Meat Preservation Techniques

Meat preservation:

Processes for preserving nutritious properties, taste, texture and color of raw, partially cooked or cooked meats while keeping them edible and safe to consume.

In developed countries, this conservation depends largely upon the food industry rather than individuals.

For lesser-developed countries, the Food and Agriculture Organization considers the absence of meat preservation techniques would present a serious obstacle to the development of viable meat production by resource-poor rural livestock producers.

Advantages:

- Increase shelf life of meat.
- Easy to transport.
- Availibility of meat in every where .i.e Fish meat.
- Kills bacteria and slows growth of other types of bacteria.
- Adds some flavor to meat by some techniques.

Techniques:

1.The freezing

2. Smoking

3. Drying

4.Partial Drying/Intermediate-Moisture Foods

5. Canning

6. High-temperature Short-time Processing (HTST)

7. Fat Embedding

8. Ionising Irradiation

1. The freezing

The freezer temperature needs to be at 0°F or lower. If you are going to be freezing a large amount of food at one time, you can turn the freezer setting lower so that added food does not raise the temperature of already frozen food in the freezer. Temperature affects the size of the ice crystals in the food. Large ice crystals, caused by freezing foods too slowly, result in loss of liquid from the meat, diminished weight and darker appearance. Temperature fluctuations also affect the size of ice crystals. Put no more unfrozen food into a freezer than can freeze within 24 hours; this is about 2 to 3 pounds of food per cubic foot of freezer space. Food will freeze more quickly if it is spread out over the freezer and if the food comes into contact with the freezer walls. Frozen packages can be rearranged and stacked later.

Basic cleanliness is important in any method of food preservation. Select meat that has been butchered and processed under sanitary conditions. Work on a clean surface and wash hands and equipment frequently to avoid cross contamination.

Vapor proof wrapping material prevents air from coming into contact with the meat. Select freezer bags specifically labeled for freezing; light weight storage bags are more porous. Flexible bags work well for packing products with irregular shapes such as poultry, fish, and many cuts of meat. Plastic freezer wrap, freezer paper, and heavy-weight foil can be cut to the desired size. Individual servings of meat such as chicken breasts may be wrapped separately and then placed in a larger freezer bag.

The storage life of frozen meat depends upon the type of meat, the cut and the fat content of the meat. Meats with higher fat content have a shorter storage life because they will develop rancidity more quickly. The salt in cured meats also hastens rancidity. According to the National Center for Home Food Preservation, beef roasts and steaks will maintain quality for up to 1 year; pork or veal roasts for 8 months; pork chops for 4 months; ground meat for 3 months; ham for two months; uncooked whole chicken or turkey for 1 year but chicken parts for 9 months; turkey parts for only 6 months; bacon 1 month and frankfurters 2 months. The food will be safe for a longer period of time if it remains frozen, but the quality will be lower.

Do not stuff poultry, pork chops, or other meats before freezing. Bacteria that causes food poisoning could easily grow in the stuffing. Remove the stuffing from cooked poultry before freezing the leftovers and freeze them separately.

Cooked meat and leftovers may be frozen if certain precautions are followed. The cooked meat must be refrigerated as quickly as possible after cooking or removal from the oven. No food should be left at room temperature more than a total of two hours. Smaller portions of meat will cool more quickly than one large roast or a large turkey. Refrigerate in shallow containers. Leftover meats should be frozen within a day or two of cooking.

When it is time to thaw frozen meat, thaw it in the refrigerator. Never thaw frozen foods on the counter.

2. Smoking

Smoking is the process of flavoring, cooking, or preserving food by exposing it to smoke from burning or smoldering material, most often wood. Meats and fish are the most common smoked foods, though cheeses, vegetables, and ingredients used to makebeverages such as beer,[1] smoked beer, and *lapsang souchong* tea are also smoked.

