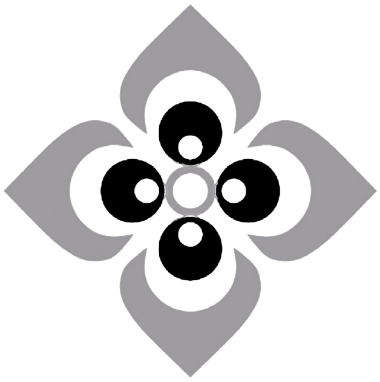

Consortium for Educational Communication

Module on

Meat Sausages

By

Sajad Ahmad Mir

Research Scholar

Food Science & Technology

University of Kashmir - 190006

Meat sausages

The term sausage is derived from latin word "salsus" meaning salt or literally translated, refers to chopped or minced meat preserved by salting. Sausages are one of the oldest forms of processed foods, their origin being lost in antiquity. It has been reported that sausages were used by Babylonians and Chinese about 1500 B.C, although documented proof is lacking. However there are some well documented references about the usage of sausages, and notable among them is Homers Odyssey. In 830 B.C, Homer wrote about smoking and salting meats in the Odyssey and he clearly describes the cooking of meat in natural casings as follows. " As when a man beside a great fire has filled a stomach with fat and blood and turns in this way and that and is very eager to get it quickly roasted so to and fro Odyssey tossed and pondered how to lay hands upon the shameless suitors, he being alone and they so many.

It is difficult to fit sausages into one single definition since they are many and varied. Attempts however have been made to define sausages either by shape, type or meat content. Characteristically, sausages are comminuted processed meat products made from red meat, poultry or a combination of these with water, binders

and seasoning. They are usually stuffed /encased into casing (intestines/stomach/esophagus of animals) and may be cured, smoked or cooked. Sausages are popularly defined as cylindrical in shape with hemispherical ends. This conventional definition by shape is becoming less popular, with greater demand for convenience leading to sausages of different shapes and sizes. With prime interest in the presentation and customer appeal sausage making has become creative with regard to shape. Some customers may require various cuts across the length to achieve a certain shape at cooking for plate presentation. Others may like a shape that is compatible with meal/sandwich packaging to provide the desired effect. The FAO (1985) views sausages as one of the oldest forms of meat processing in which meats go through various modification processes to acquire desirable organoleptic and keeping properties.

Consumer acceptance

There are hundreds of different sausage products available to the customers today. As the distribution system improved and people from different geographical regions intermixed as a result of more travelling, there was an interchange and popularization of certain sausages products until some of them become almost universally acceptable. Thus frankfurters, bologna, pepperoni and many other

sausages are available throughout the country. Nevertheless, even these universally popular products vary from place to place as a consequence of flavor and seasoning preferences. "Most of the sausages available in United States are of European origin, though some sausage products have originated in America, such as scrapple (commonly called Philadelphia scrapple) and Lebanon bologna. Traditional sausages from non-European countries have also been introduced like Chinese sausages as goin gchong and bok yu chong.

Consumers today eat sausages because of convenience, variety, economy and nutritional value. Sausage products take little time in preparation with some sausages being ready to serve and others needing only to be warmed. Sausages are economical since they are commonly manufactured from cheaper cuts of meat and from by-products.

Classification of sausages

As it is difficult to define sausage in a single definition, same way no single classification system is completely satisfactory. For convenience sausages can be classified into following ways.

1) Degree of chopping

a) Coarsely ground

b) Emulsion or finely chopped

2) Degree of cooking

a) Uncooked

b) Cooked

3) Level of smoking

a) Unsmoked

b) Smoked

4) Amount of water added.

a) No water

b) Water added

5) Curing

a) Uncured

b) Cured

6) Fermentation

a) Unfermented

b) Fermented

7) Amount of moisture in the final product

The above system of classification is not universally applied as many sausage products cut across classification and may fall into two or more systems.

Classification according to USDA Meat Inspection system

This system of classifying sausages is probably used more widely than any other, since all federally inspected sausages come under

this classification scheme. The USDA system of classification of sausages are:

A) Fresh sausages

B) Uncooked smoked sausages

C) Cooked smoked sausages

D) Cooked sausages

E) Fermented sausages

F) Luncheon meat

A) Fresh sausage

Fresh sausages are usually made from fresh, ground meat viz; carabeef, beef and pork, which are seasoned and stuffed into casings, or left in bulk form. Their taste, texture, tenderness and color are directly related to the ratio of fat to lean. Fresh sausage is neither cured nor smoked but must be kept under refrigeration and thoroughly cooked before serving. Examples are fresh pork sausage, fresh beef sausage, breakfast sausage. Fresh pork sausages are usually made from fresh or frozen pork but not including pork by-products. The fat content of the finished product should not be more than 50%. In case of fresh beef sausage the finished product should not contain more than 30% fat.

