MEAT AND POULTRY PRODUCTS

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Postmortem muscle that has gone through physical and / or chemical alterations is considered as processed meat. Meat processing includes chemical and enzymatic treatments, massaging and tumbling, curing, smoking, stuffing, cooking, canning, irradiation, dehydration, size reduction and mixing of meat with various additives. Meat and poultry products are primarily of two types, viz., whole muscle and comminuted products. Whole muscle products can be cured or uncured products. There are several traditional as well as newly developed convenience meat and poultry products from whole muscle as well as from comminuted / minced / ground meats.

The following aspects are presented in this topic.

1. Principles of development of meat products
2. Cooking methods for meat
3. Meat curing and smoking
4. Meat and poultry products

1. PRINCIPLES OF DEVELOPMENT OF MEAT AND MEAT PRODUCTS

Meat and poultry products have both positive and negative nutritional attributes. Meat has quality proteins rich in essential amino acids. They are also rich source of micro nutrients such as vitamins and minerals, which are beneficial nutritional qualities of meat. Negative nutritional profiles include high levels of saturated fatty acids, cholesterol, sodium, high fat and calorie contents. Animal production and meat processing strategies help develop healthier meat and meat products. Animal production strategies include production of lean meat by dietary manipulation, alteration of fat by increasing healthy fatty acids such as conjugated linolenic acid in feeds. Meat can be enriched by incorporating essential vitamin E and mineral such as selenium in feed formulations. Meat processing strategies include enriching meat with fiber and healthy unsaturated fatty acids (Omega – 3 fatty acid), fortification of meat products with essential vitamins, minerals, antioxidants.

Various ingredients having different functional properties are used in the production of meat and poultry products. Soybean products, cereal (wheat, barley, corn, rice) flours and potatoes (starch) are used as extenders / fillers in meat products. They improve emulsion stability, water binding capacity and slicing characteristics. They also enhance flavor, reduce shrinkage and formulation costs. Addition of 10 – 15 % water helps in solubilization of proteins, temperature control and machinability. Common salt (1.5 – 5 %) enhances flavor, solubilises proteins, retards microbial growth and extends shelf life. Nitrite / nitrate (< 200 ppm) helps attractive color development, flavor protection and bacteriostatic effect. Phosphates (< 0.5 %) improve water holding capacity. Sweeteners (sugar 1 – 2 %) reduce harsh hardening effect of salt and help develop attractive color. Inclusion of spices improves flavor of meat products.

2. COOKING METHODS FOR MEAT

Cooking is transfer of heat which affects quality and properties of meat and meat products. Transfer of heat in meats is slow due to low thermal conductivity. Cooking destroys food poisoning and spoilage organisms and provides a firm texture by denaturing proteins. Dry heat and wet heat cooking are the two conventional cooking methods used for fresh or processed meat. They are briefly described below.

i. Dry heat cooking: The main features are:

a. No use of water to cook the food and
b. Food is left dry and heat is applied directly to the food by way of convection. The action or movement of hot air around the food cooks it. The main methods of dry cooking are:

- *Baking:* Food is put into an enclosed area where heat is applied and the movement of heat within the confined space acts on the food to cook meat.

- *Steaming:* Water is added to a pot and then a stand is placed inside the pot. The water level should be under the stand. There is no contact between the food and water. Food is then placed on the stand and heat is applied. The hot steam rising from the boiling water

acts on the food and the food gets cooked. This method of cooking is very good as the food does not lose its flavor and loss of nutrients is less during the cooking.

- *Roasting:* Direct heat is applied to the food. The heat seals the outside part of the food and the juice inside the food cooks the food. Roasting is mainly used for cooking fleshy foods like fish, meat or chicken. There is very little nutrient loss and the flavor is not spoiled. Food is frequently rotated so that heat is applied to all parts of the food.

