
UNIT 6 DAIRY, POULTRY, MEAT AND FISHERIES

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6.0 OBJECTIVES

After reading this unit, you should be able to:

- state the present production status and importance of livestock products including fisheries in national economy;
- enumerate important value added products from milk;
- indicate steps for clean milk production;
- give the basic features of poultry management and preservation of eggs and meat;
- indicate important preservation and processing techniques for meat;
- differentiate between the culture and marine fisheries; and
- outline the principles of preservation and processing of fish.

6.1 INTRODUCTION

Animal husbandry, dairying and fishery activities along with agriculture have been an integral part of human life since the beginning of civilization. Man has been domesticating animals either for food or for cultivation and transport. These domestic farm animals or livestock such as, dairy cows/ buffaloes, goat, sheep, beef cattle, horses, pigs, chicken and turkeys play an important role in the socio- economic life of India. Livestock products play a pivotal role in improving the livelihood of a large number of people by providing food products and by-products for human utility. Besides providing high quality foods such as milk, eggs, meat, fish etc; the livestock sector provides employment to millions of rural farmers and people engaged in secondary and tertiary business related to it. The unit gives a profile of important livestock products in reference to food processing industries.

6.2 PRODUCTION AND ECONOMIC IMPORTANCE

6.2.1 Production

India has vast resource of livestock and poultry. India ranks first in respect of cattle and buffalo, second in goat, third in sheep and seventh in poultry population in the world. The country has 57% of the world's buffalo population. Table 6.1 gives the livestock population details and a profile of livestock products, i.e. milk, eggs, meat and fish is given in Table 6.2, 6.3 and 6.4.

Table 6.1: Livestock population
(million nos.)

Sl. No.	Species	Livestock census		Growth rate (%) 1997 over 1992 annual (comp.)	
		1992	1997		
1.	Cattle	204.58	198.99	-2.79	-0.56
2.	Buffalo	84.21	89.91	6.77	1.32
3.	Sheep	50.78	57.29	12.82	2.44
4.	Goat	115.28	122.71	6.45	1.26
5.	Pigs	12.79	13.29	3.91	0.77
6.	Others	3.22	3.28	1.86	0.37
Total Livestock*		470.86	485.36	3.08	0.61
7.	Poultry	307.07	347.11	13.04	2.48

* - excludes pack animals, yaks and mithuns

Source: Annual Report (2003-04), Dept. of Animal Husbandry & Dairying, Ministry of Agriculture.

Table 6.2: Production and availability of milk and eggs

Particulars	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Milk (million tones)	72.1	75.4	78.3	80.6	84.4	86.2	88.1	91.00
Per capita availability (gms/day)	207	213	217	220	225	230	231	232
Eggs (Million numbers)	28689	29476	30447	36632	38729	39823	40403	41000
Per capita availability (nos./head/ annum)	30	30	32	36	38	39	40	41

Source: Compiled from Basic Animal Husbandry Statistics 2004, Dept. of Animal Husbandry & Dairying

Table 6.3: Meat production – 1997 to 2003

(in 000 Tons)

Year	Beef & Veal	Buffalo Meat	Mutton & Lamb	Goat meat	Pig meat	Poultry meat	Total Meat
1997	1378	1403	222	458	533	630	4626
1998	1401	1380	226	462	543	710	4721
1999	1421	1398	228	466	560	821	4894
2000	1442	1421	229	467	578	1081	5218
2001	1452	1428	230	469	595	1251	5426
2002	1463	1443	233	470	613	1401	5622
2003	1490	1471	234	473	630	1600	5898

Source: Compiled from Basic Animal Husbandry Statistics 2004, Dept. of Animal Husbandry & Dairying

Table 6.4: Production and export of marine products

Year	Fish production (million tonnes)			Export of marine products	
	Marine	Inland	Total	Quantity ('000 tonnes)	Value (Rs. crore)
1950-51	0.5	0.2	0.7	20	2
1960-61	0.9	0.3	1.2	20	4
1970-71	1.1	0.7	1.8	40	35
1980-81	1.5	0.9	2.4	80	235
1990-91	2.3	1.5	3.8	140	893
2000-01	2.8	2.8	5.6	503	6296
2001-02	2.8	3.1	5.9	458	5815
2002-03	3.0	3.2	6.2	521	6793
2003-04 (P)	3.0	3.4	6.4	412 (P)	5739

Source: Economic Survey (2004-05)

Requirement: The per capita animal protein availability is about 10 grams as against minimum requirement of 20grams (from milk 10g, meat 4g, fish 4g, egg 2g). The estimated demand for the present population would be milk 104 million tonnes, meat 7.7 million tonnes, fish 7.7 million tonnes and eggs 4.6 million tonnes (104 million number). A significant gap exists between the requirements and production.

Milk Production: India continues to be the largest producer of milk in the World. The milk output during 2003-04 was anticipated to be 88.1 million tonnes and is expected to reach the level of 91.00 million tonnes during 2004-05. The per capita availability of milk is also expected to increase to 232 g per day during 2004-05 from 207 g per day in 1997-98.

Egg Production: Poultry development in the country has shown steady progress over the years. The current production of eggs is estimated to about 41.00 billion (in numbers) during 2004-05. Currently India ranks fifth in egg production in the World.

Fish Production: There has been significant growth in fish production in the country in the recent years. India is now the third largest producer of fish in the world, and second largest producer of fresh water fish in the world. During the year 2002-03, the total fish production was 62.00 lakh tonnes comprising 30.00 lakh tonnes of marine fish and 32.00 lakh tonnes of inland fish. The fish seed production during the year 2002-03 was 16,333 million fry. Fish is a source of cheap animal protein and current per capita consumption of fish in India is around 9 kg per annum as compared to 11 kg recommended by World Health Organization (WHO).

Meat and Meat Products: Though the country has a good livestock population yet most animals are not bred/ reared in industrialized or scientifically controlled methods for meat production, which is reflected by a generally low annual slaughter rate across all species except pig. Most of the production of meat and meat products continues to be in unorganised sector. The share of bovine meat in the total meat production is about 60% as against small ruminants (sheep and goats – 15%), pigs (10%) and poultry (12%). There are about 3,600 licensed slaughter houses operating in the country, most of them being run and maintained by local municipal bodies. Overall, the scenario is: abattoir management is poor, technologies employed are out of date and hygiene and sanitary conditions are not perfect. As per FAO data the per capita / year meat consumption is 5.2 kg.

