
UNIT 1 GENERAL PRINCIPLES OF PROCESSING OF MEAT PRODUCTS

Structure

- 1.0 Objectives
- 1.1 Introduction
- 1.2 Purpose of Meat Processing
- 1.3 Primary Factors in Meat Processing
- 1.4 Classification of Ingredients and Meat Products
 - 1.4.1 Classification of Ingredients
 - 1.4.2 Classification of Meat Products
- 1.5 Basic Processing Procedure
 - 1.5.1 Comminution
 - 1.5.2 Emulsification
 - 1.5.3 Formulation
 - 1.5.4 Enrobing
 - 1.5.5 Canning
 - 1.5.6 Fermentation
 - 1.5.7 Restructuring
 - 1.5.8 Cooking/Heat Processing
 - 1.5.9 Curing and Smoking
- 1.6 Hurdle Technology
- 1.7 Let Us Sum Up
- 1.8 Key Words
- 1.9 Some Useful Books
- 1.10 Answers to Check Your Progress

1.0 OBJECTIVES

After reading this unit, you will be able to:

- list advantages of meat processing;
- describe different methods of processing;
- explain the principle of different methods of processing;
- classify meat products; and
- state different ingredients used for processing of meat.

1.1 INTRODUCTION

Meat has been consumed as a part of the diet by man since prehistoric times and is an excellent source of high quality protein and various micronutrients. In spite of religious taboos and socio-economic constraints, it still finds a prime place in the diet of over 70 per cent Indians. Most of the meat produced in India is for domestic consumption and only a small part of it is exported.

Origin of meat processing is lost in antiquity but probably began where primitive man first learned that salt is an effective preservative and that cooking prolongs the keeping quality of fresh meat. In any case meat processing had its origin before the dawn of civilization. Modern food processing traces its origin to the development of canning for which Nicholas Appert, a chef, received an award from the French Government in 1809. Since that time advances in technology have continued to change the processing methods.

We process meat to different products primarily to improve taste and keeping quality. In processing, meat is subjected to different processes like curing, grinding, mixing with different ingredients, cooking, packaging etc. Thus, processing of meat causes considerable changes in the natural state of meat. In this unit, we will learn about advantages, classification and different methods of processing of meat. By properly understanding different methods of processing, you can prepare any type of meat product.

1.2 PURPOSE OF MEAT PROCESSING

The purposes of meat processing are changing from time to time. Originally, meat processing was aimed at improving shelf life, flavour and nutritive value. Then the emphasis was shifted to modify or upgrade the less desirable meat cuts to desirable products. Now-a-days, the concept of processing has changed to provide convenience and variety products. Thus, that in processing of meat, low value meat cuts are processed to improve shelf life, flavour, taste, nutritive value and convenience.

The processing of meat into meat products is advantageous for the following reasons:

- Addition of different ingredients to meat improves taste and flavour.
- Specific processing conditions and ingredients improve shelf life.
- Processed products are convenient to handle and eat.
- Processing improves nutritive value.
- Products of specific requirements can be prepared e.g., for children, old age or obese people.
- Processing add value to meat.
- Low value meat cuts can be better utilized in the processed products.
- Edible meat byproducts can be effectively utilized in the processed products.
- Processing improves demand and marketability of meat.
- Meat protein can be provided to consumers at affordable price.
- Processing industry creates employment.

1.3 PRIMARY FACTORS IN MEAT PROCESSING

When we process meat to make products, the following factors are to be considered:

Cohesion : The product should retain its physical integrity after processing.

Fat : Like water, maximum amount of natural and added fat should be retained during processing till consumption.

Moisture : Maximum amount of natural moisture (water) of meat and added water should be retained during processing. This is very important for yield and quality of the product.

pH : The pH of meat governs the functional properties of meat, which is very important for product preparation.

Protein : The quality of protein is important particularly in emulsion type meat products.

WHC : Water holding capacity of meat plays important role to get good quality meat products.

1.4 CLASSIFICATION OF INGREDIENTS AND MEAT PRODUCTS

Different processing methods and ingredients are used to prepare different types of meat products.

1.4.1 Classification of Ingredients

We can classify the ingredients into meat based and non-meat based ingredients.

Meat based ingredients: Ingredients that are obtained from slaughter of animal are called meat based ingredients e.g., lean meat (fat is trimmed off from meat), meat fat, edible byproducts, meat trimmings etc. these are the major ingredients of any meat products.

Non-meat ingredients: Large numbers of non-meat ingredients are required for providing taste and improving quality. These ingredients also reduce the cost of meat products. These can be classified into different categories like additives, binders, extenders etc. For example: salt, phosphate, sodium nitrite, flours, starches etc. You will study these ingredients in detail in 3rd unit of this block.

