Physical Changes in Stored Meat

Meat undergoes the following superficial changes as a result of storage

i. **Shrinkage:** Shrinkage means loss of weight as a result of evaporation of water from meat surface.

ii. **Swelling:** This means condensation of water vapour on meat brought from a cold store into ordinary room temperature.

iii. **Loss of Bloom:** Bloom is defined as colour, texture and general appearance of carcass surface. This is caused by excessive intake of water, dehydration or undue oxidation.

Dehydration

This is an old method of food preservation which is still popular in Nigeria today. To achieve best results, meat should be pre-cooked at temperatures below 70^{o}C. Low fat meats dry more rapidly and they are more easily rehydrated. Dehydration does not affect the gross chemical composition of meat. However, dehydrated meat reabsorbs water only to about 60% of the original moisture content. Some of the disadvantages of drying include:

1. Flavour loss due to conversion of water soluble compounds to insoluble compounds
2. Loss of some nutritive components especially thiamine and pantothenic acid which are components of the Vitamin B complex

Salt curing

This is a method of preserving meat with the use of brine solution. Brine solution contains the following:

Water	4.50 Litres
Salt	1.02 kg
$NaNO_3$ or KNO_3	21.25g
Sugar (optional)	56.75g

The action of salt curing on meat can be preservative or bacteriostatic.

a) Preservative action

b) Bacteriostatic action

Smoking

Smoke is produced as a result of anaerobic distillation of wood followed by partial oxidation. If the oxidation is complete, there will be production of water and oxygen and not smoke, since wood's main components are cellulose (50%), hemicellulose (25%) and lignin (25%) which all contains carbon, oxygen and hydrogen.

Smoke contains well over 200 compounds of which are aldehyde, phenols, acetate and resins. These compounds prevent oxidative activities, provide flavour for the meat and have germicidal effect.

Smoking is the process of allowing smoke produced from natural wood, twigs, heather or the fruits of trees to act on the surface of meat and meat products. During smoking the smoke is transferred to the product through the process of absorption, adhesion, condensation, diffusion, dissolution and deposition.

There are many methods of producing smoke these include; smouldering of wood, by friction, steam, gas pyrolysis, vibratory feeder and liquid smoke production.

Action of smoke on texture, flavour and colour of meat

Texture: The effect of smoke on texture meat depends on the relative humidity and the smoke temperature. At relative humidity of 65 – 70%, the surface of the meat will be dry. During smoking, as temperature increases from 49^{o}C to 82^{o}C, the meat protein coagulates and the meat is toughened.

Colour: The surface colour of well-smoked meat is light golden yellow to dark brown shades. The colour varies with the type of wood burnt, the density of smoke and the temperature of the smoke.

Flavour: The smoky taste in smoked meat product is as a result of the phenolic fraction of smoke. The type of wood can also affect the flavour, soft woods give acrid flavours.

Chemical preservatives

Antibiotics: these have been used to preserve and improve the keeping quality of beef carcases, poultry and fish. These antibiotics are added to water in a proportion of 5 to 40ppm and the meat is dropped into the treated water. Alternatively, the antibiotic is added to ice in amounts of 2 – 5ppm and the fish (or meat) is transported in the treated ice. The storage life of such treated meat, poultry and fish is considerably increased.

Disadvantages of this method include

1. Antibiotics are not effective against yeasts and moulds

2. These antibiotics may occur as residues in the meat which when consumed may be hazardous to the health of the consuming populace.
3. The widespread use of antibiotics in food encourages the appearance of antibiotic-resistant strains among pathogenic bacteria present.
4. There is the danger that producers may tend to depend more on drugs than good hygienic practices.

Cold storage

Chilling

Chilling involves refrigerating meat to temperature just above freezing point. This temperature must be maintained throughout the meat until it is delivered to the consumer. Meat will not keep for a long time unless it is proper chilled. In chilling, care should be taken to prevent meat from being frozen as meat upon thawing develops characteristics which are considered not so desirable than those possessed by chilling. Quick chilling of carcase is necessary in order to prevent the growth of spoilage organisms. This process is achieved by rapid circulation of air at low temperature (1 to 2^{o}C or as low as -7^{o}C) and controlled humidity. Chilling of some of the thicker muscles is sometimes accelerated by the injection of liquid carbon dioxide into the muscle.