6.2.2 Economic Importance

Employment Generation: Animal Husbandry sector provides large self-employment opportunities. According to National Sample Survey Organization's latest survey (1999-2000), the estimate of employment in animal husbandry sector was 11 million in principle status and 8 million in subsidiary status, which is 5% of the total working population. Women constitute 71% of the labour force in livestock farming. Poultry provides employment to about 1.5 million people. The fisheries sector provides employment to over 11 million people. About 0.5 million women are employed in pre and post harvest operations in marine sector.

Value of Output: According to estimates of the Central Statistics Organization (CSO), the value of output from livestock and fisheries sectors together was about Rs. 1,86,094 crores at current prices during 2002-03 (Rs.156, 080 crores for livestock sector and Rs. 30,014 crores for fisheries). The livestock and fisheries sectors contributed 6.5 percent of total GDP(5.4 percent from livestock and 1.1. percent from fisheries) in 2003-03.

Export Earnings: Total export earnings from livestock, poultry and related products were Rs. 4734 crores in 2003-04. Out of the total exports, leather sector accounted for Rs. 2568 crores in value terms.

Export Potential of Marine Products: There has been steady growth in the export of fish products. During 2001-02, the country exported 4.58 lakh tonnes of marine products, which resulted in export earning of Rs. 5815.00 crores. Efforts are being made to boost the export potential through diversification of products for export. The country has now also started export of frozen squid, cuttle fish and variety of other finfishes. During 2002-03, the country has exported 5.21 lakh tonnes of marine products valued at Rs.6793.05 crores.



Check Your Progress Exercise 1

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Give the milk production and per capita availability of milk for the year 2002-03.

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2. Give the cattle and buffaloes population as per 1997 livestock census.

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3. List the economic importance of animal husbandry sector.

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6.3 DAIRY

We know that the milk is the lacteal secretion of the mammary glands of animals. Milk provides both energy and the building material necessary for growth. It also contains antibodies which protect the young animals against infection. In short, milk is a complete food in itself and nature has designed it as a food for the young ones during the first period of life. Let us know more about milk.

6.3.1 General Characteristics of Milk

The principal constituents of milk are water, fat, proteins, lactose (a type of sugar) and minerals (salts). Figure 6.1 shows the important constituents of milk in brief.

The milk of different species, although containing- the same constituents in general, varied in composition and properties in minor ways. Table 5 gives the composition of milk of a few mammals. Milk constituents are divided mainly into three groups namely, water, fat and solid-not-fat (SNF). Milk contains on an average 87 per cent water, 3.9 per cent fat, 4.9 per cent lactose, 3.5 per cent protein and 0.7 per cent minerals, vitamin and other constituents. Milk of ruminants like cow, buffalo and goat is ideally suited for human consumption and meet the basic dietary requirements of human beings.

Table 6.5: Average composition of milk from various species

Species	Constituents %					
	Fat	Proteins	Lactose	Ash	Total Solids	Water
Cow	4.0	3.4	4.6	0.74	13.64	86.36
Buffalo	7.3	3.8	4.9	0.78	16.78	83.22
Goat	4.0	3.7	4.5	0.85	13.05	85.95
Sheep	6.2	5.2	4.7	0.90	17.00	83.00
Camel	3.0	3.9	5.4	0.74	13.04	86.96
Human	3.5	2.0	6.8	0.30	12.60	87.40

Please incorporate the concept and role of co-operatives in milk production following account may help:

In India ‘White Revolution’ was brought due to operation Flood, largest dairy project for increased milk production in world. The key role in its success was played by “Co-operatives” a concept introduced by Dr. V. Kurien, father of white revolution small co-operatives at village level that involved the participation of farmers (milk producers) and collection centre (processors) was mutually helpful. Today almost all states have ‘Milk Co-operatives’ with AMUL (Anand Milk Producers Union Ltd.) becoming a global brand.

