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Man has satisfied his hunger with animal food from the ancient times. Animal sources include many food items such as meat, poultry, fish, eggs, etc. In general animal foods play an important role in the diet of man since they provide a variety of nutrients that are difficult to obtain in adequate quantities from plant source.

2.1 MEAT

The meat may be defined as ‘the muscles of warm blooded terrestrial four legged animals, the chief ones being cattle, sheep, pigs and rabbits’. Meat also includes the glands and organs of these animals.

2.1.1 Structure and composition of meat:

- **Structure of meat:** Lean meat is the muscle tissue of animals. This is referred to as flesh. It is made up of the following parts:

i. Muscle tissue:

It is composed of muscle fibres. These are made up of cells which contain protein called actin and myosin. Short and fine muscle fibres come from young animals. Long and thick muscles fibre come from older animals.

ii. Connective tissue:

Bundles of muscle fibres are held together by creamy white connective tissues. These connective tissues are spread throughout the muscles. Connective tissue is made up of collagen and elastin which are fibrous proteins. Connective tissues are prominently found in legs and neck of animals.

iii. Fatty tissues:

Fat is deposited in the fat cells. From these fatty cells, fatty tissues are formed. Fatty tissues are found around various organs like kidney, heart, liver and under the skin.

iv. Bone:

Meat is also composed of bones. Bones are mainly composed of bone tissues. Organ meats do not contain bones.

v. Blood vessels and nerve tissue:

These are distributed within connective tissues and bones.

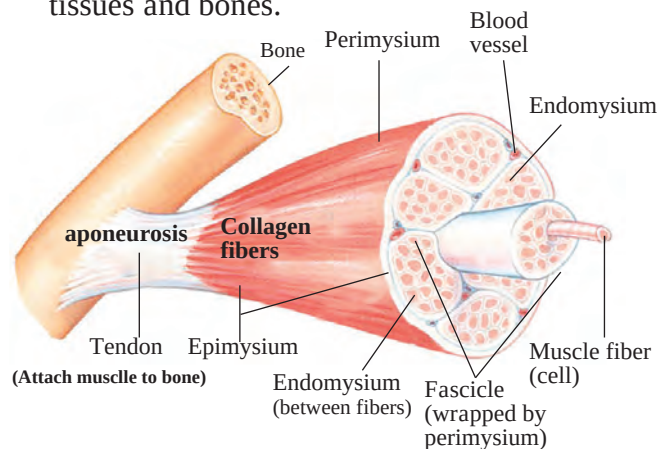


Fig. 2.1 Structure of meat

• Composition of meat:

- i. **Protein:** Muscles contain 15 to 20 percent protein. The lean meat contains 20 to 22 percent proteins. Meat proteins contain all essential amino acids that are beneficial to human beings. Actin, myosin, collagen elastin, albumin and globulin are the major proteins that are present in meat.

- ii. **Fat:** The fat content of meat varies from 5 to 40 percent. It varies with the type, breed and age of the animal.

- iii. **Carbohydrate:** These are found only in very small quantities in meat known as glycogen and glucose.

- iv. **Water:** About 70 to 75 percent of meat muscles is composed of water. In young animals, this proportion is higher and in older animals the proportion decreases.

- v. **Vitamin:** Meat has most of the fat soluble vitamins namely vitamin A, D, E and K. Meat is also a good source of B-complex vitamins especially thiamine, riboflavin and niacin.

- vi. **Minerals:** Mostly all minerals vital to human beings are present in meat. It is a good source of phosphorus, iron and copper.

- vii. **Pigments:** Myoglobin and haemoglobin are the two red characteristic colour pigments of meat which are responsible for the meat colour.

2.1.2 Effect of cooking on meat:

Cooking can make meat more tender or less tender than the original raw cut. When meat is cooked, three types of changes take place. They are as follows:

- Melting of meat fat
- Dissolution of collagen in hot liquids to become soft gelatin
- Tissue softening and muscles fibre separation

Due to overheating, muscles fibres contract and meat shrinkage take place. Also it becomes tougher with evaporation of moisture, and tissue become dry and tougher. The overall effect of cooking meat is beneficial from nutrition and digestion point of view.