1.4.2 Classification of Meat Products

Meat products can be classified into different categories mainly on the basis of chunk/particle size, extent of comminution or method of processing.

(A) Classification according to chunk/particle size

- i. Whole muscle - chunk size > 2 to 3 cm^3 e.g., ham.
- ii. Comminuted - chunk size < 2 to 3 cm^3 e.g., reformed hams, ground meat patties.
- iii. Emulsion - fine, pasty, homogenous mixture e.g., sausages, patties.

(B) Classification according to degree of comminution (i.e., Extent of division of meat into meat pieces or particles)

- i. None e.g., ham, bacon
- ii. Some e.g., reformed ham, restructured products
- iii. Coarse e.g., meat balls, ground meat patties
- iv. Fine e.g., sausages

(C) Classification according to the type of processing

- i. Cured meat products
- ii. Smoked meat products
- iii. Restructured meat products
- iv. Emulsion type meat products

- v. Fermented meat products
- vi. Enrobed meat products
- vii. Intermediate moisture meat products
- viii. Canned meat products.

Check Your Progress 1

1) What is the purpose of meat processing?

.....
.....
.....
.....
.....

2) Classify the meat products according to type of processing.

.....
.....
.....
.....
.....

3) Match the following meat products with degree of comminution of meat:

Meat products	Degree of comminution
i. Sausages	a. Coarse
ii. Reformed ham	b. Whole muscle
iii. Ham	c. Small pieces
iv. Meat balls	d. Fine

1.5 BASIC PROCESSING PROCEDURE

1.5.1 Comminution

Comminution is the first step for production of comminuted meat products. The particle size of the meat cuts is reduced by the process of comminution. The degree of comminution (or particle size) depends upon the type of the processed products. Meat may be coarsely comminuted or finely ground. It is often a unique characteristic of a particular product. Comminution improves uniformity of the product and increases tenderness by reducing the particle size.

Meat grinder/mincer, silent cutter, emulsion mills and flaking machines are commonly used for comminution. For sausage type product, grinders are usually employed as first step in the comminution and for non emulsified sausages, grinding is often the only form of comminution. Silent cutter is used to reduce the particle size of meat and fat and for mixing ingredients prior to their emulsification. Emulsion mills are used for emulsion preparation at much less time.

Prior to further processing, ground meats are subjected to an additional mixing which is known as blending. This is done to distribute the ingredients uniformly. Meat, seasonings and other ingredients are blended prior to emulsion preparation.

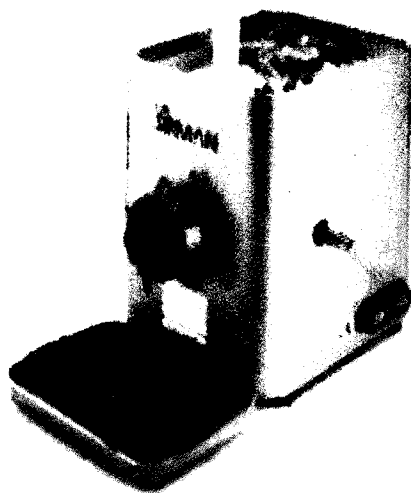


Fig. 1.1: Meat mincer (used for mincing meat)

1.5.2 Emulsification

An emulsion is a stable mixture of two immiscible substances. Emulsion type meat products are the most popular processed meat products. When lean muscle tissue, fat, water and salt are mixed together and subjected to high speed cutting and mixing action, a batter is formed. This batter is called emulsion. In emulsion, lean meat and other ingredients like free fat and added water form a matrix. Thus, fat and water do not separate during cooking.

Thus an emulsion can be defined as a mixture of two immiscible liquids, one of which is dispersed in the form of small droplets or globules in the other liquid. The liquid that forms the small droplets is called as dispersed phase and the liquid in which droplets are dispersed is called continuous phase. The size of droplets ranges from 0.1 to 5.0 micrometers (μm) in diameter. Special equipment called 'bowl chopper' is used for preparation of emulsion. Emulsions are generally unstable unless another component, known as 'emulsifying' or 'stabilizing' agent is present. Emulsifying agent or emulsifiers will be discussed in unit -3 of this block.

In meat emulsion, muscle and connective tissue fibers form a matrix which is suspended in an aqueous medium containing soluble proteins and other soluble constituents. Soluble proteins coat the fat particles which are dispersed in the matrix (Fig. 1.2). The soluble protein may be either sarcoplasmic or myofibrillar. Myofibrillar proteins are much more efficient emulsifying agents. Salt is used in emulsion preparation to solubilize these proteins into the aqueous phase so that they become available for coating the fat particles.