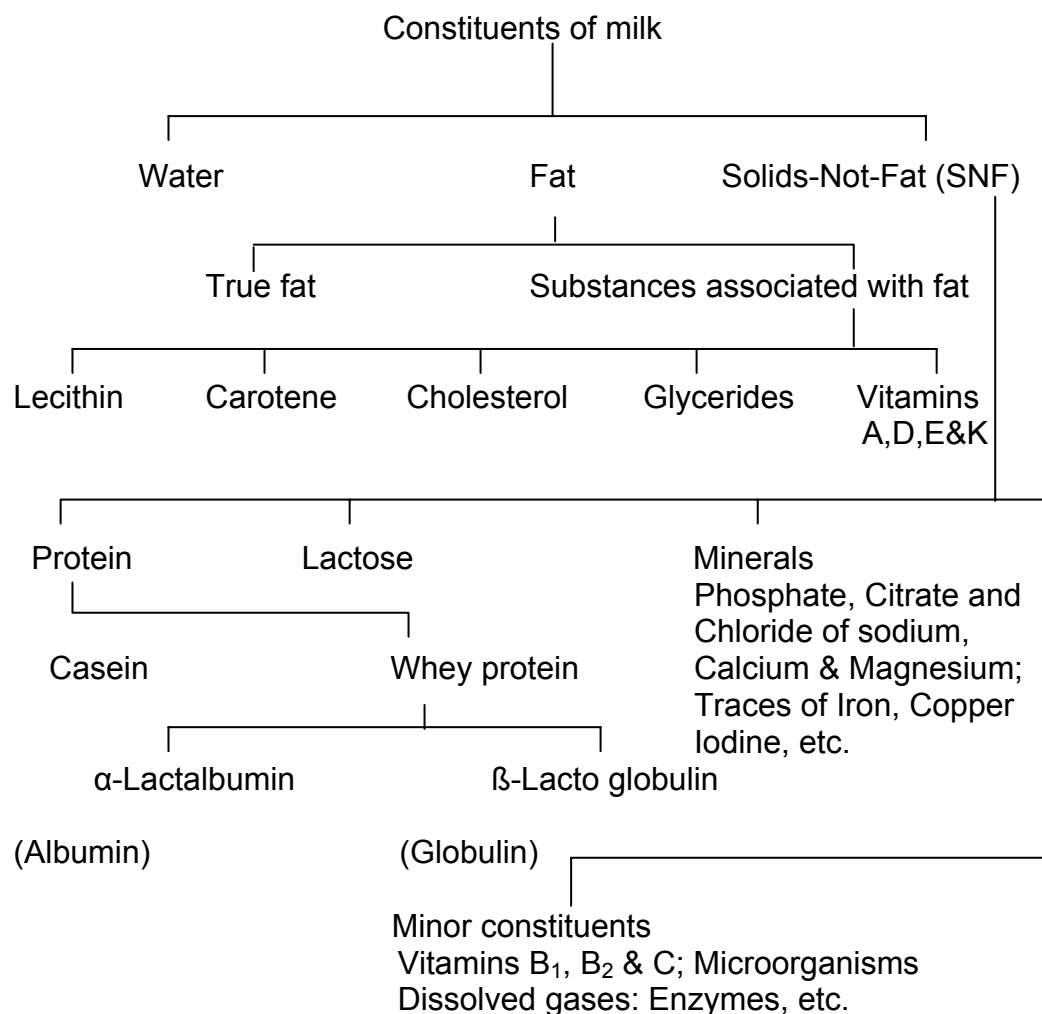


Figure 6.1: Milk constituents

6.3.2 Nutritional Importance of Milk

We know that the milk is recognized as almost an ideal food. It has high nutritive value. It supplies body- building proteins, bone- forming minerals and health giving vitamins. Lactose and milk fat furnish energy. Besides supplying certain essential amino acids and fatty acids, it contains the nutrients in an easily digestible and assimilable form. All these properties make milk an important food for pregnant mothers, growing children, adolescents, adults, invalids, convalescents and patients alike. The nutritional importance of milk is significant with reference to our country as large population is vegetarian and for them milk & milk products are the only source of animal proteins. Besides, human milk has immunoglobuling, lactoferried, lysozyme and bifidus factor. These Bioprotective attributes make it a perfect food for infants. It's been clinically established that breast fading is best for infants.

6.3.3 Clean Milk Production

Milk is virtually sterile in the udder of a healthy animal. Milk once secreted becomes the target for contamination during milking, milk handling, transport and storage. The degree of infection and the composition of the bacterial population depends on the cleanliness of the animal's environment and the cleanliness of the new surface with which the milk comes into contact, e.g., the pail or milking machine, the strainer, the tanker or the tank and agitator. The bacteria can also get into the milk via the milker, the animal, the litter and the

ambient air. Initially high bacterial counts and rapid growth of microorganisms will badly affect the keeping quality of the raw milk and the quality of products manufactured from such milk. Milk contaminated with pathogenic bacteria may be harmful to human health. Therefore, all possible measures should be taken to limit the contamination of milk and to prevent further bacterial growth. The quality aspects are gaining importance and emphasis is on the Clean Milk Production (CMP). The important steps for clean milk production are:

- i) Clean and healthy animals: The cow's body especially the udder, should be washed and brushed before milking. Diseased animals should be kept separately.
- ii) Clean Housing: Sheds, mangers, paddocks, water trough, floor should be clean and there should be good drainage.
- iii) Fly proof milking parlour.
- iv) Disease-free environment: milker with clean habits (nails well trimmed).
- v) Clean Utensils, Milking pails.
- vi) Clean water.
- vii) Clean milking: Before milking, clean the udder with a cloth dipped in antiseptic solution such as potassium permagnate; wetting of hands with milk should be avoided.

6.3.4 Basic Milk Processing

Milk after being received at dairy plant is subjected to various unit operations. A few basic processing operations to which the milk is subjected are given here.

Reception and storage of milk : Each milk processing plant or chilling centre where milk is received in raw or chilled condition, requires a separate area for milk reception, commonly known as Raw Milk Reception Dock (RMRD). Milk is received at the dock either in cans directly from the producers / collection points or in insulated tankers from the chilling centres. The steps involved in the process are given in Figure 6.2.

Steps involved in Milk Reception at the Dock (RMRD)

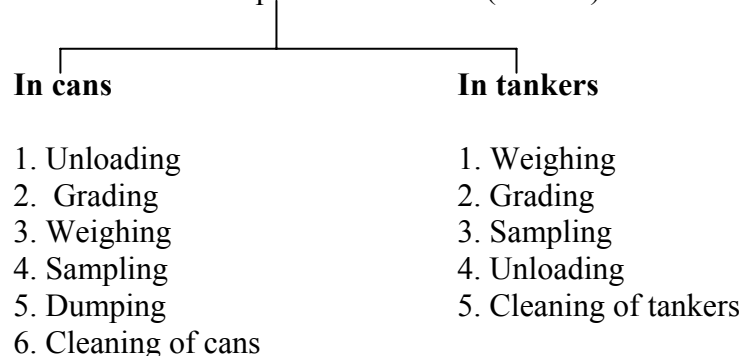


Figure 6.2

The milk is chilled as early as possible in order to check the growth of organism present and maintain the keeping quality of milk. The chilled milk is stored in storage tanks or silos (large storage vertical tanks).

Milk separation: The process of separating out cream from milk is known as separation. It is based on the principle of difference in specific gravity between the fat (0.90-0.93) and the serums or solid-not-fat (1.027-1.036). This can be done either by gravity or by applying the centrifugal force. The dairy plants use 'Centrifugal Cream Separators' in which centrifugal force is applied to enhance rate of skimming, i.e. separating force is multiplied many times than that of gravity and the separation takes place more completely and instantaneously.

Pasteurization: Pasteurization is a process applied to a product with an object of minimizing possible health hazards arising from pathogenic micro-organisms associated with milk by heat treatment, which is consistent with minimal chemical, physical and organoleptic changes in the product. The term pasteurization as applied to market milk today refers to process of heating every particle of milk to at least 63° C (145° F) for 30 minutes or 72° C (161° F) for 15 seconds (or the temp-time combination which is equally efficient) in an approved and properly operated equipment. After pasteurization milk is immediately cooled to 5° C (41° F) or below. LTLT (Low temperature long time) is suitable for small quantities ranging from 200-1000 litre requiring low initial cost of production. HTST (High temperature short time) treatment is ideal for large scale handling of 5000 litres per hour (LPH) or higher. The complete process of preheating, heating, holding, pre-cooling and chilling is completed in a plate type heat exchanger mounted on a compact frame with inter connected sections to make the process continuous. Phosphatase test is carried out to determine whether milk has been properly pasteurized or not.