2.1.3 Methods of cooking meat:

Depending upon the tenderness of meat, various methods of cooking are used. Moist heat method is used for making less tender cuts to more tender, since this provides a means for the conversion of collagen to gelatin. Braising, stewing and pressure cooking are the moist heat methods used for cooking meat, while dry methods include roasting, broiling, pan broiling and frying. Generally, lower cooking temperature for a longer period of time is better than higher temperature for a short period of time. Due to this, increased juiciness, less shrinkage and more uniform colour throughout the cuts is observed.

Changes during cooking:

Cooking destroys the microorganisms that may have contaminated meat and the naturally occurring enzymes also. During cooking denaturation of protein takes place. Colour of the meat changes during cooking. On heating, red meat generally turns brown due to the oxidized pigments in meat. It is considered as the desirable effect.

2.2 POULTRY

The term poultry is applied to all domesticated birds used as food and it includes chicken, duck, geese, turkey and pigeon. Of these, chicken and turkey are the most commonly used for their meat. The poultry birds kept for eggs are called as 'layers' and the meat birds are 'broilers'. The method of re-production of poultry is known as 'hatching' to get the chicks (generally, within 21 days from the fertile egg).

2.2.1 Composition of poultry:

- i. **Protein:** Poultry meat has a high protein content varying from 20 to 25 percent.
- ii. **Fat:** There is little fat in the meat of young birds, but the fat content is changed by age and species of poultry.
- iii. **Vitamins and minerals:** Poultry flesh is a good source of B-complex vitamins and minerals.
- iv. **Water:** It contains about 70 percent of water.

2.2.2 Classification of poultry:

Poultry is classified on the basis of age. Age influences tenderness and fat content which decides the cooking methods. The classification according to Indian standards are given as follows,

Table 2.1 Chicken classification according to Indian standards:

Type	Specifications
Broiler/fryer	Chicken aged 8-10 weeks, male or female
Rooster	Chicken aged 3-5 months, male or female
Stag	Male chicken aged 10 months
Fowl/stewing chicken	An adult chicken aged 10 months
Cock	An adult male chicken aged more than 10 months

2.2.3 Cooking of poultry:

Raw chicken has little or no flavour and it develops during cooking. Like meat, moist heat method and dry heat methods are used for cooking. The cooking method is selected on the basis of the tenderness of the poultry and its fat content. Moist heat methods are applied to older and tougher birds while dry heat methods

are applied to young tender birds. To obtain tender, juicy and uniformly cooked poultry, low to moderate heat is to be used. Intense heat results in the toughening of proteins, shrinkages and loss of juiciness. The overall effects of cooking poultry improve the sensory qualities, palatability and digestibility.

2.3 EGG

India is the largest egg producer in the world. The annual egg production has been reported to about 75 billion. From prehistoric times, eggs of many species of birds have been in use as food. But the most commonly preferred for table purpose use are hen's egg. Egg is a major ingredient used in various dishes e.g. cakes, puddings, souffles and other fancy dishes like egg rice, cutlets, etc.



Fig 2.2 Egg

2.3.1 Structure and composition of egg

• Structure of egg:

A fully developed egg has a shell, two membranes, albumin or white of the egg, yolk or yellow of the eggs. The approximate weight

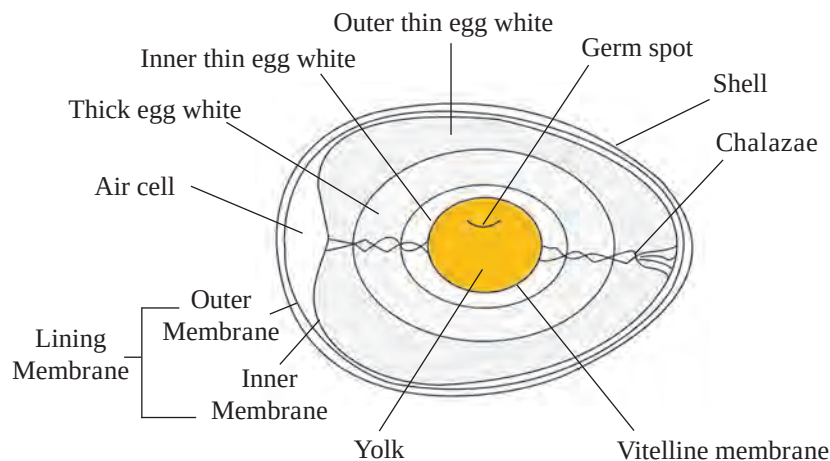


Fig 2.3 Structure of an egg

of hen's egg varies from 40 to 70 g. The whole egg is oval shaped, one side being narrower than the other blunt edge. The different parts of an egg are shown in figure given below.