Types:

a. **Cold smoking** can be used as a flavor enhancer for items such as chicken breasts, beef, pork chops, salmon, scallops, and steak. Some cold smoked foods are baked, grilled, steamed, roasted, or sautéed before eating. Smokehouse temperatures for cold smoking are typically done between 20 to 30 °C (68 to 86 °F). Cold smoking does not cook foods.

b. **Hot smoking** exposes the foods to smoke and heat in a controlled environment. Hot smoking occurs within the range of 52 to 80 °C (126 to 176 °F). Within this temperature range, foods are fully cooked, moist, and flavorful. If the smoker is allowed to get hotter than 185 °F (85 °C), the foods will shrink excessively, buckle, or even split. Smoking at high temperatures also reduces yield, as both moisture and fat are "cooked" away.

c. **Smoke roasting** or **smoke baking.** It may be done in a smoke roaster, closed wood-fired masonry oven or barbecue pit, any smoker that can reach above 250 °F (121 °C).

3. Drying

Micro-organisms cannot grow unless there is sufficient moisture available to them and drying meat under conditions of natural temperatures and humidity with circulation of air and the assistance of sunshine is the oldest method of preservation (FAO 1990 c).

The free water in a food product, i.e. excluding the water bound to proteins, is termed the water activity. Free water is that part that can be removed as water vapour (and is not the same as the total moisture content). "Water activity" is defined as the ratio of water vapour pressure measured in the product to the pressure of a saturated water vapour atmosphere at the same temperature.

The minimum moisture content necessary for bacterial growth varies with the type of organism. The lowest value for normal bacteria is water activity 0.91; for normal yeasts it is 0.88; for normal moulds 0.80; and for salt-tolerant (halophilic) bacteria it is 0.77.So water activity must be reduced below these levels to preserve the food.

Muscle meat of almost any kind can be dried but it is necessary to use lean meat since fat becomes rancid during the drying process. Drying involves the removal of moisture from the outer layers and the migration of moisture from the inside to the outside, so the pieces of food must be thin. The meat is cut into long thin strips or flat thin pieces and preferably salted, either dry or by dipping into salt solution, to inhibit bacterial growth and to protect from insects.

The pieces are suspended in racks in freely circulating air under hygienic conditions and protected from dirt and dust for the several days required. If the air is warm and of low humidity with relatively small temperature fluctuations between day and night the time needed will be shorter. Slow drying allows deterioration since micro-organisms can multiply in the early stages while the moisture content is still high enough. Another problem arises from the practice in developing countries of using meat from unchilled carcasses and while the temperature is still high the meat ripens rapidly so changing the flavour. At the same time there is some oxidation of the fat so further lowering the quality of the finished product.

There are a number of traditional dried products in various regions. For example biltong in South Africa, which is made from beef or antelope meat cut into strips 1 - 2 cm thick, salted, with the addition of nitrate or nitrite , spiced and dried in air for 1 - 2 weeks.

The outer layer of biltong is hard and brown with a soft, inner, red inside, and is eaten raw. It will keep for a year if stored in airtight packaging.

Typical analysis per 100 g: 11.5 g water, 1.9 g fat, 12.5 g ash, 65 g protein, 1.3 MJ (300 kcal).

Jerked beef or charque is the product used in South America which may be made from beef, llama, sheep, alpaca. The fresh meat is cut into large pieces no more than 5 cm thick, salted, pressed for several days and dried - but it still contains moisture which is allowed to drain freely from the product. It keeps for months at ambient temperatures and is resistant to insect infestation and mould growth.

Pemmican is dried meat that has been powdered or shredded and mixed with fat to form a solid product. Typical analysis per 100 g:- 3 g water, 40 g protein, 45 g fat, 2.4 MJ. Pemmican was almost a routine food taken on earlier expeditions until replaced by modern types of dried meat products.

Other traditional dried products include pastirma (Turkey, Egypt and Armenia), odka (Somalia and other countries of East Africa), qwanta (Ethiopia and East Africa) and kilishi (Nigeria and West Africa). There is a variable loss of vitamins from such products due to the long drying times which can be shortened by the use of modern drying techniques.

Such a procedure is freeze-drying which causes little or no loss of vitamins and results in products which are readily rehydrated and much closer in texture and flavour to fresh meat than the traditional dried product but calls for specialised equipment.

4. Partial Drying/Intermediate-Moisture Foods

In dried meats the water activity is below levels needed for microbial growth so the product is shelf-stable but there will still be chemical and physical changes due to rancidity and discolouration which call for adequate packaging. Some products such as "dry" sausages and hams cannot be dried adequately without spoiling the product - they are termed "semi-dry" - so it is necessary to combine an incomplete reduction in water activity with other methods such as lowering of pH or the addition of nitrate.