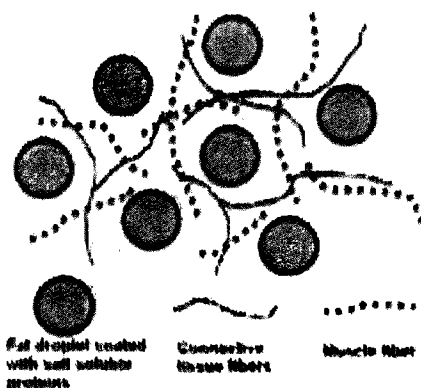


Fig. 1.2: Schematic diagram of meat emulsion showing dispersed fat droplets surrounded by protein matrix

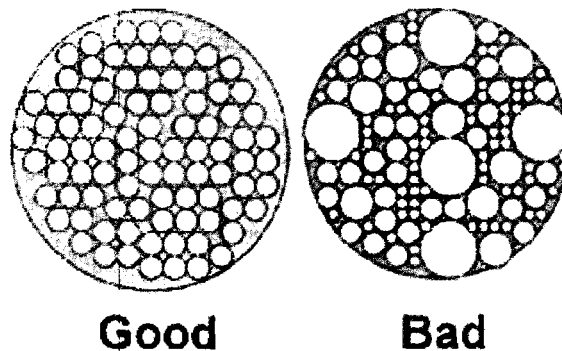


Fig. 1.3: Diagrammatic comparisons of good and bad emulsions. Equal sized fat droplets are uniformly distributed in good emulsion

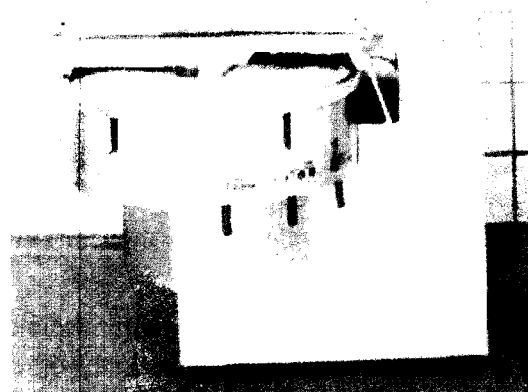


Fig. 1.4: Bowl chopper (used for preparation of meat emulsion)

Purposes of preparation of emulsion

- Meat of spent animals can be effectively utilized for preparation of emulsion.
- During mincing and chopping, muscle and connective tissue fibers are broken and thus meat tissue becomes tender.
- Emulsion prevents moisture and fat loss during cooking. This improves qualities particularly juiciness, texture, flavour and cooking yield of the product.
- The batter prepared can be transformed to a variety of products of different taste, shape and characteristics.
- The volume of product can be increased by incorporating number of edible meat byproducts, low value meats and non-meat ingredients.
- Emulsion based meat products can be prepared economically than other meat products.

Factors affecting stability of emulsion

- i. **Temperature during emulsification:** Emulsion temperature increases during chopping and emulsification due to friction in the chopper. Increase in temperature helps to release soluble protein, accelerates cured colour development and improves flavour characteristics. But too high temperature, adversely affect the emulsion stability by denaturing the soluble proteins and melting fat particles. Final emulsion temperature must be within 20-25°C. The temperature can be

controlled or reduced by adding ice rather than water to the meat ingredients during chopping and emulsification.

- ii. **Fat particle size:** Meat fat must be subdivided into smaller particles until an emulsion is formed. With the reduction in particle size of the fat, total surface area of the fat particles proportionately increases. This increase in surface area requires much more soluble protein to completely coat the surface of the smaller particles. Thus the over chopping of meat fat can result in a large surface area which can not be coated by available soluble proteins to adequately stabilize the emulsion. Uncoated or partially coated fat particles results in unstable emulsion.
- iii. **pH:** Solubility of the protein depends upon the pH of the medium. More protein is extracted as the pH of muscle increases. Thus higher pH values results in more stable emulsions. The amount of fat emulsified per unit of protein is referred to as emulsification capacity. The amount of protein extracted is affected by several factors.
- iv. **Amount and type of soluble protein:** Pre-rigor meat is superior in terms of emulsion stability to post-rigor meat as 50 per cent more salt soluble proteins can be extracted in pre-rigor stage. Myofibrillar proteins are salt soluble and superior to sarcoplasmic proteins as emulsifying agents. Therefore, more fat can be emulsified with the protein extracted from pre-rigor meat than with same amount extracted post-rigor. Emulsion stability increases as the amount of soluble protein available to act as emulsifying agent increases.

1.5.3 Formulation

Formulation is nothing but the mixing of different ingredients like meat, curing mixtures, seasonings, binders, fillers and water to produce processed meat products of uniform appearance, composition, taste and physical properties from batch to batch and time to time. Formulation is also important from the view point of quality standards of the meat products which should be maintained while using the least cost raw materials. You will learn about curing mixtures, seasonings, binders, fillers and water in unit-3 of this block. Here we will discuss about meat ingredients.