i. Shell:

The shell is the natural protective outer covering of the internal contents of egg. Shell constitutes about 11 percent of the total weight of an egg. It is made up of insoluble salts of calcium (calcium carbonate) and magnesium. Egg shell is micro porous, brittle and breaks easily. The pores are so small (micro) that they are not visible without magnification. Shells of some eggs are white and brown in colour, it depends on breed of the poultry. In a freshly laid egg, the porous shell is covered with a thin layer of gelatinous mucous coating called the cuticle or bloom. This layer temporarily seals the pores and prevents the loss of odours, flavours and gases from the egg. It also restricts the entry of micro organisms into the egg and thus protects the inner contents from various infections

ii. Lining membrane:

Within the shell there are inner and outer membranes that form the lining membrane. It protects the quality of egg.



iii. Egg white:

Egg white lies between the inner lining membrane and the egg yolk. It is composed of three layers.

- Outermost layer of thin egg white
- A layer of thick egg white
- Innermost layer of thin egg white which lies adjacent to the yolk.

In a fresh egg, thin egg white and thick egg white are in equal amounts.

iv. Egg yolk:

It is the central part of an egg. It is usually yellow in colour but the colour varies from dark yellow to orange. The yellow colour of the yolk is due to the colour pigment called xanthophyll. The yolk is enclosed in the yolk sac called the vitelline membrane. This membrane has finger like projections (thread like structure) on either side of the yolk called chalazae which is anchored in the thick egg white. These chalazae help to hold the yolk in the centre. Yolk has a germ spot which develops into a chick under suitable conditions.

• **Composition of egg:**

Egg is an excellent source of important nutrients. Egg yolk and egg white differ in their nutrient content.

i. Protein: Egg contains about 12 to 14 percent protein. Egg white contains proteins such as ovalbumin, ovoglobulin and ovomucin. Ovomucin is responsible for the thickness and slipperiness of egg white. Egg yolk contains two lipoproteins namely lipovitellin and lipovitellinin.

ii. Fat: Egg contains approximately 10 to 12

percent fat which is in a well emulsified form, therefore it is easier to digest. Egg white has only traces of fat (0.05 percent) whereas egg yolk contains approximately 31 percent fat, hence it is a good source of energy.

iii. Minerals: The whole egg contains about 1 percent minerals. Calcium is the most abundant mineral in the whole egg but it is concentrated in the shell. Phosphorus and iron along with calcium are present in yolk. Sulphur is more abundant in the egg white, chiefly as a constituent of the albumin.

iv. Vitamins: Egg yolk is an excellent source of Vitamin A, good source of thiamine and riboflavin and a fair source of vitamin D. Egg white is a fair source of riboflavin. Egg does not contain vitamin C.

v. Water: Egg contains approximately 74 percent water, but the shelf life is good because the shell protects the inner contents especially fresh egg. Egg white contains a higher percentage of water compared to yolk.

Do you know ?



World egg day is celebrated around the world every year on second Friday in October to raise awareness of the benefits of egg and its importance in human nutrition.

Table 2.3 - Nutritional composition of hens egg (100g)

Part of egg	Weight (g)	Water (%)	Protein (%)	Fat (%)	Mineral (%)
Whole egg	50	74	13	12	1
Egg white	33	88	11	0.05	0.8
Egg yolk	17	50	17	31	1.5

2.3.2 Effect of cooking on egg:

When egg is heated, proteins undergo denaturation and then coagulation. This functional property of coagulation is extremely important in performing some important functions like thickening, binding, coating, foaming, clarifying, etc.

Various egg proteins coagulate at different temperatures. Following factors affect coagulation of egg proteins.