6.3.5 Milk Products

We know that milk is a rich source of nutrients and is an essential part of diet. Milk is a unique biological fluid which can be dehydrated, concentrated, coagulated, fermented and fractionated into a vast range of milk products. The popularity and consumption of milk products is constantly increasing in our country. Nearly, 50% of the total milk production is converted into various milk products. The focus is being given to value addition and international quality assurance to the indigenous dairy products as tremendous potential has remained untapped. A profile of few popular indigenous and western products is given here.

Butter: A fat rich dairy product obtained from churning milk, cream or curd and working the grains thus obtained into a compact mass. The butter making process involves a number of stages. Churning is the key step and it involves giving violent medium agitation which breaks the emulsion of fat in serums and induces the clumping of fat globules. It is a perishable product, and therefore, it should not be stored longer than necessary. For short period butter can be stored at 4° C but if longer storage is involved it must be stored at -21 to -29° C.

Concentrated and Dried Products: Drying the milk is an efficient method of preservation. In addition, drying also greatly reduces the volume of milk, which is an advantage for long distance transportation and extended storage. Alternatively, only part of the water can be removed from the milk and water activity is further decreased artificially increasing the amount of dissolved solids. This is done by dissolving sugar in a milk concentrate. Accordingly, on the industrial scale milk is preserved by drying or evaporation. The representation composition of these products is summarized in Table 6.6.

Table 6.6: Composition of preserved milk products

Product	Fat%	Milk solid not fat %	Sucrose (%)	Water (%)
<i>Milk powder</i>				
Skim	1	95.5	–	3.5
Whole	26.5	71.0	–	2.5
<i>Evaporated Milk</i>				
Unsweetened	8	18	–	74
Sweetened	8	20	45	27

Cheese: It is defined as a product made from the curd obtained from milk by coagulating the casein with the help of rennet or a similar enzyme in the presence of lactic acid produced by adding starter culture and from which part of the moisture (whey) has been removed by cutting, cooking and pressing. The concentrated solids thus obtained are shaped in a mould and then ripened by holding it at suitable temperature (8-10° C) and humidity. There are many varieties of cheese in the world today that are differentiated by thousands of name. Moisture content of cheese serves to distinguish various categories such as hard, semi-hard, and soft. Cheddar cheese, processed cheese, mozzarella and cottage cheese are quite popular in our country.

Frozen Dairy Products: Ice-cream is a popular frozen dairy product made by rapid freezing of pasteurized mix with agitation to incorporate air and ensure uniformity of consistency. As per PFA definition, the product should contain not less than 10% milk fat, 3.5% milk protein and 36% total solids. It may contain permitted stabilizer and emulsifier not more than 0.5%.

Khoa: *Khoa* or *Mawa* is an important traditional milk product of India. It is prepared by partial desiccation of cow or buffalo or mixed whole milk in an open fire. It is used as the base in several milk sweets viz. *burfi*, *kalakand*, *peda*, *milk cake*, *gulab jamun*, etc. As per PFA rules, the khoa is the product obtained from cow or buffalo (or goat or sheep) milk or a combination thereof, by rapid drying. The milk fat content shall not be less than 20% of the finished product. In our country, khoa of three varieties, viz. *Pindi*, *Dhap* and *Danedar* is produced. *Pindi* type of khoa has lowest moisture content. Product obtained from buffalo milk is considered superior being whiter in colour and having soft smooth body and granular texture.

Chhana: It is a popular indigenous milk product obtained by acid coagulation of hot milk followed by draining of whey. According to PFA, the product shall contain not more than 70% moisture and not less than 50% fat on dry matter basis. *Chhana* is used as a base and filler for preparation of a large number of sweets such as *rasogolla*, *sandesh*, *ras-malai*, etc. Cow milk *chhana* with moist surface, light yellow colour, soft body, smooth texture and mild acidic flavour is more suitable for Bengali sweets preparation than buffalo milk *chhana*.

Ghee: Ghee is the most important traditional Indian milk product being extensively used for dietary and religious purposes. Cow ghee is golden yellow in colour whereas buffalo ghee is greenish in colour. Ghee is characterized by its pleasant, cooked and rich flavour. The preferred texture is of large uniform

size grains uniformly distributed throughout the lot. Ghee produced at different places and different conditions vary in quality. It is refined by heating in large pans at 70-80°C, the product being allowed to settle for 2 to 5 hours after removing the scum formed at the top.

Dairy By-Products: A byproduct may be defined as a product of commercial value produced during the manufacture of a main product. Skim milk, whey and butter milk are the industry's principal byproducts, residues from the manufacture of cream, cheese and butter, respectively.



Check Your Progress Exercise 2

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Give the average composition of cow milk.

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2. Enumerate the important steps involved in clean milk production.

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3. Define pasteurization.

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6.4 POULTRY

Poultry keeping in our country is as old as our civilization. Red jungle fowl found in India and its neighbouring countries is considered to be progenitor of all domestic breeds of fowl. Now, we include ducks, geese, turkeys, pheasants, pigeons, peafowl, guinea fowl and chickens in the list of species under the general term poultry. Chicken, the most popular domesticated poultry, account for more than 90% of the total poultry population of the country. The poultry provides us eggs and chicken.. Rural backyard poultry

contributes about 30% of the egg production. The Govt. of India has taken a new initiative of development of rural backyard poultry with a more holistic and self-reliant approach. Let us know more about eggs and poultry.

6.4.1 Poultry Production

The current poultry population in the country is above 435 million and accounts for 4% of the world poultry. The common breeds are shown in table 6.7.

Table 6.7: Common poultry breeds

S. No.	Breed	
1.	American Breeds	Plymouth Rock, Rhode Island Red, New Hampshire
2.	Asiatic Breeds	Brahma Cochin Langshan
3.	Mediterranean Breeds	Leghorn Minorca
4.	English Breeds	Cornish Australorp
5.	Indigenous Breed	Aseel Busra Chittagong, Kadaknath

The important economic traits in reference to rearing of poultry at small scale for egg purpose are - egg production, egg weight, egg quality, body size and confirmation, growth, feed efficiency and fertility and hatchability. Production economics of a commercial layer (for egg purpose) is entirely different than that of a commercial broiler (chicken purpose). The main attributes of a commercial layer are high egg production, low body size, less feed consumption, optimum egg size, good egg quality and high mobility and of a commercial broiler are high juvenile body weight especially at the marketing age, better feed efficiency and low brooder house mortality.