Proper selection of meat ingredients is a basic requirement for producing uniform processed meat products. Meat and by-products vary widely in chemical composition, in colour, water binding capacity and emulsification capacity etc. Thus the processor must have sufficient information about the properties and composition of various available meat tissues in order to formulate the meat product successfully.

Skeletal muscles is the primary raw material for processed meat products. But to reduce the cost of production, other low priced cuts/ raw materials are also used. For example: liver, kidneys, heart, spleen, tongue, snouts, partially defatted tissue, fat and blood.

One must consider the binding ability of the meat to other ingredients. The binding ability of meat includes the ability to

- hold meat pieces together.
- produce desired texture.
- stabilize the fat and
- chemically bound water.

As the binding ability of meat ingredients depends upon the amount of extractable actin and myosin, skeletal muscles are having the most desirable combination of these properties.

According to the binding ability, there are following four categories of meat:

1. **High binding meats:** These meats possess high binding capacity. These include - bull meat, cow meat, boneless pork shoulders, lean pork trimmings (80% lean) and poultry meat (without skin).
2. **Intermediate binding meat:** These meat possess intermediate binding ability. These include - beef cheek and head meat, beef flanks, plates, navel, pork cheek and head meat, beef shank.
3. **Low binding meats:** These meats possess low binding properties. These include - regular pork trimmings, pork jowls, beef brisket, heart, weasand meat, giblets, tongues, trimmings and deboned poultry back.
4. **Filler meats:** The filler meats are able to absorb large amounts of water but contribute little to emulsification. These include - ox lips, tripe meat, pork stomachs, skin, snouts, lips and livers.

Other aspects of formulation will be dealt in unit-4 of this block.

Check Your Progress 2

- 1) Enlist the advantages of preparation of emulsion based meat products.

.....

.....

.....

.....

.....

- 2) Name important ingredients used in preparation of meat emulsion.

.....

.....

.....

.....

.....

- 3) List important points to be remembered during preparation of emulsion.

.....

.....

.....

.....

.....

1.5.4 Enrobing

Enrobing is the coating of surface of product with edible materials. You might have seen a number of enrobed products in the market like enrobed groundnuts, peas, grams etc. Enrobed fish and chicken parts are also popular in certain parts of our country. Now-a-days different types of meats and meat products are coated to provide wide range of meat products. Beside raw or cured chunks, restructured or emulsion based products can also be enrobed to further improve the sensory qualities and shelf life of the products. Enrobed products are also called battered and breaded products. The process, thus, can be called as battering and breading. The ingredients used in enrobing (coating) are wheat flour, corn flour, rice flour, gram flour, proteins

e.g. milk powders, egg albumen, cereal flours, soya proteins, seasonings, spices, salt, sugar, fat and hydrogenated oils etc.

Enrobing of any product is advantageous because of improved appearance, taste, juiciness, flavour, tenderness, nutritive value, cooking yield and shelf life of the product.

Some of the examples of enrobed products are:

- *Bone in product e.g.*, chicken drumsticks, chicken cut up parts.
- *Whole muscle or meat chunks e.g.*, breast fillets of chicken, chunks of pork, mutton and buffalo meat.
- *Ground meat products e.g.*, enrobed nuggets, enrobed patties.

Method of Preparation of Enrobed Products

Preparation of enrobed products generally consists of three steps: battering, breading and frying.

- A thin suspension of different ingredients called batter is applied on the surface. Some times, before batter application, pre-dusting with dry flours is done to ensure better adhesion of batter.
- Coated product is then dusted with dry material like dried breadcrumbs. This is called breading.
- Battered and breaded product is then deep fat fried.

The details of each step will be discussed later under heading of enrobed meat products.

1.5.5 Canning

Canning is a thermal process that employs heat (steam) to sterilize the product placed in a sterilized container (can). The major reason for canning meat is to provide safe products that have desirable flavour, texture and appearance during storage for sufficient long time.

In canning, meat or meat products are subjected to heat treatment to kill spoilage microorganisms. The heat treatment is generally given after packing the products in cans or in retort pouches. The machine used for heat treatment is called retort. The heat treatment is scheduled in such a way so that it either commercially sterilize the product i.e. destroys all viable microorganisms or pasteurize the product i.e. destroy most of the microorganisms (not all).

Steps of Canning

- Cooked or raw meat and gravy are filled into cans. Cans shall not be completely filled. Some of the space (as per specification) must be left.
- Air present in cans is removed mechanically and seaming is done with the help of machine.
- The cans are subjected to high temperature under pressure as per requirements.
- Immediately after thermal processing, cans are cooled to 30-40°C.