- i. Concentration and part of egg used:** The concentration and the time required for coagulation depends on the proportion of egg in any mixture. Egg white proteins begin to coagulate at about 60°C. The coagulation of egg yolk begins at 65°C and is completed at 70°C. Egg, when diluted with other liquid like milk requires a much higher temperature for coagulation.
- ii. Temperature and time:** The rate of coagulation increases with increasing temperature and time of cooking. A rapidly heated egg mixture coagulates at higher temperature and may curdle than a slowly heated mixture. Therefore, in preparation of soft custard, double boiler helps to give a soft smooth product. The egg white coagulated at higher temperature is firm and tough as compared with the soft and tender product obtained when coagulation takes place at

a lower temperature. If eggs are cooked approximately at 85°C, a soft and tender product will be formed.

- iii. Stirring:** For getting a smooth product stirring is essential as due to stirring, heat is distributed uniformly at the time of cooking and hence a smooth product is formed.
- iv. Effect of other ingredients:** Dilution of egg with milk or water raises the coagulation temperature. Presence of acid or salts speeds up the process of coagulation whereas sugar slows the process.

Foam Formation:

When egg is beaten, it produces foam by incorporating air into it. The foaming of egg plays an important role in many foods because it makes the product light in texture and contributes sponginess due to leavening action. Egg white foams readily to a large volume when beaten. When whole egg or egg yolk is beaten, the volume of foam is lesser in comparison to egg white foam. This is due to the presence of fat which interferes in foam development. When egg yolk alone is beaten, the colour changes to pale yellow due to incorporation of air.

Stages of foam formation in egg white:

- 1. Foamy stage:** When eggs are slightly beaten, big bubbles are formed. It resembles soap solution. This foamy stage

is highly unstable. Egg whites are beaten to this stage in food preparations where it is used as thickening, emulsifying, binding, foaming or clarifying agent.

2. **Soft peak stage:** When beating is continued, more air is incorporated into the white. Air bubbles become smaller. When the beater is lifted, the foam forms a soft peak which curls over if the beater is withdrawn. It will also flow when the bowl is tilted.
3. **Stiff peak stage:** On further beating, air cells become very small and even sized. Foam is glossy and holds an upright peak. When the beater is lifted, it will not flow. At this point, the foam reaches its maximum volume and stability. This stage foam is used for puffy omelets, sponge cake and souffles.
4. **Over beaten or dry foam stage:** When the egg whites are over beaten, the foam begins to look dry and the volume of foam decreases. Liquid separates at the bottom of the bowl. At this stage, foam does not perform any function in food preparation.

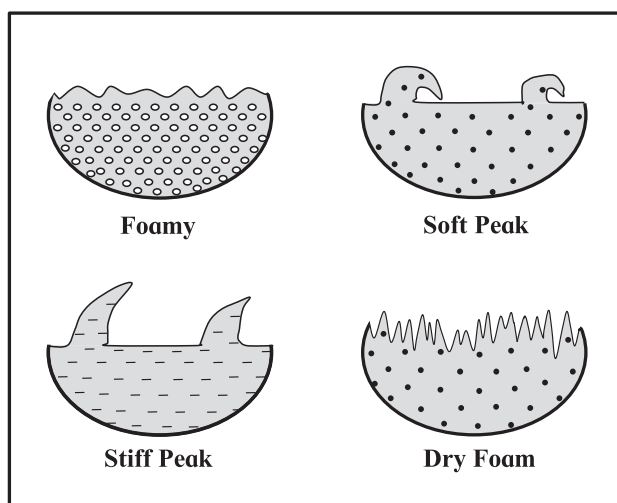


Fig 2.4 Stages of foam formation

2.3.3 Functions of egg in cookery:

Egg is useful in many food preparations. Egg can be used alone or in combination with other foods. The functional properties of eggs are as follows:

1. **Leavening agent (foaming):** One of the most common uses of eggs is as a leavening agent. A leavening agent helps to make a cooked product rise. When eggs are beaten they hold small air bubbles. When heat is applied, the air bubble cells expand resulting in the leavening (spongy) of the product. The egg white foams are of important in the development of light structure and good volume of food preparations, especially baked products such as cakes and muffins.
2. **Coating agent:** When a food preparation is dipped in egg and cooked in oil, the surface is sealed by the immediate coagulation of egg protein. This solid thin coating of egg prevents disintegration of the product and further fat penetration. Meat balls, cutlets, banana fritter are few examples where egg acts as coating agent.
3. **Binding agent:** When raw egg is added to any food mixture and cooked, egg protein coagulates and this enables the egg to bind particles or pieces of food together. Hence, egg and other food material bind together, and helps to retain their shape. Minced meat cutlets and *kababs* are some examples where egg acts as a binding agent.
4. **Thickening agent:** As egg protein coagulate due to heat, the product becomes more viscous. This thickening property of egg is used in various products such as custards and cream pie fillings.