Hatching of Eggs: Hatching is production of baby chicks from fertile eggs. In early days eggs were hatched by placing them under broody hens and desi hens were ideal for this purpose. At present, incubators are used to hatch eggs. They provide similar environment as that of broody hens but more efficiently. Incubators can hatch several thousands egg at a time. The physical factors necessary for successful incubation are temperature, humidity, gaseous environment and turning of eggs. The incubation temperature usually varies from 37.2 – 37.8° C (99.5° F to 100.5° F). In fowls, the hatching period is 21 days. For obtaining better hatch and healthy chicks, the incubators and hatchers should be neat, clean and free from microbial load and should function properly.

6.4.2 Poultry Management

It refers to the husbandry practices to maximize the efficiency of production by satisfying the basic needs of the birds. It involves the management of chicks, layers and broilers.

- a) *Chick Management:* It is also known as brooding management. The chicks are transferred to a brooder house immediately after hatching and reared there for 6 to 8 weeks of age. Brooder house should be draft-free, rain-proof and protected against predators. Suitable litter material like saw dust and paddy husk should be spread to a depth of 5 cm. depending upon their availability and cost. Right temperature in a brooder house is very essential. Too high or too low a temperature slows down growth and causes mortality. During the first week the temperature should be 95° F (35° C) which may be reduced by 5° F per week during each successive week till 70° F (21° C). The behaviour of chicks provides good indication of whether they are getting desired amount of heat. Infrared lamps are also good for brooding. Plenty of clean and fresh water should be provided.
- b) *Grower Management:* The objective of the growing phase is to produce a pullet (young hen) which will come to lay around 20 weeks of age with an average body weight of 1.2 to 1.4 kg. Grower management especially remains the same as that of chick management except for the additional floor, water and feeder space. The floor, water and feeder space required for a grower are 950-2350 cm², 1.5 to 2.5 cm. and 7.5-12.5 linear centimeter, respectively. Water is essential and its requirement depends upon temperature, humidity, age, dietary constituents, activity and air movement. Deworming is essential and is done bi-monthly to keep the birds free from parasitic diseases. De beaking is recommended between 12 and 16 weeks. Feed restriction is essential to reduce the feed cost and productivity.
- c) *Layer Management:* The flock should be transferred from grower to layer house at 18 to 20 weeks of age. Floor space of 2300-2800 cm², feeder space of 10 cm. and water space of 2.5 cm. per bird are recommended for egg type chicken in floor house. One laying nest for every 4 pullets is necessary. A platform in front of the nest entrances helps the birds to have access to the nest. From 21 weeks, the lighting should be increased gradually till it reaches 16-17 hours per day and maintained at that level thereafter. Correct lighting boosts up egg production by 5 to 10 percent.
- d) *Male Management:* Breeder mate management remains essentially the same as that of layer management except that male breeder's diet should be fortified with extra calcium, manganese and vitamin E to ensure proper fertility.
- e) *Housing:* The objective of providing housing to poultry is to protect from sun, rain and predators. Poultry houses should be well ventilated, reasonably cool during summer and warm in winter. In our country, open-sided poultry houses are popular. The poultry house should not be expensive. The floor should be moisture proof, free from cracks, easily cleaned, rat-proof and durable.
- f) *Feeding of Poultry:* Feeding constitutes an important concern in poultry management since major expenditure (60-70%) in poultry raising is feed cost. More than 40 nutrients are required. The birds should be given

balanced ration, i.e. supply different nutrients – i.e. fat, carbohydrates, proteins, minerals, vitamins and water in right proportion. Conventional poultry ration include many cereals like maize, rice, wheat, barley and a few by-products such as wheat barn or rice polish, animal and vegetable protein sources like fish-meal, meat-meal, soyabean-oil-meal, groundnut cake, etc. The ration is fortified with adequate quantity of minerals and vitamins either in chemically pure form or through ingredients known to be rich in these nutrients. Efforts are being made to use agro-industrial products to replace more costly ingredients.

6.4.3 Composition and Nutritive Value of Egg

The main parts of an egg are shell (8-11%), albumen (56.61%) and yolk (27-32%). Egg contains about 2 parts white to 1 part yolk by weight. The whole mixed egg contains about 65% water, 12% protein and 11% fat. The composition of the white and the yolk differ considerably. The yolk is rich in fat, fat soluble vitamins A,D,E, and K and in phospholipids including the emulsifier lecithin (Table 6.8)

Table 6.8: Chemical composition of the hen's egg

Fraction	%	% of Constituents			
		Water	Protein	Fat	Ash
Whole Egg	100	65.5	11.8	11.0	11.7
White	58	88.0	11.0	0.2	0.8
Yolk	31	48.0	17.5	32.5	2.0
Fraction	%	Calcium carbonate	Magnesium carbonate	Calcium phosphate	Organic matter
Shell	11	94.0	1.0	1.0	4.0

Nutritionally, eggs are a good source of fat, protein, vitamins and minerals, especially iron. It is often used as a standard for measuring the quality of other food proteins. Its high nutrient content, low calorific value and easy digestibility make it a valuable protective food in human diet.

Quality Factors

The important quality attributes of eggs are: egg size, cleanliness and soundness of shell, albumen and yolk quality, nutritive value, wholesomeness, functional properties, etc. Egg size can be adversely affected by inadequate level of protein and essential fatty acids in layer's (hen's) diet and high environmental temperature.

The quality of egg starts deteriorating soon after it is laid unless proper care is taken to maintain it following better methods of assembly, cleaning, grading, packaging, storage, transport and distribution. Fresh eggs have a high yolk rather than a flat yolk and a larger amount of thick white relative to running thin white. This causes a stale egg to spread out over a larger area than a fresh egg. Fresh eggs taste better, are nutritious superior, are easier to separate into

whites and yolks for manufacturing purposes, and perform better in whipping and baking applications. Storage is best at a temperature slightly above the freezing point of the egg. For short period of storage, fresh eggs could be stored at 12.5° C to 15.5° C (55-60° F) and 70-80% RH. For long term storage, the room temperature should be at -10°C ($14 \pm 1^{\circ}\text{F}$) and RH 80-90% as this relative humidity will sufficiently retard evaporation without danger of mould growth.