Essential Features of Canning Process

- Contamination and spoilage shall be prevented before processing.
- Correct heating and cooling schedule is essential to ensure destruction of microorganisms.

- Adequate care is essential for containers. Container shall not contaminate food.
- Post process contamination shall be prevented.

Aseptic canning : In this process meat products and cans are sterilized separately and then sterilized meat products are filled into sterilized cans. Cans are hermetically sealed under sterile conditions. This method uses more heat for substantially shorter periods of time than conventional canning. But it is difficult to maintain sterile conditions during filling and sealing of cans. Nutrients, colour, taste, odour, and texture of the product are maintained in this process but it is relatively expensive.

Retort pouches : Now-a-days, multiple layer flexible pouches are also used instead of metal cans. These are called retort pouches. Product is filled in these pouches and then these are subjected to high temperature process. As these are made up of thin layers, heating and cooling is very rapid. The quality of products is better maintained. It is easy to open a pouch than a can. In spite of these advantages, the use of pouches in canning is not very common as the cost of a pouch is more than a can.

Detail of canning will be dealt later in this course under the heading of canned meat products.

1.5.6 Fermentation

Fermented meat products are prepared by microbial fermentation and dehydration to develop specific flavour and texture. In the production of fermented meat products, we add selected bacterial culture to the minced meat. These are called 'starter culture'. Starter cultures are available commercially. These contain microorganisms like *Lactobacillus*, *Pediococcus*, *Lactococcus* and *Micrococcus*.

After addition of starter culture to minced meat, mixture is kept at specific temperature and humidity for a specified period. This allows maximum growth of added bacteria. This process is called 'fermentation'. During fermentation bacteria utilize sugar and produce lactic acid, which causes decrease in pH. After completion of fermentation, product is dried to specific moisture level. After drying, products are cooked or smoked.

Longer shelf life of fermented meat products is due to creation of adverse conditions for bacterial growth as listed below:

- Lower pH
- Lower moisture content and thus lower water activity
- Competitive bacteria (large number of lactic acid bacteria prevents growth of spoilage bacteria).

You will learn more about fermented meat products in the next block of this course.

Check Your Progress 3

- 1) List different steps for preparation of enrobed meat products.

.....
.....
.....
.....

- 2) Name major ingredients used for battering meat and meat products.

.....
.....

.....
.....
3) Write the advantages of enrobing meat or meat products.

.....
.....
.....
.....
4) What is aseptic canning?

.....
.....
.....
.....
5) Write the reasons behind longer shelf life of fermented products.

1.5.7 Restructuring

Restructured technology is also a popular processing technology for preparation of different meat products. Restructured meat products are generally prepared from less expensive cuts, tough cuts, meat trimmings or combination of these.

In this technology, small pieces of meat or meat trimmings are joined together to get bigger pieces. The bigger pieces can be again cut into smaller pieces. Thus, we can get meat pieces/products of desirable shapes and sizes. During the process of binding small pieces, sensory qualities are improved by use of different additives. These types of meat products have sensory characteristics between ground meat and intact muscle steaks. Restructured meat products are primarily classified according to method of particle reduction used in production of these items, e.g. chunked, flaked, chopped etc.

Method of Preparation of Restructured Products

In general, preparation of restructured products consists of two steps. First, reduction of particle size and second, binding of pieces.

- Particle size reduction is done by sectioning, chunking, slicing, flaking or chopping.
- Binding of particles is ensured by different chemicals or processes with the objective to produce a viscous exudates (gel) on the surface of meat particles.
- Salt and phosphates are generally used along with tumbling, massaging or simple mixing to extract salt soluble proteins required for formation of binding materials or gel. The gel sets and binds meat pieces together before or during cooking.

Step-wise procedure for preparation of restructured product

- Meat pieces are cut to required size.
- Salt and phosphate are added directly to meat particles and blended in paddle type mixer till tachy exudates appear on the surface of meat pieces. This indicates extraction of meat proteins.

- Sometimes meat pieces added with salt and phosphate are put in massager or vacuum tumbler. Meat pieces are put in the drum of these machines and rotated. This facilitates extraction of proteins.
- After extraction of proteins with salt and phosphate, other ingredients are added and mixed in a blender or mixer.
- This mix is stuffed into molds of desired sizes and shapes or into the casings.
- After stuffing, product is marketed in frozen form or cooked under steam or dry heat and then marketed.

Three basic procedures for the production of restructured meat products are as follows:

- Chunking and forming
- Flaking and forming
- Tearing and forming.

These will be elaborated in the next block of this course.