- *Grilling:* Food is cooked over hot charcoal on an open fire. The food is placed on top of the burning charcoal. Sometimes food is placed on wire mesh over the open fire to grill the food uniformly.

ii. Wet heat cooking: A few important methods of wet cooking are:

- *Boiling:* It is the most common method of cooking and also the simplest. Enough water is added to food and then heated over the fire. Heated water cooks the food. During the heating process, the nutrients can get in to the water and the flavor is reduced with this method of cooking. Boiled water rich in soluble nutrients can be used in brine or in curry preparation.

- *Stewing:* Food is cooked using a lot of liquid. The pieces of meat, fish or chicken are chopped and added to the stew. The liquid is slightly thickened and stewed food is served in that manner. Food pieces are cooked together at the same time in one pot and the loss of nutrients is minimal.

- *Barbequing:* It is most suitable to cook meat cutlets, fish or chicken pieces. The meat is usually marinated with spices and tenderizers for sometime before it is cooked. With this method of cooking, a sheet of metal with stands is heated up and oil is used to cook the food. The food is then turned over a couple of times before it is dished out.

- *Frying:* The two types of frying methods, viz., shallow and deep fat frying can be distinguished as below:

Shallow fat frying: A little amount of oil or fat is smeared on the pan and food is cooked in a frying pan. The food is turned over a few minutes or is stirred around a couple of times before it is cooked and dished out.

Deep fat frying: Large amount of oil or fat is used in cooking the food. Oil or fat is put into a deep pan and is heated to boiling point. Food is then put directly into the hot boiling oil and cooked.

3. MEAT CURING AND SMOKING

Historically, curing of meat was developed as an art of preservation using salt. The salted meat undergoes complex ripening reactions. This provides unique sensory profile to the product. Eventually other ingredients like nitrate, nitrite, sugar, phosphates etc. are added to the curing mixture, each with a specific role in the curing process.

Meat pigments and stabilization of meat color

Several pigments are present in muscle. They are myoglobin, residual haemoglobin, cytochromes and flavin. Myoglobin is the most abundant. Myoglobin, like haemoglobin, is a heme protein, consisting of globin (a protein) complexed to heme moiety. Heme moiety consists of an iron nucleus attached to a porphyrin ring. In uncured meat, on exposure to atmospheric oxygen, the ferrous (Fe^{2+}) iron in the heme moiety absorbs oxygen forming "oxygenated" myoglobin. This imparts a bright red color to meat. The ferrous iron then gets "oxidized" to ferric (Fe^{3+}) form, resulting in metmyoglobin, which is brownish in color. Subsequent degradation of metmyoglobin leads to discoloration in meat.

Role of nitrite in color fixation: The fixation of color in meat pigment myoglobin by nitric oxide derived from nitrite is a main reaction in meat curing. The nitric oxide (NO) gets attached to the Fe^{2+} and blocks "oxygenation". The nitricoxidemyoglobin so formed on heat application transforms into a permanent pink compound called "nitrosohemochrome" which is the color of the cured product. Ascorbic acid, ascorbate or erythorbate as an ingredient in the curing mixture helps maintain a reducing atmosphere and also reduce nitricoxidemetmyoglobin to nitricoxidemyoglobin.

Preservative functions of components: Sodium chloride (common salt) exerts inhibitory effect on bacterial growth by bringing down the water activity. Nitrite plays an important role in retarding the growth of several bacteria, particularly *Clostridium botulinum*. The phenolic constituents in smoke also have bactericidal action.

Components to improve sensory qualities: Phosphates improve the texture by enhancing the water holding capacity of muscle proteins. The phosphates increase the pH. Salt is a major component to imparting taste. Nitrite produces typical cured flavor. Smoke components, particularly phenols, aldehydes and ketones, contribute to the flavor of smoke - cured products.

