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Lecture title: **Meat Hygiene: Meat preservation part I**

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Summary:

Because meat is high in protein and moisture, meat is potentially an ideal medium for bacterial growth, the primary purpose of food preservation is to prevent food spoilage. Wether food spoilage is mild or extreme, the primary cause is the action of micro- organisms' bacteria, molds and yeasts aided by enzymes. as living organisms can survive and develop only under particular environmental conditions. under unfavorable condition they fail to develop.The meat from animals properly handled and processed will have a low pH value which will aid in the preservation process.

Goals For Preservation

•Safe meat products (microbiologically, chemically and physically)
•Long shelf life
•Good appearance
•Good texture
•Good flavor
•Nutritive value

Physical changes in stored meat:

-shrinkage
-sweating
-loss of bloom

Shrinkage or loss of weight occurs as a result of evaporation of water from the meat surfaces, carcasses cut into quarters dissipate water vapor rapidly and continuously and retail joints even more so. On the other hand, evaporation is inhibited by membranes such as the pleura and peritoneum and in carcasses of well- nourished animals by solidifications of the superficial fat and drying of the connective tissues. A freshly carcass dissipates body weight slowly, losing 1.5-2.0% of weight by evaporation during the first 24 h of hanging. loss of

weight during storage depends on the humidity of the storage room: the drier the air the greater amount of evaporation. avoidance of all evaporative weight losses by high humidity facilitates the formation of moulds, so an accurate balance between temperature and humidity must be maintained.

Sweating: this denotes the condensation of water vapor on meat brought from a cold store into ordinary room temperature. The condensation occurs because the refrigerated carcasses lower the temperature of the air below the dew points. This will differ between the seasons.

Loss of bloom: bloom is defined as the color and general appearance of a carcass surface when viewed through the semitransparent layer of connective tissue, muscle and fat which form the carcass surface. If these tissues become moist, the collage fibers in the connective tissues swell and become opaque and the meat surface assumes a dull. loss of surface bloom in beef carcass may also be caused by dehydration or undue oxidation, but it may be prevented by avoiding temperature fluctuations. it is also important to keep the relative humidity of cooling chambers high and ensure free circulation of air. muscular tissue also tends to become brownish on exposure to air as myohaemoglobin changes to the brown pigments methaemoglobin, but the actual amount of exposed muscle in a side of beef is so small that this is of little or no consequence. Refrigeration has little effect on the carcass fat except in the case of frozen meat which has undergone a prolonged period of storage, in which case rancidity may develop.

Chemical changes in stored meat:

-breakdown of protein

-rancidity

The chemical changes that take place after slaughter are indicative of a slight degree of breakdown of protein, due either to endogenous enzymes or to those of microorganisms. The odor of the meat becomes progressively more marked but never undesirable, the flavor may be described stale, rendering the meat unpalatable but not repulsive. The storage life of meat is more dependent on the chemical changes that take place in fat rather than in muscle . the condition of fat therefore determines the length of storage for whilst the lean

muscle of a carcasses may be still improving in flavor the changes in fat may render the meat repugnant and unmarketable.

Methods of meat preservation:

-drying

-curing

-smoking

-canning

-irradiation

-chilling

-freezing

-cooking

-antioxidants

-preservatives

Drying

Drying reduces the water activity. It is a very old technique and one that is still used

Curing

curing: defined as the addition of salt (NaCl) and nitrate/nitrite or nitric oxide to the meat, which results in a conversion of the meat pigments, predominantly myoglobin, to the nitroso or cured form.