1.5.8 Cooking/Heat Processing

Probably meat cooking had been occurred first time accidentally when fresh meat was exposed to heat or fire. Now it has been modernized and sophisticated. Cooking not only improves the eating and keeping qualities of the meat product but also provides a variety of meat products

Effects of cooking on meat products

- Meat proteins are coagulated and denatured by cooking. The colour of the product is changed by changed solubility of the meat protein.
- Meat palatability is improved by cooking because it intensifies the flavour and alters texture of the product.
- Storage life of meat product is increased by cooking due to destruction of a considerable number of microorganisms as well as reduced water content.
- Texture and tenderness of the meat products are modified by cooking.
- Red colour of cured meat product is stabilized by cooking.
- Development of off-flavour in the meat products can be prevented by inactivation of the indigenous proteolytic enzymes through the process of cooking.

Methods of cooking

Three basic methods of cooking are:

- (i) Dry heat cooking
- (ii) Moist heat cooking
- (iii) Microwave cooking.

Mostly the foods are cooked by a combination of two methods. For example, meat may be cooked partly by dry heat and partly by moist heat.

- (i) **Dry heat cooking:** When meat is cooked by surrounding hot air, it is called as dry heat cooking. Relatively tender cuts of meat are cooked by dry heat cooking. Roasting, broiling and frying are different dry heat cooking methods.

Roasting: Tender cuts like veal shoulder, pork shoulder, leg of lamb, veal leg, ribs of beef etc. are roasted generally. The meat cuts (atleast 2½ inches thick)

are placed in an open roasting pan with fat side up and then placed in a hot air oven at a temperature of 250°-350° F. Higher temperature can also be used for browning effect and increased flavour of the product. It may be used in preparing precooked frozen beef.

Broiling: Tender steaks of beef, chops of lamb and cured ham steaks are generally cooked by broiling. In this method of cooking, meat cuts are supported by wire grill and heat is either supplied from above as in a gas/ electric oven or may be from below as with a charcoal oven. Time required for cooking depends upon the desired doneness of the products.

Frying: Frying may be of two types: shallow pan frying and deep-fat frying. When the meat cuts are fried in a small amount of fat in a frying pan, it is called as shallow pan frying. In deep-fat frying, meat cuts are fried in large amount of fat in a deep-fat fryer. Generally small meat cuts like sliced steaks, veal chops, lamb chops etc. are cooked by this method.

- (ii) **Moist heat cooking:** In this method hot liquid or steam is used for cooking the meat. Water is added during cooking and the container is covered with a lid to condense the steam for most effective cooking. Stewing, braising, pot-roasting, simmering and pressure cooking are commonly used moist heat cooking methods.

Stewing: Usually less tender small meat cuts are covered with water or tomato juice and then cooked at a simmering temperature after covering the container with a lid. Stew may be or may not be browned in fat. Vegetables may also be added. Consistency of the stew must be slightly thick.

Braising: This method is also suitable for less tender cuts like breast of lamb, chuck roast of beef, veal and pork chops etc. Here dry and moist heat –both are used. The meat cuts are browned by dry heat cooking in a small amount of fat, then cooked by moist heat by adding water, vegetable stock, milk or gravy etc. The container is covered and simmered at a temperature just below the boiling. Vegetables may be added and must be sufficiently cooked.

Pot-roasting: This procedure is similar to braising; only difference is the time of adding the vegetables.

Pressure cooking: Tough meat cuts like breast of lamb, chuck roast of beef etc. are cooked by this method. This method uses higher cooking temperature and minimum time to make the tough meat cuts tender in a short time by means of pressure. In pressure cooking, meat cuts may lose their normal texture.

Simmering: Meat cuts or products are cooked in water at a temperature considerable below the boiling temperature (160°-170°C). Generally meat cuts are cooked in casings or bags to avoid excess shrinkage loss.

- (iii) **Microwave cooking:** This method uses energy from electromagnetic field. Generally 915 MHz and 2450 MHz frequency microwaves are used for this purpose. Food absorbs energy from the electromagnetic field and intermolecular collision in the food converts this energy to heat. So heat is generated within the food and not transferred from the surrounding environment which is common in other conventional method of cooking. This is advantageous because of rapid and uniform heating of the food particles, lower energy usage and ease of control. Foods must be cooked in a container other than metal because microwave does not penetrate metal. Brownness can not be developed by this method. This method is widely used in meat industry specially for thawing of frozen meat before further processing.

1.5.9 Curing and Smoking

Curing and smoking are two different methods of processing but sometimes cured products are smoked for desired flavour. You will study about these two processing methods in next unit of this block.

1.6 HURDLE TECHNOLOGY

This is also known as “combination preservation”. As you are aware each and every technique of preservation if applied alone has some extreme effect for desired result. To overrule any extreme effect of a single technique it was found wise to use different technique in combination so that desired result could be obtained by gentle treatment. In combination preservation process, a number of hurdles are used to prevent the growth of microorganisms. These include pH decrease, use of preservatives, lowering of water activity by applying different principles simultaneously, use of heat, storage at low temperature, etc. By using hurdle technology, quality of the product is not affected and at the same time the shelf life of the product is greatly improved. Intermediate moisture meat products are also prepared using hurdle technology.