Antioxidants: Lipid oxidation leading to rancidity is a major deteriorative reaction in cured products. The autooxidation is catalyzed by heme compounds especially iron. The warmed over flavor in cured meat is related to oxidative rancidity. Nitrite retards lipid oxidation. The smoke components, especially phenols, act as antioxidants. Ascorbic acid also acts as antioxidant.

Toxic factors: Nitric oxide from nitrite reacts with secondary amines in meat and produces nitrosamine, which is carcinogenic (cancer causing). Food regulations restrict the use of nitrite to 200 ppm in the final products. Benzpyrine component of wood smoke is another source of toxins.

Nitrite substitutes: Due to the nitrosamine scare search is on for substitutes for nitrite. The potential alternatives are: (i) Sorbic acid and sorbates, (ii) Sodium hydrophosphate and (iii) Fumarate esters. These compounds may be used with reduced nitrite levels. Irradiation also lowers nitrite levels. Acidulation by lactic acid producing bacteria is another alternative approach. Ascorbate and erythorbate also may be used as "blocking agents", which can trap surplus NO radicals.

Role of smoke: Wood contains 40 - 60 % cellulose, 20 - 30 % hemicelluloses and 20 - 30 % lignin. Smoking is a partial dry distillation process, which happens with internal temperature range of 200 - 400 °C. The smoke generated has two major phases: vapor and particle. All the

volatile compounds are in vapor phase. The particle phase contains carbon, tar and low volatile polycyclic hydrocarbons. The volatile fraction consists of phenols, alcohols, organic acids, carbonyls and lower hydrocarbons. Smoke components help in preservation and impart a typical color and flavor to the product.

Methods of curing: Dry salt curing, Pickle curing, Artery pumping or Injection curing (Stitch pumping) and combination of any two methods are the different methods of curing meat.

In the production of ham and bacon, pickle injection to the level of 10 % of its weight followed by 5 % dry cover cure is generally practiced to obtain best results. The concentration of pickle solution is maintained between 60 - 65° salinometer readings.

Curing time and temperature: About 36 h per pound of meat at temperature between 2- 6 °C and at relative humidity of 80 - 85 % is suitable for ham and bacon curing.

Smoking

Cured meats are generally smoked. The cured meats are desalted for about 1 hour in running water to remove excess of salt and then subjected to smoking. The purpose of smoking meats are: (i) To develop flavor and color, (ii) To give preservative action to meats by controlling bacterial population and (iv) To retard fat oxidation. Smoke is generated by the slow combustion of wood. Modern smokehouses are provided with filters to remove dust and tarry particles and also with heaters to heat the smoke to the desired temperature.

Hams and bacon are generally smoked up to 6 hours at smoke temperature of 60 °C. After curing and smoking, ham and bacon are covered with polythene sheets and stored in cool and dark place to avoid fading of color.

4. MEAT AND POULTRY PRODUCTS

A brief account of preparation and mechanism of forming in to a product for a few typical meat and poultry products is given below.

i. Biriyani: Biriyanis and pulavs may be described as complete meals, containing rice, meat, fat and spices. This preparation is a highly developed art. The traditional chef's process involves frying, braising and stewing a variety of ingredients into a final step of "dum" processing. Dum processing is a kind of baking on hot charcoal from top and bottom of the closed vessel. The process optimization takes into account aspects like meat : rice ratio, the absorption of spice flavors by meat and rice and finally the texture of meat.

ii. Tandoori chicken: It is a delicacy prepared from young chicken and cooked in a specially built oven called "Tandoor". The essential steps are: (i) Dressing and deskinning chicken (from 3 - 4 weeks old birds), (ii) Marination, *i.e.* application of a spice mix for a specified duration and (iii) Cooking in tandoor. The tandoor is heated with charcoal and is so constructed that the refractory surface of the interior creates radiant heat to 300 - 350 °C. The cooking is done in a very short time at such high temperature. This imparts the desired texture and flavor characteristics typical of tandoori chicken. The **c**hoice of the bird, composition of the marinating mix, duration of marination and manner of cooking govern the quality of the finished product.