Ingredient	Level in curing brine	Function
Sodium chloride	15-30%	Preservative; improves texture
Sodium nitrate*	0.15–1.5%	A source of nitrite
Sodium nitrite*	500–1000 ppm	Preservative; reduced by meat enzymes to NO, which combined with myoglobin (the uncured meat pigment) forms nitrosomyoglobin, the cured meat pigment
Polyphosphates	2-4%	Reduce cooking losses, e.g. during smoking; improve texture
Sugars, e.g. sucrose, maple syrup	1-4%	Improves flavour by masking the harshness of the salt
Liquid smoke †	ca. 1%	Flavouring agent
Sodium ascorbate	0.2-1.0%	Reducing agent. Improves colour formation and stability by effecting rapid reduction of NO_3 to NO_2 in the meat

Table (1) Curing salts and additives

Myoglobin in freshly cut uncured meat is in the reduced form (purple), which in contact with air is rapidly oxygenated to oxymyoglobin, which is bright red and responsible for familiar color of freshly cut meat. If oxidized, these pigments are converted to metamyoglobin, which is unattractive and gives a brown or grey color.

Under suitable conditions, these pigments can be converted to the nitroso form (nitrosomyoglobin) by the addition of nitric oxide. During the curing process, nitric oxide is formed by reduction of nitrites formed by bacteria from nitrates. Nitrosomyoglobin gives freshly cut cured meat its bright red color but is unstable and rapidly oxidizes to the brown and grey forms.

Modern cured meats have much lower salt contents than those produced traditionally. For example, traditional bacon might contain over 5% salt, but some modern products have only 2%. This is partly because of changes in preferred saltiness and partly because of a desire to reduce sodium levels in foods for health reasons. Indeed, in some cases sodium chloride is replaced by potassium chloride, or other potassium salts. This reduces sodium to minimal amounts but results in a much less stable product that needs to be stored at refrigeration temperatures.

Other curing ingredients

In normal curing processes various other substances may be included in the salt mixture.

- **Polyphosphates** improve water-holding capacity (WHC) and so increase the amount of curing brine that can be taken up by the meat and improve product yield.
- **Sugars** (sucrose or glucose) improve flavor.
- **Ascorbic acid** this acts as a reducing agent and inhibits the breakdown of the nitrosylmyoglobin so preventing discoloration, Ascorbic acid also tends to inhibit nitrosamine formation. Therefore ascorbic acid is used instead.

Common defects in cured meat:

1- Fiery red areas are caused by lack of available nitrite especially in deep meat cuts.
2- Jelly pockets are caused by injection of brine into connective tissues ,which is denatures.
3- Areas of discoloration may be caused by bruising or blood splashing this can be very obvious in the cooked product.

4- Rancidity in frozen bacon may be identified by pronounced yellowing of the fat. Although all bacterial growth stops when bacon is frozen, certain chemical reactions can proceed at -8°c.
5- Browning , the cured meat pigment nitrosomyoglobin changes to the brown metamyoglobin owing to dehydration caused by low humidity, high temperature and oxidation caused by prolonged exposure to air, excessive nitrate and poor packaging.
6- Greening may be caused by excessive nitrate and by bacterial contamination.

Microorganisms on cured product:

The most common form of spoilage found on cured meats is mouldiness, which may be due to:Aspergillus ,Alternaria, Fusarium, Mucor, Rhizopus and Penicillin Micrococci are resistant to salt and consequently are most common where salt levels are high. Lactobacilli are less resistance to salt but more resistant to smoke. Acinetobacter ,bacillus, pseudomonas and proteus may result in the fermentation of sugars in the product to produce sours of various types

Modified atmosphere packaging (MAP)

Utilizes sealed high-barrier packages in which the air has been replaced with a mixture of gases which reduce the rate of deterioration of the meat. Most often these gases include 10 -50% carbon dioxides, which inhibits the growth of many microorganisms that cause spoilage of refrigerated meat. For fresh red meat the mixture often contains 20-50% oxygen so that the myoglobin will be in the oxygenated cherry-red form. The meat must be sealed in high-barrier films which will keep the air out and prevent the modified atmosphere from escaping.

Preservatives

A preservative is defined as any substances which prolongs the shelf-life of food by protecting it against deterioration caused by micro-organisms There are three categories in use of preservatives:

1- Benefit to food industry, retailers and consumers
2- Safety in use.
3- Satisfactory standard of purity of the chemical.