Freezing

Meat has no definite freezing point because of its complex structure. Freezing meat at very low temperature, the quality of the meat is retained better.

In freezing meat, the internal temperature of the meat should be reduced to -18^{o}C. To store already frozen meat, the air temperature must be equal to or less than -14^{o}C and this will kept the meat for 9months and above. Pork should be stored at -18^{o}C and will keep well for 6months. There should be proper spacing of boxed meat or meat products as they are placed in the freezer between layer boxes and between boxes in the individual layers.

To transport frozen meat and prevent thawing during transportation, the vehicle and cargo space should be capable of a maximum air temperature of -10^{o}C.

Food Irradiation

Food irradiation is a physical means of food treatment by exposing food either pre-packed or bulk to gamma rays, x-rays or electrons, in a special room and for a specific duration of time to achieve a desired aim.

Technically, gamma rays can be produced from radioisotope sources e.g. ^{60}Colbat or ^{37}Cesium. Foods treated with ionizing radiation are safe for human consumption. It has been shown that it is not possible to activate or induce radioactivity in any food material passed through irradiator regardless of the length of time of radiation exposure, hence toxicological testing of foods so treated is no longer required. Gamma rays kill micro-organisms in meat without a significant rise in the temperature of the product. However, the resultant chemical changes in the irradiated product have been found to change the aroma and odour of such product.

DRUG RESIDUES IN FOOD ANIMALS

Residues of drugs in food animals refer to the presence of drugs as residual deposits in meat, milk, eggs and other foods of animal origin at levels higher than the maximum permitted in the food product. Such can be antibiotics, anthelminths, anti-protozoans, hormones, organophosphates and biologicals such as vaccines.

In most livestock production systems, drugs such as antimicrobials are used for the prevention and treatment of animal diseases and to improve the efficiency of animal production. These agents usually find their way into animal tissues by direct routes through injections or indirectly via the feed.

Antibiotics used for the treatment of food animals do not pose a health hazard to the consumer, provided they are properly used in accordance with the recommendations for their use: proper dose, proper route of administration, proper species of animal and adequate withdrawal period before slaughter.

Residues of drugs in meat, milk or eggs and processed foods may result from intentional or accidental exposure of animals or animal products to drugs. Intentional exposure is a result of drug usage for the purposes of prevention and treatment of diseases, growth promotion and as feed preservatives. Accidental exposure, which is also referred to as unintentional exposure however occurs as a result of circumstances not intended to protect the feed or the food-producing animals. This includes the contamination of food and water by industrial chemicals.

Residues which may consist of parent compound, metabolites or decomposition products may accumulate and be deposited or stored within cells, tissues or organs of food producing animals, and may produce deleterious effects on the health of the

consumers. The public health concern is because of the potential carcinogenicity, mutagenicity, teratogenicity and long term toxic effects of the residues of these drugs on human. The concern about antibiotic residues in meat however is mainly on hypersensitivity reactions and the possibility of the development of micro-organisms resistant to antibiotics in human.

Antibiotic residues in animal tissues may lead to the emergence of resistant strains of bacteria in animals and the passage of these via the food chain of animals to man.

Apart from the safety aspect, the presence of antibiotics in milk can interfere with micro-organisms essential for the maturation of cheese and yoghurt and their presence in meat can also cause fermentation failure in sausage production.

Control of Antibiotic residues in meat

- There is a need for legislative control over the licensing and supply of Veterinary drugs. Legislative control of Veterinary drugs involves making laws governing the use of Veterinary drugs.
- There is a programme of advice and education about the use of Veterinary drugs by farmers/food animal producers.
- There is the monitoring for residues in the meat and meat products available for human consumption.

Methods of detection of Drug Residues in Meat

The main analytical methods used for the analysis of residues of Veterinary drugs in animal tissues are

- Microbiological assay
- Immunoassays
- Chromatographic methods

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