iii. Shami kabab: This is a more homely type of traditional meat product, prepared usually from minced mutton (sheep meat). Bengal gram is used as filler, along with spices and

condiments. The kabab in the shape of flattened balls is fried in fat or oil. It has been developed in to ready – to - cook (shaped and frozen) or ready – to - eat (cooked, packed and frozen) forms.

iv. Sasusages: Sausages (Latin word *Salsus* means salt) are comminuted meat products containing salt, spices, fat and other ingredients. Ground meat sausages are prepared by chopping or grinding meat along with water / ice, salt and other ingredients. Emulsion type sausages are prepared by solubilising meat proteins and suspending fat particles in the protein solution (Fig. 1).

Shelf stable products: The basic approach to produce product with shelf stability is application of techniques like reduced water activity and controlled pH. Additives like salt and other humectants are used to retain high moisture in order to achieve better texture and taste qualities. A few shelf stable products are described below.

i. *Chicken pickle:* The product is developed using chicken meat, vinegar, salt, spices and other condiments. Quantities of ingredients, acidity, saltiness, taste and flavor are optimized to obtain the final product with a pH of 4.2 and moisture level of about 30 %. The product can be stored up to a period of 6 months at ambient temperature.

ii. *Intermediate moisture meat (IMM)***:** The IMM is developed by the reduction of water activity and partial dehydration using humectants. Intermediate mutton fry exhibits shelf stability and is safe up to 2 months. The IMM can be used for the preparation of meat pickles and cutlets.

iii. *Chicken wafers:* This is a snack food item based on chicken meat and carbohydrate blended with or without flavorings and processed as wafers. Tough meat from spent hens or layers can be efficiently utilized in the product. The product is made in raw ready – to - use and fried ready – to - eat form and packed in sealed pouches. The raw ready – to - use type product can be stored up to 1 year at ambient temperature. Fig. 2 lists a few varieties of meat and poultry products.

Conclusion

Meat processing includes chemical and enzymatic treatments, massaging and tumbling, curing, smoking, stuffing, cooking, canning, irradiation, dehydration, size reduction and mixing of meat with various additives. Whole muscle and / or comminuted meat can be used for the preparation of meat and poultry products. Whole muscle products can be cured or uncured products. There are several meat and poultry products.

Animal production and meat processing strategies help develop healthier meat and meat products. Various types of ingredients having different functional properties are used in the production of meat and poultry products. Baking, steaming, grilling and roasting are the main methods of dry heat cooking. Boiling, stewing, barbequing and frying are different types of wet heat cooking methods of meat. Meat curing involves treating meat with common salt, nitrate, nitrite, sugar and phosphates. Cured meats are generally smoked to develop unique taste, flavor and color. The curing also preserves meat by controlling bacterial population and retarding fat oxidation. Application of techniques like reduced water activity and controlled pH produces shelf stable meat and poultry products. Additives like salt and other humectants are used to

retain high moisture in order to achieve better sensory quality attributes, especially in intermediate moisture meat products.