5. **Emulsifying agent:** Egg yolk is a good emulsifying agent. An emulsifier helps to hold together the moisture and oil phase in the product. Whole egg and egg white are also used as emulsifiers. However, egg yolk is rated as four times as effective an emulsifier compared to egg white. **Lecitho-proteins** that are present in egg yolk are responsible for the emulsifying property of egg yolk. In preparation of mayonnaise and ice cream, eggs are used as emulsifying agents.
6. **Clarifying agent:** In the preparation of clear soup, a small amount of egg is added for clarification. While coagulating, proteins hold suspended particles which can be removed by straining.
7. **Decorating agent:** Egg makes some products more attractive and palatable. For cake decoration, egg is the main ingredient in royal icing. Similarly, egg is used for glazing certain bakery products. It is brushed on the surface of products like biscuits, puffs and buns before baking which imparts shiny and smooth appearance with yellow attractive colour. Slices of boiled egg are used to decorate salad, *biryani*, *pulao* and other products.
8. **Tenderizing agent:** In baked goods, egg helps to retain moisture during baking and storage. Egg binds the other ingredients together and forms a barrier through which moisture cannot escape easily. Hence, eggs contribute to smoothness, moistness, sponginess, and desirable texture (crispy) in baked products.
9. **Flavour and colour:** Egg imparts a desirable flavour and colour to many preparations such as cakes, egg noodle, salads and custards. An eggless cake does not have the same aroma and flavor as other cakes in which egg is added.

2.4 FISH

Fish is a food of excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals. It is estimated that there are about 25,000 species of fish living today. About 250 different species of fishes are used for edible purposes. Commonly consumed varieties of fish are salmon, sardine, mackerel, tuna, catfish, brown duck, ribbon fish, prawns, pomfret, rohu, trout, tilapia (chilapi), etc.



Fig 2.5 Fish

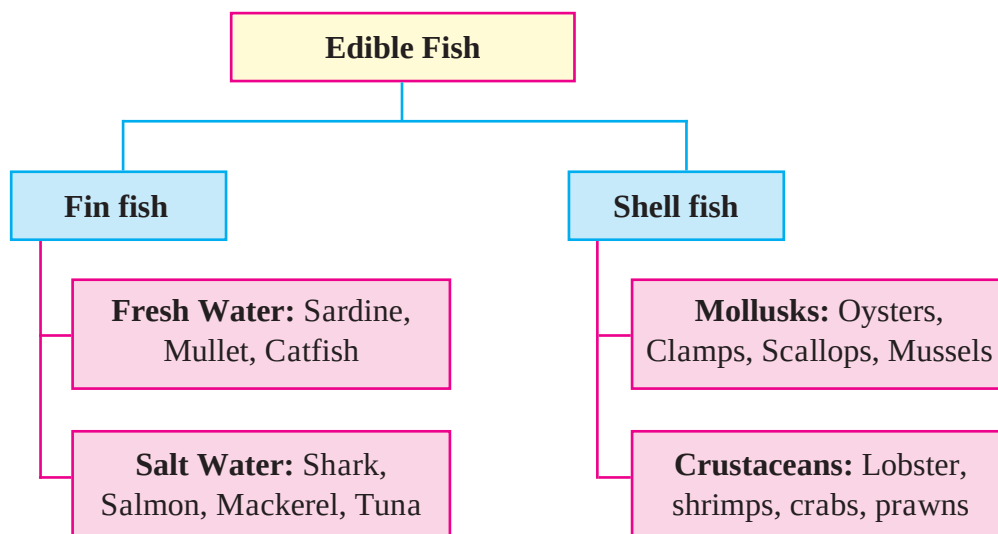
2.4.1 Classification of fish:

Edible fishes are classified into two major categories as fin fish and shell fish based on their anatomical differences. The fin fishes have bony skeleton, whereas, fishes without a skeleton but covered with some type of hard shell are shellfishes. Fin fish classified into fresh water and salt water fish. Shell fish is further classified to mollusks and crustaceans. Edible shellfishes are mainly salt water fishes. Fishes are also classified on the basis of fat content.