Intermediate moisture meat (IMM) products can be defined as the products that are partially dehydrated and have a suitable concentration of dissolved solids. The dissolved solids bind remaining water sufficiently to inhibit growth of bacteria, molds and yeasts. Thus, the intermediate moisture products are characterized by low water activity (water available for growth of bacteria). Typical intermediate moisture foods have water activities ranging from 0.6 to 0.85 and moisture content of 30 to 50%. The IMM products are generally shelf stable without refrigeration or thermal processing. Due to these properties, IMM products are important in defence services. However, due to lower moisture content, some people do not like the texture of IMM products.

Development of IMM Products

Development of IMM products generally consists of the following principles:

- Lowering of water activity by addition of solutes/additives such as glycerol, sucrose, glucose and salt. The additives used to lower the water activity are called ‘humectants’. These substances bind with the water and thus make this water unavailable for bacteria.
- Retarding microbial growth by addition of anti-microbial agents such as propylene glycol, sorbic acid.
- Heat treatment to inactivate enzymes.
- Further depression of water activity by partial dehydration.

Thus, in simple words, the preparation of IMM products consists of following steps:

- Meat pieces are marinated in a solution containing salt, sugar and other chemicals
- Cured pieces are cooked
- Cooked pieces are partially dehydrated

Different hurdles involved in preventing microbial spoilage of IMM products:

- Lower water activity (a_w) by use of comparatively higher concentration of sodium chloride, use of sugar (mainly sucrose) and use of humectants (mainly glycerol)
- Use of antimicrobial agents e.g., sodium benzoate, sodium nitrate/nitrite, trisodium citrate.

- Decrease in pH.
- Decrease of moisture content (by drying)

Check Your Progress 4

1) Write the important steps for preparation of restructured meat products.

.....

2) List different cooking methods.

.....

3) List characteristics of intermediate moisture meat products.

.....

4) Write factors responsible for lowering water activity of intermediate moisture meat products.

.....

5) Match the following equipments with the processing method where they are primarily used.

Sl.No.	Equipment	Sl.No.	Type of processing
i	Bowl chopper	a)	Restructured products
ii	Vacuum tumbler	b)	Fermented products
iii	Humidity chamber	c)	Emulsion based products
iv	Retort	d)	Canned meat products

6) Match the processing steps with the types of product.

Sl. No.	Steps	Sl. No.	Type of product
i.	Use of solutes to decrease water activity	a)	Enrobed meat products
ii.	Battering	b)	Restructured products
iii.	Extraction of proteins	c)	Intermediate moisture meat products
iv.	Addition of starter culture	d)	Fermented meat products

7) Match the following actions during processing with the method of processing

Sl. No.	Action during processing	Sl. No.	Processing methods
i.	Coating of fat particles with proteins	a)	Canning
ii.	Binding of meat pieces	b)	Fermentation
iii.	Reduction in pH	c)	Emulsion preparation
iv.	Seaming and heat treatment	d)	Restructuring

1.7 LET US SUM UP

Meat is processed to different types of products primarily to improve taste, shelf life and provide convenience. Meat processing involves different processes like curing, smoking, emulsion preparation, restructuring, canning, fermentation and enrobing. Each process requires different raw materials, chemicals, methods, cooking and packaging and results in specific type of product. In emulsion preparation, meat proteins get solubilized and coat the fat particles. Thus, prevent fat and water loss during cooking. In restructured products, small meat pieces or meat trimmings are joined together by proteins extracted from meat. For preparation of fermented meat products, bacterial cultures are added into the meat. These products have low pH and longer shelf life. In canning, products are subjected to high temperature to kill the spoilage bacteria. In enrobing process, qualities of products are further improved by coating meat products with edible coating materials. Lower water activity ensures long shelf life of the products in intermediate moisture meat products.

Thus, by properly processing meat, we can ensure effective utilization of low value meat and byproducts and can provide large number of tasty meat products to the consumers. The meat processing is also helpful in providing livelihood to unemployed youth and can tackle problems of under nutrition in our country by providing high quality proteins at affordable price.

1.8 KEY WORDS

Back slopping	: Method of inoculation of meat. In this, raw mixture from the previous day's batch is added to the new batch.
Bowl chopper	: Special equipment required for making emulsion (minced meat is chopped with very sharp blades).
Emulsion	: Stable mixture of two immiscible substances.
Emulsifier	: A substance that keeps the mixture stable by reducing the surface tension.
Enrobing	: Coating meat or meat products with edible ingredients.
Emulsion stability	: It is measure of amount of fat, water and solid released during cooking of emulsion.
Fermentation	: Process of conversion of sugar into lactic acid by desirable bacteria.
Hurdle technology	: Process by which bacterial growth is prevented by simultaneous use of many factors like pH, temperature, preservatives, water activity etc.