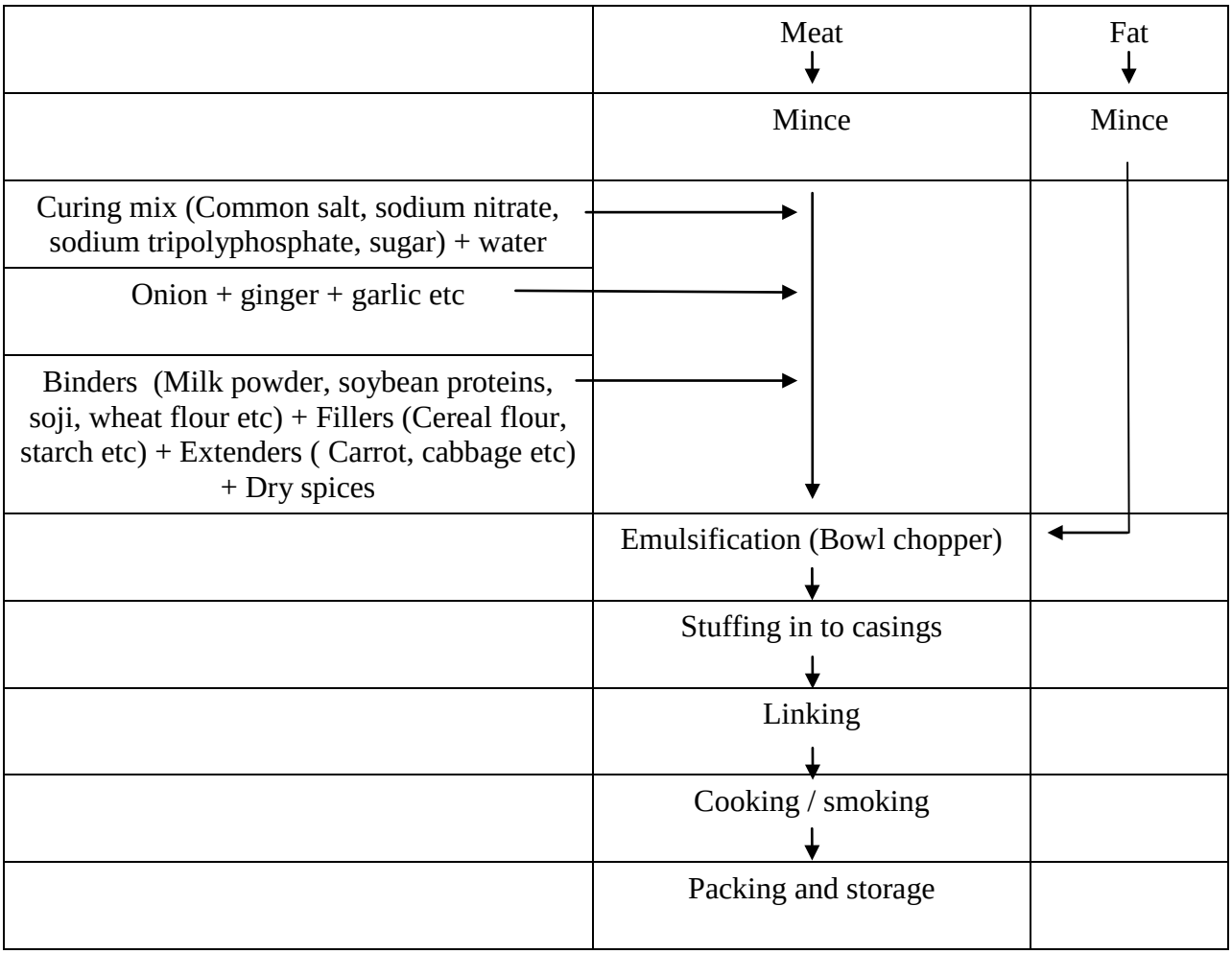
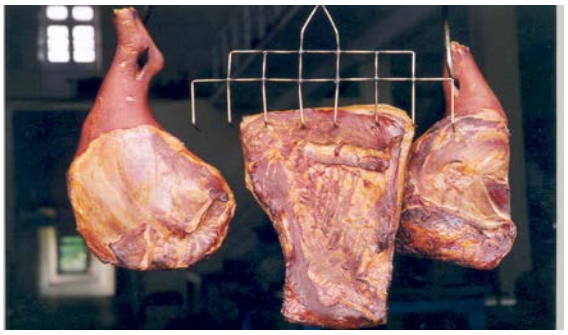


Fig. 1. Essential steps in the production of meat sausages

Shami Kabab



Ham and Bacon

Chicken Wafers (Shelf stable)

Sausages

Tandoori Chicken

Fig. 2. A few varieties of meat and poultry products