fairly brief treatment. They may also alter the flavor of food.

***** Gentle heating (about 60-70 °C, up to boiling, 100 °C) :***

Kills most bacterial cells in a few minutes, but does not affect some species which form spores. It also denatures proteins, so it deactivates enzymes.
Most cooking does this, and pasteurization milk is carefully controlled to prevent flavor changes, although it does not quite kill all contaminating bacteria.

***** Steam under pressure :***

raises the temperature (usually to 120 °C or more) , is the most effective method, since it kills all vegetative cells(in seconds) and spores (need about 15-20 min.), such as in pressure cooker, Autoclaving .Such heating to high temperatures by steam injection is followed by rapid cooling. The whole process of canning includes, cleaning, blanching, filling of cans or jars, sealing, autoclaving and cooling.
After heat treatment, it is essential to ensure that foods cannot become contaminated by contact with raw food, because they are now more easily colonized by bacteria.

- ***Low temperature treatment :***

Can retard the growth and metabolic activities of M.O and lower the rate of chemical reactions and the action of enzymes.

Refrigeration:

Chilled foods are those foods stored at temperatures near, but above their freezing point, typically 0–5 ^{0}C, is slows down the biological, chemical, and physical reactions that shorten the shelf life of food. All perishable foods should be refrigerated as soon as possible, preferably during transport, to prevent bacteria from multiplying.

Though psychrotrophs can grow in chilled foods they do so only relatively slowly so that the onset of spoilage is delayed. Though mesophiles cannot grow at chill temperatures, they are not necessarily killed.

Only for few days 4°C to 7°C, because it decays more slowly. Bacteria are not killed, but merely less active.

If foods are kept for longer periods undesirable changes due to active enzymes and psychrotrophs organism (*Ps. fluorescence* and some *Micrococcus spp*.) take place causing spoilage.

Chilling will produce a phenomenon known as **cold shock** which causes death and injury. Cold shock depends on a number of factors such as the organism (Gram-negatives appear more susceptible than Gram-positives), its phase of growth (exponential-phase cells are more susceptible than stationary phase cells), the temperature differential and the rate of cooling, and the growth medium (cells grown in complex media are more resistant).

Advantages:

- Slows microbial multiplication.
- Slows autolysis by enzymes.

Disadvantage:

- Slow loss of some nutrients with time

Freezing:

Freezing is the most successful technique for long-term preservation of food since nutrient content is largely retained and the product resembles the fresh material. The temperatures used in frozen storage are generally less than (-18 ^{0}C). At these temperatures no microbial growth is possible (completely inactive) , but internal enzymes still active and eventually spoil a product.Low temperature is not the only inhibitory factor operating in frozen foods ; they also have a low water activity produced by removal of water in the form of ice. But yeasts and moulds that are both psychrotrophic and tolerant of reduced water activity. Thus meat and poultry stored at (-5 to -10 ^{0}C) may slowly develop surface defects such as black spots due to the growth of the mold *Cladosporium herbarum,* white spots caused by *Sporotrichum carnis*. As with chilling, freezing will not render an unsafe product safe – its microbial lethality is limited and preformed toxins will persist. Frozen chickens are, after all, an important source of *Salmonella.*

Thawing of frozen foods is a slower process than freezing. Even with moderate size material the outside of the product will be at the thawing temperature some time before the interior. So with high thawing temperature, mesophiles may be growing on the surface of a product while the interior is still frozen. Slow thawing at lower temperature is generally preferred.

Advantages:

- Prevents microbial growth by low temperature & availability of water.
- Generally good retention of nutrients.

Disadvantages:

- Blanching of vegetables prior to freezing causes loss of some B-Group vitamins and vitamin C.
- Unintended thawing can reduce product quality.

2. Removal of water (Drying):

Is an ancient technique known for preserving food, is the process of dehydrating foods until there is not enough moisture to support microbial activity. It can be

used with most foods, including fruits, vegetables, meats, seafood, grains, legumes, and nuts .Good air circulation assists in evenly drying the food.
The early method of drying was by direct exposure to the sun's rays; in modern industry the process is hastened by complex apparatus and by chemical agencies. The use of sugar was early combined with drying. Smoking, a method used mainly for fish and meat, combines the drying action with chemicals produced from the smoke, which form a protective coating.
The most important types of commercial drying are: Conventional (heat) Vacuum (pulls the water out) Osmotic (water drawn out by osmosis) Freeze-drying (To remove water from food when it is in a frozen state, usually under a vacuum).

The greatest **advantages** of drying food include**:**

- Produces concentrated form of food.
- Inhibits microbial growth & autolytic enzymes.
- Retains most nutrients.

Disadvantages:

- Can cause loss of some nutrients, particularly thiamin & vitamin C.
- Sulphur dioxide is sometimes added to dried fruits to retain vitamin C, but some individuals are sensitive to this substance.

3. *Osmotic Pressure Treatment*

Salting:

Is the preservation of food with dry edible salt, is related to pickling (salty water). It is one of the oldest methods of preserving food, and two historically significant salt-cured foods are dried and salted cod (usually referred to as salt fish) and salt-cured meat. Vegetables such as runner beans and cabbage are also often preserved in this manner.

Salting is used because most bacteria, fungi and other potentially pathogenic organisms cannot survive in a highly salty environment, due to the hypertonic nature of salt. Any living cell in such an environment will become dehydrated through osmosis and die or become temporarily inactivated.

The inhibitory effects of salt are not dependent on pH, as are some other chemical preservatives.