B) Uncooked, smoked sausages

These are almost similar to fresh sausages except that they are smoked to give the product a characteristic flavor and color. These must be fully cooked before eating. Examples are kielbasas and mettwurst.

C) Cooked, smoked sausage

These are made from meats which are ground, seasoned, stuffed into casings, smoked and cooked. These can be eaten cold or reheated. Examples are Berliner, cotto-salami etc.

D) Cooked sausages

These are comminuted, semi-solid sausages often prepared from one or more kinds of raw skeletal meat and/or poultry. They shall not contain more than 35% fat and no more than 10% added water. They may be either smoked or unsmoked. Cooked sausages are often served cold. Examples are bologna, frankfurters, liverwurst, knockwurst and similar products. Products made from all meat or all meat from single species may be so labelled, that is “All meat” and “All Beef” respectively.

B) Fermented sausages

Fermentation which is one of the oldest methods of meat preservation is used in making fermented sausages. Fermented sausages are characterised by their relatively long shelf life, a distinctive tangy flavor, which is brought about by production of

lactic acid in the fermentation process. Traditionally, fermented sausages are made using lactic acid bacteria naturally present in the meat or with the inoculation of the new batch from outside. The introduction of micro flora occurs at the chopping point and the mix is filled into casings and left to ferment and then dried. Some processes allow drying before cooking. The development of the pathogenic bacteria is inhibited by the acid produced by the fermentation. The low pH and the dry nature of the product are primarily responsible for the long keeping quality. Fermented sausages have relatively higher meat content and take a longer time to prepare owing to the series of required drying processes, which may take up to seven weeks. Semi-dry sausages are smoked, cooked and finished off as dried.

Fermented sausages are classified into semi dry and dry sausages

1. Semi-dry sausages

These are fully cooked in the smoke house to aid in the drying process. They usually contain more residual moisture than dry sausages.

Examples include summer sausage or thuringer sausage and Lebonon bologna

2. Dry sausage including salami

These are lightly smoked and are dried, firmer and higher in

price than semidry sausages.

Examples include salamis, pepperoni and Genoa.

B) Luncheon meat

This cured cooked product is made from comminuted meat and may contain mechanically deboned meat and added water and/or ice upto 3% of total.

Sausage casings

Sausage casings are usually made from parts of the alimentary canal of various animals. Historically sausages have been manufactured from natural casings. These natural casings are largely made up of collagen which has the unique characteristics of variable permeability. Moisture and heat make casings more porous and tends to soften them. Natural casings readily permit smoke penetration and do not contribute any undesirable flavours. Sausages made from natural casings have a snap when bitten into, which is considered desirable sensory characteristics. When stuffed, natural casing sausages have a characteristic curved shape. Natural casings are usually obtained from particular ruminants like cattle, buffalo, sheep and goat. Almost the entire ruminant/beef gastrointestinal tract can be used and casings are obtained from oesophagus, small intestines (round and runners), caecum, and large intestines. Pig casings are derived from stomachs,

small intestines, large intestines. Bladders are used for minced luncheon meats. Small hog casings (i.e from small intestines) are probably the most widely used. Commercial sausage makers often use "sewed casings" sewed casings are obtained from two natural casings that are slit, matched up and stitched together. This increases the uniformity and strength of the casings. Each type of casing can be stored for a reasonable length of time if salted in a controlled and refrigerated environment. All natural casings need to be prepared before use. The casings should be rinsed thoroughly in lukewarm water to remove salt before use. The alternatives to natural casings are synthetic casings made from edible or inedible materials. The three most common types of synthetic casings are collagen, cellulose and artificial casings. Collagen casings are made from the gelatinous substance found in the connective tissue, bones and cartilage of all mammals. The substance is harvested from the animals and reconstructed in the form of paper like edible casings. Cellulose casings are made from solubilised cotton linters, the short fibres that adhere to the cotton seed. The interior surface of cellulose may contain a water soluble dye which colors the sausage surface during heat processing. They are uniform, very strong and generally used for slicing sausages such as salami. Artificial inedible casings are made from plastics

and do not require refrigeration. Artificial casings are used by commercial producers and can be made in different colors. For example some manufacturers use red casings for bologna, clear casings for some salami and white casings for liverwurst. Artificial casings strength and uniformity are similar to cellulose. Synthetic casings are more consistent in diameter throughout their length, have a higher tensile strength than natural casings, and are cost effective for manufacturers. They can be stored for longer periods of time and require less preparation prior to use.