6.4.4 Preservation of Shell Eggs

Preservation of shell eggs are based on simple principle of retarding the microbial growth and sealing pores of the shell to minimize the evaporation of moisture and escape of gases. The common methods include i) thermal processing, ii) immersion in liquid, iii) oil-coating, iv) cold storage, and v) pickling.

In flash heat treatment, the eggs are immersed for 2 to 3 seconds in water at 71° C. The treatment destroys bacteria present on the surface of shell and seals the shell internally by coagulating a thin film of albumen immediately below the shell membrane. Oil treatment preserves the egg by forming a thin film on the surface of shell and thereby sealing the pores. This treatment should be given preferably within a few hours of lay to retain better internal quality. The eggs should be washed before coating. The oil used must be colourless, odourless, less viscous and free from fluorescent materials. Eggs can be dipped in oil or sprayed with it. Vegetable oils such as groundnut oil mixed with 0.0125% BHT is a good sealing agent, but the mineral oils of food grade are preferable as they are less susceptible to oxidative changes during storage. Under village conditions, immersion in lime water and water glass is also useful. In lime sealing, the eggs are immersed in clear lime solution (prepared by using quick lime, water, table salt) and then taken out. Eggs are dried at room temperature and transferred to filter flats.

Dehydration and freezing are the commonly used methods for the preservation of liquid whole egg, albumen and yolk separately, depending upon their use in bakery products, confectionaries and other food or non-food products.

6.4.5 Processing of Poultry Meat

Poultry meat has high nutritive value. It is easily digestible and its protein content is in general higher and fat content lesser than in most of the red meats. Chicken meat contains all the essential amino acids and quantitatively compares closely with milk and egg proteins. It has less carbohydrate, but is a good source of Vitamin B, iron and phosphorus.

The scientific and hygienic processing of poultry is must for processing the quality of meat. Figure 6.3 gives the flow sheet for preparation of ready-to-cook chicken. These are packed immediately either in polyethylene bags of medium density (200 gauges) or vacuum packaged in heat shrinkable film bags.

Procurement of Birds
Handling period (withdraw feed only)
Ante-mortem inspection
Killing-bleeding
Scalding (58° - 60° C for 1 to 2 minutes)
Defeathering
Singering
Hand finish
Evisceration
Post-mortem inspection
Washing and cleaning
Chilling (in slush ice to 4° C or lower)
Draining
Packaging

Chill storage at 2° C (to
be sold within a week or
10 days)

Frozen storage at - 18° C
after freezing at - 40° C
(for storage up to 9
months)

Figure 6.3: Flow sheet for the preparation of ready-to-cook chicken

Check Your Progress Exercise 3



Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What is brooding?

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2. Give the composition of white egg and yolk.

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3. Enumerate the methods for preservation of shell egg.

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6.5 MEAT

We know that the word “meat” in its broadest sense means the flesh of animals, especially of mammals or birds rather than fish. However, the term in reference to food processing includes all those parts of the animals that are used as a food by man, and covers glands and organs such as tongue, liver, heart, kidney, brain and so on besides the skeletal tissue or flesh. In our country, sheep, goat, pig and poultry are reared primarily for meat production. Though meat has a very high biological value, its production and processing has always been the subject of social considerations. The per capita animal protein availability is about 10g as against the World average for 25g. Considering the targeted minimum requirement of 20g per capita per day for animal protein, 4g will come from meat remaining 16g from other livestock products. The estimated demand of meat for the present population would be 7.7 million tonnes as against the present production of 5.7 million tonnes. The meat is not an essential item of diet for a large population of the country. The annual meat production of the country is about 4-6 million tonnes and we are placed at number eight position in the world. .

We export both frozen and fresh chilled meat to more than 54 countries in the world. There is, however, very little processing of meat (1%) for ready to eat meat products. About 40 million people are engaged in meat sector, namely, trade of live animals, hides, bones, caesings, horns and hooves, etc. This sector when organized on scientific lines will generate more employment in rearing of animals on scientific lines and processing of slaughter house byproducts for allied industries. The country is poised to achieve the Pink Revolution through buffalo rearing for meat production. A brief profile of meat production and meat products in reference to food technology is given below.

6.5.1 Structure and Composition of Meat

Meat is predominantly composed of muscle tissue along with various types of connective tissue. A cut of meat consists of lean tissue, which, aside from water, is chiefly protein, with some fatty tissue and bone. Muscle is composed of bundles of hair like muscle fibers. These protein muscle fibers are held together by proteniacous connective tissue which merges to form a tendon which in turn connects the muscle to bone. The connective tissue contains two proteins called collagen and elastin. Collagen on heating in the presence of moisture dissolves and yields gelatin. Elastin is tougher and is a constituent of the ligaments. In well fed animals, fat penetrates between the muscle fiber bundles and this is fat marbling. There are relationships between muscle structure and meat technology. Thinner muscles fibers are tenderer than

thicker muscle fibers, and thinner muscle fibers are more common in young animals. Marbled fat within the muscles makes for more tenderness.

Composition of Muscle Tissue: Muscle tissue contains approximately 75% water and 25% solids, of which 19% are proteins. Lipids constitute about 2.5% to 5% of muscle. It contains Cu, Zn, Na, Hg, K, Mg and low amount of Ca. Most of the calcium in the body of an animal is found in the bones, so the edible portion of meat is low in this mineral. Liver is an especially rich source of iron and a concentrated source of Vitamin A. Meats are excellent source of niacin and riboflavin and are good source of thiamine.

6.5.2 Nutritive Value

Meat is a very nutritious food. It is almost fully digestible. The nutritive value of meat is attributed to its abundant high quality proteins, essential fatty acids, some important minerals and B complex group of vitamins (thiamine, riboflavin, niacin, pantothenic acid, B₆, folic acid, biotin and B₁₂). Calories supplied by meat vary with the contents of fat. Organs such as tongue, brain, thymus (sweet breads), heart, liver and kidney are called variety meats. They are also excellent source of nutrients. Variety meat (organ meat) especially liver and kidney contain appreciable amounts of vitamins A, B, C, D, E and K.