In an attempt to avoid the relatively poor texture and flavour of most dried meat products a modern development is partial drying to a moisture content of 15 to 50% and then reduction of free water to the required low levels by adding humectants such as glycerol, sorbitol or other polyhydric alcohols which combine with the free water so that it cannot be used by the micro-organisms.

The meat is cut into small pieces and treated with a mild salt solution, and the humectant and an antimycotic (anti-mould agent) are added and the meat cooked to 70°C before packaging. It will keep for several months even at 38°C but there are changes in texture, colour and flavour (Lawrie 1991).

Products preserved in this way are called intermediate-moisture foods and they are more succulent than dried foods but the humectants spoil the palatability and the process has been limited to animal foods in industrialised communities and for military purposes.

5. Canning

Micro-organisms can be completely destroyed by heat (sterilisation) but a sterile product can be readily recontaminated unless it is protected. This is achieved by heating in an air-tight can or bottle, or, more recently, in a heat-resistant or aluminium foil-laminated plastic pouch. Sausages can be filled into retortable synthetic casings sealed with aluminium clips.

The procedure is to seal the food into the container and then heat it under pressure in an autoclave (retort) to the required temperature for the required length of time and to cool rapidly to avoid overheating. Overheating results in too soft a consistency and a burnt taste. It is not always possible to destroy all the organisms without excessive heat which would spoil the product so the objective is to destroy the greater proportion of the organisms when the remaining few pose no hazard so long as the container is cooled rapidly and stored below 20-25°C. This condition is termed "commercially sterile". The established standard is equivalent to a reduction in the number of micro-organisms by a factor of 10 to the power of 12 so it is clear that the higher the initial load of organisms the more will survive a standard heat treatment.

The intensity of heat treatment necessary depends on the nature of the product, its pH, and the amount of salt and other curing agents present as well as on the bacterial load. The time required at a given temperature will vary with the rate of heat penetration to the centre and so with the size of the container.

The intensity of heat treatment is defined in physical terms called F-value, which means that the product received heat treatment with the same effect on micro-organisms as exposure to a temperature of 121°C for 1 minute. The standard is based on the time required at a temperature of 121°C to destroy all spores of Clostridium botulinum, the most dangerous of all toxin-producing organisms. This is termed "the botulinum cook" and such treatment destroys practically all spoilage and other organisms. It takes 2.45 minutes at 121°C to destroy all C. botulinum spores; this is an F-value of 2.45. Spores of other organisms are less or more heat-resistant. F-value 1 is the lethal effect on micro-organisms after 1 minute at 121°C; F-value 2 (3,4) is the lethal effect after 2 (3,4) minutes.

At temperatures greater than 121°C a shorter time is needed to achieve the F-value of 1, thus at 130°C the time is 0.13 min. Correspondingly the time is longer at lower temperatures, thus at 115°C the time is 4 min at 105°C it is 40 min.

These conditions apply to foods of low acidity (pH above a value of 5) and medium acidity (pH 4.5 - 5); with more acid foods the spores of micro-organisms are less heatresistant. Meat products are mostly low-acid, while meat and vegetable mixtures are medium -acid. In practice once the F-value has been determined for a batch of food according to the size of the container the heat treatment required to treat subsequent batches is the same. Generally it has been shown that F-value 4 will usually ensure commercial sterility. Larger canned products may require F-values up to 20-25 owing to the longer periods required for heat penetration.

A fully-treated product of this type will keep for up to 4 years at ambient temperatures but even fully-preserved meat can contain a very heat-stable spore former, Clostridium sporogenes, which poses a hazard only when stored under extreme climatic conditions, namely at temperatures above about 40°C If canned meat is to be stored under such conditions then it must be treated more intensively, F-value 12 or more ("tropical preservation") and then has a shelf life up to 4 years.

Virtually every type of meat product made from chopped, cured meat can be canned, as well as stewed meat, dishes in jelly, soups with meat ingredients, and pastas and sausages in brine.