Product formulation

The manufacture of sausage requires an assemblage of different ingredients in the right proportion to produce not only desired quality and safe product but also a cost effective. In order to achieve this all the necessary ingredients have to be quantified properly to enable costing and establish the basis for the consistency of the product. The proportion of various ingredients vary according to type of product, species of meat used and location where the product is being manufactured. However for convenience the important constituents of sausage comprises of meat, fat, salt, sugar, antioxidants, preservatives, flavor, enhancers, spices and herb extracts, non-meat binders and casings (natural and artificial).

Brief description of important ingredients/ additives in sausage manufacturing

Besides meat and casings a large number of other important ingredients/additives can be combined together in varying proportions as required to form seasoning mix. Such ingredients include salt, herbs, sugar, spices, preservatives, onion, leek pieces, flavourings (natural and artificial) and non-meat binders. The description of these important ingredients is as follows:

Salt

Salt is the only non-meat substance that is always considered. It is mainly used to enhance flavor, for water absorption, protein solubilisation and also as preservative. Salt is usually added as NaCl at the rate of 1-2% either directly or as part of seasoning mixture. Some customers are health conscious and prefer low sodium foods. So if a low salt/low sodium product is required it would be reasonable to work out initially how much salt goes into other ingredients before deciding on the quantity of added salt.

Sugar

Sugar is sometimes used either for flavor or to counter slight bitter taste of salt. Sugar undergoes microbial fermentation process that causes reduction of pH of dry and semi dry sausages (e.g. pepperoni). The lactic acid produced by fermentation of sugar

(usually dextrose) reduces the pH and gives these sausages their characteristic tangy flavor.

Spice and herb extracts

A wide range of spices and herb extracts are used in sausage manufacturing to enhance flavor. These include rosemary, coriander, paprika, nutmeg, leek, cranberry etc.

Antioxidants

Antioxidants increase the shelf life of the product by preventing fat rancidity and color change. Ascorbic acid is among the most used antioxidant agents in sausage production

Preservatives

Preservatives (in small quantity) are used to increase the shelf life of the product as they prevent the growth of micro-organisms which causes spoilage and food poisoning. The most commonly used preservatives are sodium sulphite and sodium metabisulphite.

Flavor enhancers

Flavor enhancers reinforce the flavor inherent in the product by its effect on taste buds. Inspite of having desired effects on flavor the usage of flavor enhancers is decreasing because of consumer concerns. Monosodium glutamate is among the most used flavor enhancer in sausage manufacturing.

Emulsifiers-stabilisers

Emulsifiers help in stabilisation of the emulsion by enhancing the intimate holding of oil, fat and water as a mix. The most commonly used stabiliser in sausage making include diphosphates and triphosphates.

Non meat binders

Recipes which are high in fat and low in lean meat content require certain quantities of non-meat binders for exudates formation. These non-meat binders include milk powder, soy protein isolates, egg white, starches and whey powder.

Processing step in sausage manufacturing

Sausage processing is a continuous sequence of different events/ steps in which each step is an integral part of the whole process. Each step has to be taken care of equally without assigning any special importance to a particular step for the successful operation. The operational procedure begins with grinding of meat ingredients and proceeds through packing. The sequence of events is as follows:

Grinding

Meat chunks of variable size and shape are ground to form uniform cylinders of meat and fat. The screw feed in the barrel of the grinder conveys meat and presses it into the holes of grinder plate. The size of the hole in grinder plate determines the diameter

of meat cylinders and thickness of plates and number of blades determines the length of the cylindrical particles.

Mixing

Proper mixing is very important to obtain a uniform blend. Cylinders of lean and fat obtained after grinding are put in mixer for uniform distribution of lean and fat particles. Mixing helps in extraction of salt soluble proteins which coat the fat particles. This can be used for coarse ground sausages or emulsion type sausages by utilising emulsifier or chopper and with addition of required ingredients to obtain desired texture and uniformity of the composition. It should be kept in mind that mixer should never be overloaded as it prevents good mixing.