6.5.3 Production of Wholesome Meat

The essential stage requiring applications of effective measures for production of quality meat are:

- i) Animals should be given sufficient rest before slaughter.
- ii) Ample drinking water should be available to them and about 1 hour before slaughter, they should be given very little to eat but should not be starved.
- iii) The weak and diseased animals should not be slaughtered. Only those animals which produce carcasses of quality and nourishment should be slaughtered.
- iv) Slaughtering and bleeding of the animals should be done without causing excitement.
- v) The carcass unfit for human consumption should be destroyed.
- vi) Ensure environmental sanitation during transportation of meat and it is safe to the public.
- vii) Ensure personal hygiene of all those engaged in slaughtering, dressing and handling of meat.
- viii) Process equipment should be kept thoroughly clean and disinfected before use.
- ix) Meat and meat products should be stored in fly-proof containers. These must be refrigerated during summer.

Slaughter Houses or Abattoir: Slaughter houses or abattoir means any premises that is approved and registered by the controlling authority in which animals are slaughtered and dressed for human consumption. Abattoir may be small, medium or large based on the number of animals slaughtered. Based on the level of technology adopted the operations are manual, semi-mechanized or

fully automatic. The slaughter houses play an important role in the processing of animals for production of safe and wholesome meat and in the effective recovery of by-products.

The important sections of the modern abattoir are (a) Lairage for resting the animals prior to slaughter; (b) slaughter hall; (c) By-product room; (d) Meat cutting room (optional); and (e) Rendering room (optional) or simple system of treating offals or condemned carcass. The building should be furnished with fly- proof system, sufficient lighting, ventilation and water supply (Fig.4). Let us appreciate that application of modern scientific methods for processing of meat in abattoirs would provide safety, value addition, convenience and consumer satisfaction. The Govt. of India has initiated a number of programmes for improvement and modernization of slaughter production.

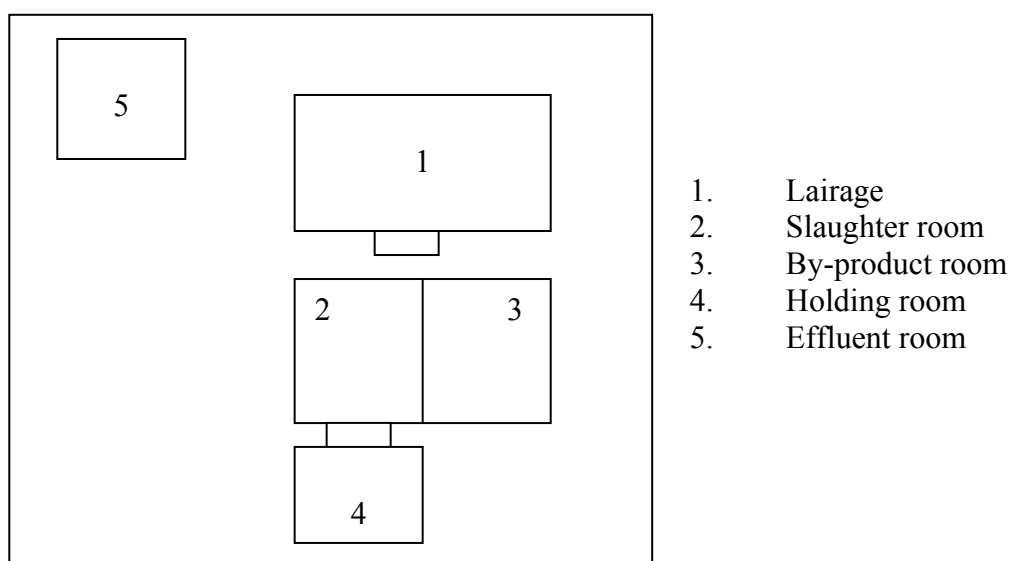


Figure 6.4: Slaughter house

Towards this end, we as trained technicians, should ensure for humane methods of slaughter and production of meat under hygienic conditions. Slaughtering of animals in unconscious state will facilitate prevention of cruelty. The essential processing steps in abattoir are: i) resting animals in lairage prior to slaughter; ii) ante-mortem inspection; iii) stunning (depends on religious customs); iv) slaughter and bleeding on the cradles; v) skinning, dressing and evisceration on the overhead rail; vi) post – mortem inspection; vii) washing; and viii) holding the carcass in chill room (optional); ix) cutting and packing (optional).

6.5.4 Preservation Techniques

Meat is a highly perishable commodity due to nearly neutral pH (low acid food), high moisture contents and rich nutrients. Various methods to extend the shelf-life of meat are: i) chilling / refrigeration; ii) freezing; iii) curing; iv) smoking; v) thermal / processing; vi) canning; vii) dehydration; and viii) irradiation.

Refrigeration/chilling: This is the most widely used method of preservations for short terms storage of meat. Storage of fresh meat is done at a refrigeration temperature of 2 to 5⁰ C. Fresh meat can be maintained in good conditions for

a period of 5-7 days at a refrigerated temperature of $4\pm 1^{\circ}\text{C}$. The cooling slows down the microbial growth and enzymatic as well as chemical reactions. Processed meat products are also stored under refrigeration till these are fully consumed.

Freezing: It is for the long terms preservation of meat. It stops the microbial growths and retards the action of enzymes. Large quantities of meat and meat products are stored, distributed and marketed in frozen form. A product can be considered frozen when its centre has a temperature of -12°C or less. The speed of freezing is a very important factor as frozen meat quality depends mainly on the size of the ice crystals formed. The quality of meat and meat products can be preserved for months together during frozen storage at -10°C . However, a storage temperature of -18°C is recommended because at this level almost all water in meat is frozen and minor fluctuations can be taken care of.

Curing: Preservation of meat by heavy salting is an age old practice. Sodium chloride and sodium nitrite are commonly used. Now a days curing of meat products is mainly for specific flavour and colour development and preservative effects of curing ingredients is an added advantage.

Smoking: Smoking helps in preservation of meat. It contains a large number of wood degradation products such as aldehydes, ketones, organic acids, phenols, etc. which exert bacteriostatic effect besides imparting characteristic smoky flavour.

Thermal processing: Thermal processing as a preservative method is employed to kill the spoilage microorganisms as against the refrigeration methods that slows or stop microbial growth. Pasteurization and sterilization are common heat processing operations that are generally used.

