FOOD PRESERVATION

Foods are preserved to prolong their shelf life. As soon as animals have been slaughtered and plant foods have been harvested deterioration begins. This involves 2 main processes:

1) Cells break down due to enzymes present in the food: this process is known as Autolysis, meaning 'self destruct'.
2) The disrupted cell structures are vulnerable to the activities of micro-organisms. Micro-organisms cause changes in odour, flavour, colour and texture of food.

For effective food preservation it is necessary to prevent both autolysis and microbial growth.

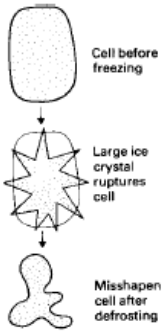
Reasons for preserving food:

- Extension of the safe storage life of food.
- Safety.
- Acceptability.
- Nutritive value.
- Availability.
- Economic viability.

Physical, Chemical and Biological Methods of Food Preservation

Freezing:

Freezing controls the growth of micro-organisms in 2 ways. The growth rate is reduced due to the low temperatures and water is unavailable because it has been converted to ice. Also, the chemical changes in food are slowed down because of the low temperature. Before freezing foods, inedible parts are removed and it is usual to blanch fruit and vegetables to inactivate enzymes. The number of bacteria is also reduced by blanching. Commercially, foods are frozen by the quick-freezing process. This method is desirable because ice crystals that form in the food are small; large ice crystals rupture the cell wall and thus change the texture and appearance of food.



Effect of Large Ice Crystals on Cell Structure

Methods of Freezing:

1. Plate-Freezing: This is the oldest method of the large-scale freezing methods. The food is packed between hollow metal plates and refrigerant is passed through the plates. Suitable foods include fish fillets (frozen into blocks → fish fingers).
2. Blast-Freezing: This involves exposure of the food to a blast of pre-cooled air (- 40°C) in a specially designed tunnel.
3. Fluidised Bed-Freezing: This is a development of blast-freezing, is suitable for food of small particle size. Suitable foods include: peas, beans, chipped potatoes and soft fruits.
4. Immersion-Freezing: This involves placing the food in the refrigerant. Brine (salt water) may be used for fish. This method is not often used.
5. Cryogenic Freezing: This method uses liquid nitrogen (-196°C) or carbon dioxide (-78°C). It allows a faster rate of temperature loss, and the frozen food has tiny ice crystals. It is more costly than other methods but it is recommended for foods such as strawberries and prawns.

Quality of Frozen Foods

During blanching of fruit and vegetables ascorbic acid (vitamin C) and thiamin (B1) are vulnerable. Nutrients in the form of thaw drip may be lost when foods are thawed – for example, thiamine from meat. Textural changes may occur; soft fruits can become mushy because the cell structure of the fruit collapses.

Chilling:

Chilling is a short term process of preservation. Chilling is based on the principle that microbial activity is reduced in cold storage conditions. At temperatures in the range 0-5ºC the growth of most species of micro-organisms is retarded. Chilled foods are prepared foods which, for reasons of safety or quality, are designed to be stored at or below 8 ºC for their entire life e.g. salads. The optimum temperature for storage is 5ºC. Cook chill products are dishes which are cooked and then rapidly chilled between 0 – 3 ºC within 90 minutes. The food is then stored in controlled low temperatures, below 3 ºC. The product should be reheated thoroughly (to above 72ºC for 2 minutes) prior to consumption.

Irradiation:

Although irradiation destroys micro-organisms it has no effect on the enzymes in food, so degradation is not prevented. Food irradiation is permitted in some countries. The commercial development of irradiation is limited due to a number of factors such as the cost of equipment, stringent tests needed for safety and the development of undesirable flavours in certain foods.

Quality of Irradiated Foods

Some small nutritional loss will occur in the food as in all processing techniques.

Heat Treatment:

Foods can be preserved by the application of heat in sufficient quantity to kill all microorganisms and to inactivate enzymes. There are 2 levels of heat processing:

1. Pasteurisation:

This is heat processing designed to kill al pathogenic organisms, and in so doing to kill most spoilage organisms. It is a short term method of preservation and it extends the storage life of the product a little but makes it bacteriologically safe. This process is used in the pasteurisation of milk for example. Raw milk is heated to 72°C for 15 seconds.

Quality of Pasteurised Foods: As with all forms of heat treatment of food, there is some nutritional loss. In the case of milk or fruit juice, the vitamin C is affected. There is no significant effect on the organoleptic qualities of the food product.

2. Sterilisation:

This is a much more severe heat process aimed to destroy all micro-organisms. Absolute sterility is difficult to obtain as some bacterial spores may survive the process. Commercial sterility is the state achieved in most canning processes, and is heat processing designed to kill virtually all micro-organisms, and most spores, which would be capable of growing during storage. Some organisms can survive the sterilisation process if not processed for enough time or at a high enough temperature, e.g. clostridium botulinum.