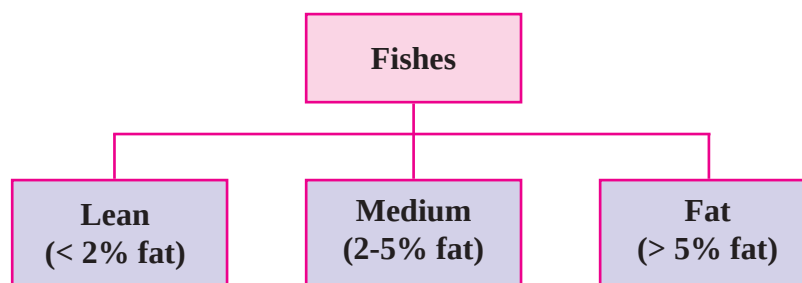
2.4.2 Composition:

The composition of fish varies considerably according to the types of fish. In general, fish is a rich source of protein, fat, minerals and vitamins.

Classification of fish based on anatomical differences



Classification of fish based on fat content



- **Protein:** Fish is an excellent source of protein (about 20 percent):
 - **Carbohydrate:** Fish contains some glycogen in muscle tissues and the liver. Fish glycogen is the source of stored energy.
 - **Fat:** fish contains less amount of fat, compared to meat and poultry. The fat content of fish varies from 0.1 to 25 percent. The fat content depends on the variety of fish, stage of maturity and the season.
 - **Minerals:** Fish is a good source of minerals. It is a good source of copper, sulphur, phosphorus, magnesium and selenium. Salt water fish contains more iron than the fresh water fish. Marine fish is a good source of iodine.
 - **Vitamins:** Fish oils are rich source of vitamin A and D. Fish flesh is a fair source of thiamine, riboflavin and a good source of niacin. The vitamin C content of fish is very low.
 - **Water:** Water content of most varieties of fish is very high. It ranges from 70 to 80 percent. This is one of the factors responsible for the high perishability of fish.
- Fish is highly perishable. Fish tissue is generally more perishable than animal tissues. Fish has very little connective tissues or has a kind of connective tissue that is very easily hydrolysed. Therefore the structure of fish, especially fin fish, is very delicate and tender even in the raw form.

2.4.3 Fish processing:

The high perishability of fish needs to be handled properly immediately after catching and it is preserved for human consumption. Fish Processing is a way of preserving fish and at the same time improving their shelf life and quality. There are various preservation methods to process fish.

- **Salting** is the process that lowers the moisture content of fish to a point where microorganisms cannot live and grow. Salt partially dehydrates the fish and kills the bacteria (osmotic effect). Salting serves to impart flavour and color to fish and has a profound effect on texture.
- **Smoking** method is an important primary operation used to give the combined effects of preservation, drying and cooking to fish. Different smoking ovens are used. The smoke gives color and flavour to the fish due to its chemical compound.
- **Drying** method is also known as natural dehydration. The most popular fish preservation method is sun drying that is done in combination with salting e.g. salted fish.
- **Curing** method involves chemical preservatives (including vinegar and salt), smoke, and other physical factors to reduce the moisture content of the fish. Cured fish



Fig 2.6 Fish processing

possess a characteristic flavour and texture completely different from those of the fresh fish.

- **Canning** is the packing of fish in an airtight containers such as tin cans and glass jars, which prevent air and microorganisms from entering. Sardines and salmon fishes are the most commonly canned fish sold in the market.
- **Fermentation** is a fish preservation method in which fish is kept in brine solution which undergoes fermentation reaction forming acetic acid and lactic acid i.e. pickeling.

2.4.4 Fish products:

- Fish paste
- Fish oils
- Fish sauce
- Fish protein concentrate
- Fish hydrolysate
- Fish meal

2.4.5 Effect of cooking on fish:

Aim of cooking fish is to destroy microorganisms, change the texture and develop desirable flavour. Fish gets cooked very easily and quickly compared to meat and poultry as it contains very less connective tissue. Fish is generally cooked by dry heat, such as baking, steaming, roasting and frying. Fish low in fat is generally fried with fat. Some fish are rich in fat and such fish require very little additional fat in cooking. Frying is one of the most popular methods of cooking fish. Frying gives brown colour, crisp texture and taste to fish.