Chopping

Chopping is done in a bowl chopper which is composed of revolving metal bowl and rotating knife blades which cut through the revolving meat mass. From chopper, meat is transferred to emulsifier for acquiring desired texture. The RPM of bowl and the speed of knife are important for better performance of chopper. During chopping the temperature of meat mass is slightly increased and number of physical and chemical processes takes place, among which Comminution and size reduction are notable. Comminution is a widely used term in the food industry as well as in sausage

making. The size reduction and emulsification have little or no preservative effect however they are used to improve the eating quality or suitability of food for further processing and to increase the range of products available. Comminution in sausage making is conducted in the presence of salt concentration sufficient to give an ionic strength to induce swelling, water binding and partial extraction of myofibrillar protein component.

Emulsifying

Emulsifying is done in an emulsifier which combines the principle of grinding and chopping. Emulsifiers give desired texture to the meat mass. Due to high velocity of the blades there is some temperature rise in the product, which in certain cases is helpful if the meat has been frozen or hydro flaked. However excessive heat transfer to the product has to be prevented and no more than 10% heat transfer should occur. This is particularly useful in making emulsion type sausages from mechanically deboned poultry meat. The greatest advantage of using emulsifiers is that there occurs proper disintegration of the meat tissue and desired texture is obtained.

Stuffing/ filling

After grinding and chopping the sausage emulsion or sausage mix or sausage dough is filled into natural or artificial casings. The

filling is done either manually or through vacuum fillers. The two most important objective of sausage filling through vacuum fillers is to achieve portioning accuracy and evacuation of air pockets from the product. The mix from the filler hopper is fed through the nozzle by a piston pump. Evacuation of air from the product enhances color stability and the visual effect of sausages. It also reduces fat oxidation and bacterial action and prevents proteolysis. A longer shelf life is therefore achieved by vacuum filling. Sausage can be filled as soft, less compact and compact in consistency depending on the producer's requirement. Achievement of good product dimensions and speed are among the critical requirements in choosing vacuum filler. It is during this stage that the shape and size of the final product is determined.

Linking and tying

After stuffing, the encased mass is tied with thread or fastened with metal clips.

Cooking

Some producers use a cooking line to form the needed demarcation. Various cooking methods and programmes are now used in sausage cooking. Oven cooking employing steaming, smoking, drying or a combination of all, and deep fat frying. Whichever method is used should have a common characteristic and capability of achieving

ambient and product core temperature requirement. Efficient cooking requires a standardised programme based on cooking temperature, product size and residence time. For instance at an oil temperature of 160 ºC sausage (100gram) could be cooked to a core temperature of 85 ºC to 95 ºC in 6 minutes. It is important to note that microbial spoilage of cooked sausages, among other factors, depends on initial microbial load, level of preservative and the temperature of cooking and storage. Microbial spoilage of marginally cooked products (apart from its inherent safety risk) might be aggravated by even slight post processing handling and storage abuse.

Smoking

Use of smoke, either natural or liquid, to achieve the desired flavour, color, antimicrobial, antioxidant and preservative effect is a common practice in sausage making. Natural smoke derived from wood (beech, oak, hickory, juniper etc.) is used to impart distinctive flavour to the sausage. Liquid smoke has been known to contain hundreds of compounds. Hanson (2000) classifies important smoking compounds into three categories, namely phenols, carbonyls and acids, which are mostly in gaseous phase. He further highlighted four ways to achieve a uniform smoking of sausages.

1. Ensure that the smoke application system works properly and consistently.
2. Ensure a uniform product surface condition before smoke application.
3. Ensure moisture or lack of it on the surface, which is the most critical determinant of smoke color.
4. Color setting immediately after smoking to prevent the development of mottled, streaky surface appearance.

Packaging and labelling

Sausage packaging material whether primary or secondary should be good enough to offer an acceptable visual and structural presentation of the product to the customer. The important criterion is that packaging material is able to form a barrier against physical abuse, contamination and damage to the product. Further packaging materials should be food grade and should not carry or transfer contaminants. A few producers have successfully used wax coated pre-printed cartons with sleeves between layers for frozen, cooked and uncooked sausages and frankfurter's. Whatever packaging material and method/technique is being applied, it is important that consistency is achieved and maintained with regard to all specified parameters. Furthermore labelling information on packaging material should be sufficient for effective traceability of

the product. Ingredients declaration (including percentage meat content), batch number, best before date, product name, plant EC number and address and product weight are the minimum details that should appear in the label.

Storage/ distribution

Manufacturers want their products to reach the recipients at the right time without any temperature or physical abuse. For the purpose of traceability many manufacturers specify a 24 hour temperature monitoring chart and tracking system as primary requirement in selecting primary transport and distribution of their product.