It was discovered in the 19th century that salt mixed with nitrites (saltpeter) would color meats red, rather than grey, and consumers at that time then strongly preferred the red-colored meat. Table salt (sodium chloride) is the primary ingredient used in meat curing. Removal of water and addition of salt to meat creates a solute-rich environment where osmotic pressure draws water out of microorganisms, slowing down their growth. Doing this requires a concentration of salt of nearly 20% .In addition; salt causes the soluble meat proteins to come to the surface of the meat particles within sausages. These proteins coagulate when the sausage is heated, helping to hold the sausage together. Finally, salt slows the oxidation process, effectively preventing the meat from going rancid.

Salt produces a number of effects when added to fresh plant tissues: Salt exerts a selective inhibitory action on certain contaminating microorganisms. Salt also affects the water activity (a_w) of the substrate, thus controlling microbial growth by a method independent of its toxic effects.

Sugar:

Such as sucrose (table sugar), exert their preserving effect in essentially the same manner as salt. One of the main differences is in relative concentrations. It generally requires about six times more sucrose than NaCl to affect the same degree of inhibition. The most common uses of sugars as preserving agents are in the making of fruit preserves, candies, condensed milk, and the like.

Microorganisms differ in their response to hypertonic concentrations of sugars, with yeasts and molds being less susceptible than bacteria. When sugars are added to foods in high concentration (at least 40% soluble solids), some of the water present becomes unavailable for microbial growth and the a_w of the food is reduced.

Some yeasts and molds can grow in the presence of as much as 60% sucrose, whereas most bacteria are inhibited by much lower levels. Organisms that are able to grow in high concentrations of sugars are designated **osmophiles**; **osmoduric** microorganisms are those that are unable to grow but are able to

withstand high levels of sugars. Some osmophilic yeasts such as *Zygosaccharomyces rouxii* can grow in the presence of extremely high concentrations of sugars.

4. Removal of air:

This technique is not usually used on its own, some of the worst food poisoning bacteria thrive in the absence of oxygen.
Vacuum packing is, however, often used in conjunction with other techniques.

5. Alteration of pH:

Pickling, usually in vinegar or other acids, lowers the pH so that bacterial enzymes cannot operate.
Examples: Sauces, pickled onions and cucumbers

6. Canning:

Is heat-treatment in an autoclave, together with sealing of the food in an air-tight container. Food is placed in a jar and heated to a temperature that destroys targeted microorganisms(Enough heat must reach the center of the jar to control the molds or yeasts or bacteria that might be a risk for that food), Heat also inactivates enzymes that cause spoilage, and air is driven from the jar during heating. Those that survive are thermophilic bacteria that cause spoilage but not illness. Some produce gases and some produce bad odors.

Canning can be divided into two methods (depends on type of food & its pH):

1-Water Boiling Canning:

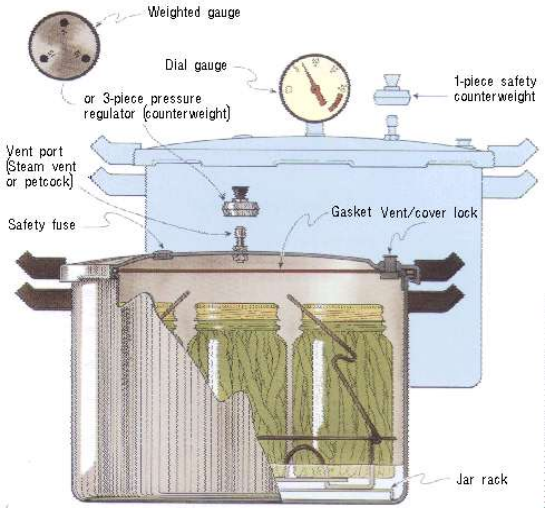
Using for high acid foods (Tomatoes, jams, fruits, sauce) with pH 4.6 or below under temperature reaches 212 degrees Fahrenheit , which Kills most food spoiling / illness causing bacteria and microorganisms except *Clostridium botulinum* (cause of Botulism).

2-Pressure Canning:

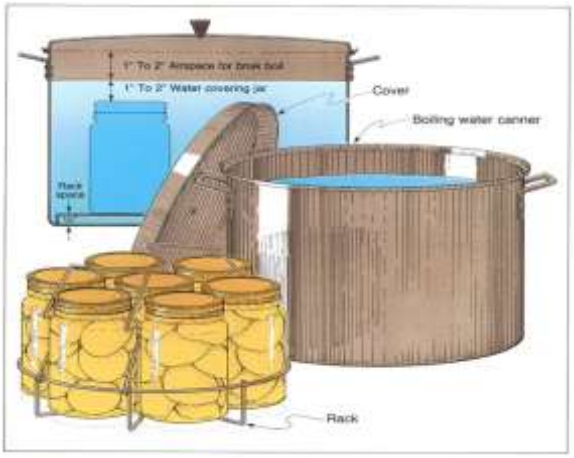
Using low acid foods (red meats, seafood, poultry, milk, and all fresh vegetables except for most tomatoes) with pH above 4.6, under 240-250 degrees Fahrenheit, Only pressure canning can reach temperatures this high, which Kills the bacteria *Clostridium botulinum.*

Safe canning is critical to have the lid seal, but that is not enough by itself. There must be enough time for the heat in the boiling water canning or the pressure canning to penetrate the food and control the undesirable microorganisms. Researchers in laboratories repeat the processes again and again until they can guarantee the control of the target microorganism. If you understand some of the factors that affect control of the microorganisms, you will better understand the processing guidelines, processing temperature, processing time and sealed lid.

The advantages of home canning are lost when you start with poor quality fresh foods; when jars fail to seal properly; when food spoils; and when flavors, texture, color, and nutrients deteriorate during prolonged storage.



Pressure Canning



Water Boiling Canning