Quality of Sterilised Foods The sterilisation process is more severe than pasteurisation, and can sometimes affect the appearance and taste of food. In milk, for example, sterilised milk develops a sweeter flavour as the natural sugars in the milk are caramelized at high temperatures. Some people find this flavour unpleasant. As with all forms of heat treatment of food, there is some nutritional loss, especially of vitamin C and B group vitamins.

Canning:

Canning involves the application of heat and aims at destroying micro-organisms and their spores. The heat-treated or sterilised food must be kept in an airtight container to prevent contamination.

Canning is carried out in 6 main stages:

1. The food is cleaned, and inedible parts such as bones in meat and stones in fruit are removed.

2. Vegetables are usually blanched either by immersing them in boiling water or exposing them to steam. Blanching inactivates enzymes in the food, and bubbles of air are driven out of the food, reducing its bulk. (REF. PROUDLOVE: page 187-188).
3. The cans are automatically filled. Fruits and vegetables and certain other foods are topped up with liquid such as brine (salt water) or syrup. The filled cans are usually exposed to steam or hot water. This causes air to be driven out.
4. The cans are sealed with a lid in an automatic machine so that they are airtight or hermetic.
5. The cans are sterilised (121°C).
6. The cans are then cooled gradually.

Aseptic Canning: This process involves the separate sterilisation of the food and can. The cans are filled in such a way that micro-organisms cannot enter.

Quality of canned food: The sterilisation process causes the loss of heat-sensitive nutrients such as ascorbic acid (vitamin c) and thiamin (vitamin B1). There are also changes in colour, flavour and texture.

Addition of Chemicals:

Acids: such as vinegar are used in pickling. The vinegar prevents the growth of micro-organisms. This is because the food is placed in a low pH solution in which micro-organisms cannot grow.

Permitted Chemical Preservatives: It helps to reduce or prevent wastage of food through spoilage caused by micro-organisms. Longer shelf life enables a greater variety of products to be kept in store and in the home.

Fats, oils and foods containing them are subject, over a period of time, to the effects of oxygen in turning the product rancid. Antioxidants are added to such foods to slow down or prevent the process of rancidity (oxidative) and thus extend the shelf life of a product.

Removal of Water:

Foods may be preserved by the addition of anti-microbial substances such as:

Salt: used in the curing of meat such as bacon. The salt or brine (salt solution) reduces the moisture content of the food i.e. it reduces the availability of water (Aw) to micro-organisms. The moisture available to the micro-organism is reduced by OSMOSIS. The salt solution is more concentrated than the cytoplasm inside the cells of the micro-organism. Therefore, water passes out of the cell and the cell becomes dehydrated. With little moisture, micro-organism growth is retarded.

Sugar: used in the manufacture of jam and crystallised fruit. The addition of a large quantity of sugar inhibits the growth of micro-organisms by making the water in the fruit cells unavailable. Again, the moisture available to the micro-organism is reduced by osmosis. The high temperature used in jamming also destroys any microorganism.

Dehydration

Traditionally, foods were dried in the sun. The original processes have advanced considerably, and moisture is now removed by the application of heat in a controlled flow of air.

Methods of Drying:

a. Sun Drying: This method is practical in hot dry climates, but the process is slow and the foods being dried are vulnerable to contamination.
b. Fluidised Bed-Drying: Warmed air is circulated around the food while it is agitated to stop it from sticking.
c. Spray Drying: Spray drying is used for liquids. The liquid is sprayed through fine nozzles into a current of hot air. The water evaporates and leaves behind a fine powder.
d. Roller Drying: This is used for pasted foods such as instant breakfast cereals. The paste forms a film on the surface of a heated roller or drum. During the rotation of the roller or drum, the food dries and is finally removed by scrapers.
e. Accelerated Freeze-Drying (AFD): This involves an initial freezing process which is followed by gradual heating in a vacuum cabinet. During this process ice crystals form and change to vapour without going through the liquid stage (sublimation). The product is porous but differs from its original form. The porous nature of the food makes it suitable for instant re-hydration.

Quality of Dried Foods: Drying alters the cellular structure of food. Retinol (vitamin A), thiamin (B1), ascorbic acid (C), and vitamin E are lost in the drying process. Foods with a high fat content are vulnerable to rancidity and discolouration.

Modified Atmosphere Packaging (MAP)

MAP is the enclosure of food in a package in which the atmosphere has been changed by altering the proportions of carbon dioxide, oxygen, nitrogen, water vapour and trace gases. The process retards microbial and biochemical activity. Products such as bacon, red meat, poultry and vegetables use this method to increase the shelf life of the product.

Vacuum Packing:

Foods such as meat or cheese are packed in impermeable plastic material, and the air is sucked out under vacuum. This method prevents the growth of aerobic micro-organisms because of the absence of oxygen.

Permeable Packaging:

Some types of plastic are semi-permeable and allow the transfer of gases such as oxygen and carbon dioxide and water vapour. This type of material is used for foods such as tomatoes, and is useful because it delays ripening and extends the shelf life by more than a week. Sometimes crusty bread is packed in a plastic covering dotted with tiny holes. This type of packaging is advantageous because otherwise trapped moisture would condense and the crust would lose its characteristic crispness.