Moist heat methods are usually not used to make the fish tender but mainly for variety e.g. fish curry. Special care has to be taken while using moist heat method as excessive cooking will disintegrate the pieces and make it less palatable.

Points to remember

Meat:

- Meat is animal flesh that is used as food. Meat of animal like goat, pig, buffalo, deer and rabbit is consumed worldwide.
- Lean meat is composed of muscle tissue, connective tissue, fatty tissues, blood vessels, nerve tissues and bones.
- Meat is cooked by dry heat and moist heat methods of cooking.
- Cooking meat increases its shelf life. There is also a change in colour, tenderness, flavour, juiciness and nutritive value.

Poultry:

- Poultry is the term applied to all domesticated birds.
- Poultry meat is rich in protein, fat, vitamins and water.
- Poultry is cooked by dry heat as well as moist heat methods

Egg:

- Egg consists of an outer protective covering called 'the shell' with an inner lining called the lining membrane.
- Inner edible contents are mainly divided into egg yolk and egg white.
- Egg is a rich source of protein, fat, minerals like calcium, phosphorus and iron, vitamin especially vitamin A, thiamine and riboflavin.
- When egg is beaten or cooked, denaturation followed by coagulation of proteins take place.
- Due to its property of foaming, emulsifying and coagulation, egg performs the functions of leavening, binding, thickening, clarifying and decorating various food products.

Fish:

- Fish is an excellent source of protein, contains low fat in variable amounts, minerals, vitamins and high percentage of water.
- Fish is cooked mainly by dry heat methods as it cooks very fast. Moist heat methods are used mainly for variety of food preparations.

Exercise

Q. 1 a. Select the most appropriate option.

- Connective tissues is made up of collagen and _____.
a. Elastin b. Plastin
c. Albumin d. Gluten
- Overheating results in _____ of meat.
a. Softening b. Shrinkage
c. Whitening d. Hardening
- _____ from the egg yolk interferes in foam formation.
a. Protein b. Water
c. Fat d. Minerals
- Protein content of poultry meat ranges from to _____.
a. 05-10 b. 10-15
c. 20-25 d. 30-35
- The poultry birds kept for eggs are _____.
a. Broilers b. Layers
c. Both a and b
d. None of the above
- The coagulation of egg yolk begins at _____.
a. 95° C b. 55° C
c. 65° C d. 75° C

- vii. _____ is a fin fish
- Lobster
 - Sardine
 - Crabs
 - Prawns
- viii. The fish contains < 2% fat are called _____
- Lean fish
 - Fat fish
 - Both a and b
 - None of the above

b. Match the following.

	A		B
1.	Muscles tissue	a.	Chicks
2.	Emulsion	b.	Collagen
3.	Hatching	c.	Mayonnaise
4.	Connective tissue	d.	Crabs
5.	Shell fish	e.	Actin and myosin
		f.	Shark

c. Do as directed.

- i. State whether following sentence is true or false.

Egg yolk is an excellent source of vitamin C.

- ii. Identify the odd word.

- Egg white
- Egg yolk
- Shell
- Fish

- iii. Name the colouring pigment found egg yolk.

X				H						L
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- iv. Unscramble the underlined word.

HLAACEZA helps to hold the yolk in centre of the egg.

Q. 2 Short answer questions.

- a. Define the following.

- Coagulation
- Foaming

- Gel Formation

- Emulsification

- b. Write short notes on the following.

- Denaturation and coagulation
- Classification of poultry
- Classification of fish
- Explain method of cooking fish

- c. Answer the following.

- Different sources of protein in our diet.
- Proteins present in muscles fibres.
- Effect of cooking fish.

Q. 3 Long answer questions.

- Discuss the different stages of foam formation.
- Write the functions of an egg in cookery.
- Describe structure and composition of meat.
- Explain in detail about the structure and composition of egg.
- Give in detail about fish processing

Project:

- Visit a supermarket. Collect information about various types of meat, fish, and poultry products available and prepare an attractive informative booklet.
- Prepare charts on products of an eggs.

Prepare an album of any ten recipe based on meat, egg, fish and poultry.