Products such as luncheon meats, liver sausage, blood sausage and jellied products are adversely affected by high temperatures and are "three-quarters preserved" at F-values 0.6 to 0.8. The temperature reached at the centre of the pack is between 108 and 112°C and the product is stable for up to 1 year if stored at temperatures no higher than 15°C.

Cooked preserved products are simply boiled until the central temperature reaches near to 100°C and they can be stored (protected from contamination) for 1 year at temperatures no higher than 10°C.

Smaller size containers are most suitable for meat products because heat penetration is mostly by conduction so larger containers would require severe heat treatment involving overcooking. Large pieces of meat products such as hams, shoulders, etc., are pasteurised. Pasteurisation is a more gentle process intended to destroy only pathogenic organisms and the treatment limits the central temperature to about 80°C (Fvalue almost zero). This destroys only vegetative cells and refrigeration is necessary to prevent germination of spores. Pasteurised products must be stored between 2 and 4°C when they have a shelf life up to 6 months.

The temperatures quoted must be reached in the centre of the pack to ensure that the entire contents are adequately heated but protein and fat are poor heat conductors. If there is enough liquid in the can, such as meat cooked in gravy, Frankfurters in brine, or through release of liquid from the meat and liquefaction of the fat, heat can penetrate by convection as well as conduction if the can is rotated during the process. This allows a shorter heating time with less damage to flavour, texture and nutrients, and the outer layer of the food is not overheated.

Canning operations must be performed only by fully-trained personnel (FAO 1990c; Hershom and Hulland 1980).

6. High-temperature Short-time Processing (HTST)

Since the effect of heat in speeding up biological reactions (in this instance destruction of micro-organisms) is greater than the acceleration of chemical reactions (in this instance damage to protein and other nutrients) heating to a higher temperature for a shorter time is an effective means of preservation. Sterilisationis achieved in a shorter time with less damage to the product. The process is termed high-temperature short-time heating (HTST) and has been particularly applied to milk but can be applied to meat if there is sufficient liquid present to allow mixing of the contents by rotating the cans in the autoclave. The cans must be cooled immediately after the temperature of sterilisation has been reached to avoid overheating.

7. Fat Embedding

A traditional process that is parallel to canning is that of cooking the meat in a vessel that can be sealed under a layer of melted fat and so protected from recontamination.

An example of such a product is mixiria of the Amazon region where the meat is roasted, sliced and sealed in jars. The layer of fat not only protects the meat from contamination but excludes oxygen, however, organisms can survive so the method is not dependable.

The process of fat embedding was tested by the Australian meat trade in the 19th century - beef was packed into barrels and covered with fat heated to 150°C - but superseded by refrigeration.

It is used to a very limited extent in some industrialised countries, in particular for a product called "potted shrimps", which have been cooked in butter and sealed into jars.

8. Ionising Irradiation

Micro-organisms can be destroyed by subjecting a food to ionising radiation produced from radioactive or electromagnetic sources. High doses (50 kiloGrays - kGy) are required for sterilisation of meat while recommendations of WHO and legislation in most, if not all, countries limit the dose at present to 10 kGy, simply because safety has been established up to this level.

The 10 kGy dose does not sterilise the product but substantially reduces the bacterial load and is effective in destroying many pathogens including Salmonellae. A dose of 2 - 5 kGy will extend the shelf life of poultry stored at 1-3°C by 8-14 days. Irradiation is of no value as a means of "cleaning up". heavily contaminated food since it would still carry a considerable microbial load, nor does it destroy toxins once they have been produced. Indeed, in some countries where irradiation is permitted microbiological standards are specified for foods to be treated. Irradiation of spices to be used for meat products has proved to be an effective way of lowering their microbial content and so increasing the shelf life of the products.

Although the preservation of food by irradiation has been intensively studied for many years its commercial application is still in its infancy. There are many problems involved since the process calls for heavy investment in factory plant and is regarded with some suspicion by consumers. Moreover irradiation does not destroy enzymes so the meat softens during storage.

Since the radiation penetrates into the product it also penetrates packaging so the food can be protected from recontamination by adequate wrapping before irradiation.

In general irradiation has some deleterious effect on vitamins but the amount of damage is not considered nutritionally significant.