- Retort pouches** : Flexible multilayered pouches used in place of metal cans.
- Starter culture** : Bacterial culture used for preparation of fermented meat products.
- Vacuum tumbler** : Drum type machine in which meat pieces are rotated under vacuum to extract proteins. Used in restructured meat products.
- Water activity** : It is the relative availability of water in a substance and defined as the vapor pressure of water divided by that of pure water at the same temperature; therefore, pure distilled water has a water activity of exactly one.

1.9 SOME USEFUL BOOKS

Ranken, M.D. (2001). *Handbook of Meat Products Technology*. Blackwell Science Ltd.

Barbut, Shai. *Poultry Products Processing*. CRC Press, Boca Raton, Florida.

Pearson, A.M. and Gillet, T.A. (1999). *Processed Meats, 3rd edition*, An Aspen Publication, inc., Gaithersburg, Maryland.

Price, J.F. and Schweigert, B.S. (1971). *The Science of Meat and Meat Products, 2nd edition*. W.H. Freeman and Company, San Francisco.

1.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Purpose of meat processing is to improve the shelf life, flavour, taste, nutritive value and utilization of low value meat cuts for the production of convenience food.
- 2) According to types of processing, meat products are classified into:
Cured meat products, smoked meat products, restructured meat products, emulsion based meat products, enrobed meat products, fermented meat products, canned meat products and intermediate moisture meat products.
- 3)
 - i. Sausages- Fine
 - ii. Reformed ham- Small pieces
 - iii. Ham- Whole muscle
 - iv. Meat balls- Coarse

Check Your Progress 2

- 1) Advantages of preparation of emulsion based meat products are effective utilization of tough meat and low value cuts, improved tenderness and juiciness, higher yield, variety of products.
- 2) Important ingredients used for meat emulsion are meat, fat, chilled water, salt, phosphate, binder/extenders, spices, condiments.
- 3) Important points to be remembered during preparation of emulsion are—
 - Level of different ingredients

- Recommended sequence of addition of ingredients
- Temperature should not rise beyond 10°C
- Under-chopping or over-chopping should be avoided.

Check Your Progress 3

- 1) Steps for preparation of enrobed meat products are-
 - application of batter
 - breading
 - deep fat frying.
- 2) Major ingredients used for battering meat and meat products are- flours (gram, corn or rice flours), water, salt and spices, egg liquid, milk powders, curd and cream.
- 3) Advantages of enrobing meat and meat products are improved appearance, taste, juiciness, flavour, tenderness, nutritive value, cooking yield and shelf life of the product.
- 4) Aseptic canning is the process where meat products and cans are sterilized separately and then sterilized meat products are filled into sterilized cans. Sealing is done under sterile atmospheric conditions. This process conserves nutrients, colour, taste, odour and texture but this is relatively expensive.
- 5) The reasons behind longer shelf-life of fermented products are – low pH, lower moisture content (low water activity) and reduced growth of spoilage bacteria due to competition with lactic acid bacteria.

Check Your Progress 4

- 1) Important steps for preparation of restructured meat products are as follows:
 - Cutting of meat pieces,
 - Extraction of proteins by salt and phosphates,
 - Mixing of other ingredients,
 - Stuffing into molds,
 - Freezing and/or cooking.
- 2) Cooking methods are listed below:
 - (i) Dry heat cooking: Roasting, Broiling and Frying
 - (ii) Moist heat cooking: Stewing, Braising, Pot-roasting, Pressure cooking and Simmering
 - (iii) Microwave cooking.
- 3) Characteristics of intermediate moisture meat products are as follows:
 - Have low water activity (0.6 to 0.85),
 - Have low moisture content (30 to 50%), utilize hurdle concept to decrease water activity,
 - Shelf stable without refrigeration.
- 4) Factors responsible for lowering water activity of intermediate moisture meat products are use of salt, sugar, glycerol, etc.
- 5)
 - i. Bowl chopper – Emulsion based products
 - ii. Vacuum tumbler – Restructured products

- iii. Humidity chamber – Fermented products
- iv. Retort – Canned meat products
- 6) i. Use of solutes to decrease water activity – Intermediate moisture meat products.
- ii. Battering – Enrobed meat products
- iii. Extraction of proteins – Restructured products
- iv. Addition of starter culture – Fermented meat products
- 7) i. Coating of fat particles with proteins – Emulsion preparation
- ii. Binding of meat pieces – Restructuring
- iii. Reduction in pH – Fermentation
- iv. Seaming and heat treatment – Canning.