Pasteurization refers to moderate heating in the temperature range of 58°C to 75°C . The process extends the shelf life but the product needs to be stored under refrigeration. Sterilization refers to severe heating above 100°C whereby all spoilage microorganisms in meat are killed. It renders the product commercial sterile. Such meat products have a recommended shelf life of two years in cans and one year in retort pouches at ambient temperature in tropics.

Canning: It is a process of preservation achieved by thermal sterilization of a product held in hermetically sealed containers. The product have a shelf life of at least 2 years at ambient temperature. The steps involved are (i) Preparation of meat and gravy, (ii) Precooking of meat, (iii) Filling in cans, (iv) Exhausting, (v) Seaming, (vi) Retort or thermal processing, (vii) Cooling and (viii) Storage.

Dehydration: Removal of water from meat lowers the water activity considerably to prevent the growth of spoilage organisms. Freeze drying of meat is a satisfactory process of dehydration preservations due to better reconstitutions properties, nutritive quality and acceptability. Freeze dried products are packaged under vacuum and have very good storage stability. The process has been largely used for preparations of the dehydrated meat soup mixes.

Irradiation: Food irradiation is referred as cold sterilization as microbial destruction of foods take place without significantly raising the temperature of food. A dose of 50-100 k rad (radurisation) can enhance the shelf – life of

fresh meat cuts and poultry products by 19 days whereas a dose of 4-5 M rad (radurisation) can sterilize pork, poultry and fish.

6.5.5 Meat Products

Meat cutting: Meat cutting refers to the skill of separation of carcass into wholesale primal cuts in order to facilitate requirements of meat trade, cater to the consumer preference and convenient handling by the butchers. The basic requirements in cutting are:

- i) The carcass has to be essentially chilled for proper meat cutting and trimming job.
- ii) Meat cutting room should be maintained at a temperature of 15-20⁰ C and relative humidity of 80%. This environment is wholesome for meat and convenient to workers.
- iii) All the meat cutting equipment and machinery should be made up of stainless steel and be sufficiently sharp.
- iv) Cutting methods varies from country to country. Bureau of Indian Standards (BIS), specify the division of carcass into right and left sides. In our country, people go for six cuts only – neck, shoulder, rack, foreshank and breast, loin and leg.

Tenderizing meat is another important operation which is done by using mechanical methods, enzymes and salt. It affects palatability of meat.

Type of products: Meat products include a variety of products such as sausages, cured and smoked meat products (ham, bacon), canned meat (canned beef, luncheon meat, canned hams) and cooked meat products (patties, kababs, meat balls, nuggets). The purpose of meat processing to products are primarily preservations by inhibiting or preventing spoilage, improving the palatability and providing variety for trade. Meat processing to products facilitates utilization of certain cuts from the carcass which are having poor utility otherwise. The processing also help in development of convenience products for consumers. Economics of meat processing rests with the ability to utilize fats and other carcass trimmings and low value carcass cuts and by products to produce acceptable products.

Nature and role of ingredients: Meat quality plays an important role. Additives such as water or ice, salt, phosphate, nitrate, nitrite, sugar and anti-oxidants are added to improve product quality characteristics during processing. Ice chills meat during chopping or mixing operations and prevents mechanical over-heating, helps in dissolving salts, gives fluidity and facilitates proper filling. Salt reduces microbial growth, solubilizes muscle protein and imparts taste. Phosphates increase water holding capacity, fat binding, emulsion stability and ensure decreased cooking losses. They have a synergistic effect in improving the quality of meat products in combination with 1 to 2 % salt, and are used at 0.5 % level. Sugar at the level of 0.5% is added to provide flavour, mask the salt flavour and act as a preservative. Spices and condiments such as onion, ginger, black pepper, cloves, etc. are also used to improve flavour and taste of the meat products.

Processing methods: Processing refers to any treatment including salting which brings about a substantial chemical and physical changes in the natural state of meat. The preservatives processes such as curing, smoking, cooking,

canning, freezing, dehydration, are also used in meat product preparations. Processing imparts considerably shelf stability to meat. The common processing techniques in reference to meat product preparations include: (i) comminution, (ii) emulsification, (iii) meat extension, (iv) pre-blending, (v) hot processing and (vi) cooking.

Meat products: Meat products are classified into the following groups

- i) Cured and smoked meats
- ii) Sausages
- iii) Intermediate moisture and shelf stable meat products
- iv) Restructured meat products
- v) Canned meats
- vi) Other meat products

Ethnic meat products: The range of popular products include, meat curries with gravy, fry or *pulav* (with rice) kababs (*sheek kababs*, *shami kababs*, *boti kababs*), *tandoor products* (tandoor chicken), grilled products and pickles.

By-products: Animal by-products are available from live animals, slaughtered animals and dead animals. The returns from the by-products are also important as meat forms only one-third of live weight of the animal while by-products from two-third. Utilization is important not only to ensure cost-effective utilization process but also for proper disposal to prevent environmental pollution and adverse effect on the main enterprise. Edible by-products from slaughtered animals include blood, variety meat, organ meats (tongue, heart and liver), casing and bones. Non-edible by-products include blood (blood meal), bones (bone-meal, ossein), horns and hooves, gastro-intestinal contents (feed, fertilizers), glands (hormones) and bile (bile salts). Dead animals are also a significant source of useful by-products when collected and processed. Hides and skins, horns and hooves, bones and bone – products, meat-meal and technical fat are the useful products from dead animals.

Among the animal by-products leather and leather products, bone and bone products, and woollen carpets are the major items of export. Other by-products those are exported include animal casings, edible offals, bile paste, gallstones and bristles. Animal glands and organs, viz. ovary, testis, pituitary, adrenal, pineal, parathyroid, thyroid, thymus, spleen, bile, lungs, liver, stomach, brain, spinal column, and seminal vesicles are utilized for medicinal and pharmaceutical purposes.

Check Your Progress Exercise 4



Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. State the measures for production of quality meat.

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2. List out various methods used to extend the shelf life of meat.

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3. Name some of the value added products prepared from meat.

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6.6 FISHERIES

Fish is a valuable food due to presence of high quality proteins, i.e. presence of essential amino acids and fat (high proportion of poly unsaturated fatty acids - PUFA); rich source of B group of vitamins namely thiamine, riboflavin, niacin and pantothenic acid and important minerals such as iodine, phosphorus, active iron and sodium. The composition of flesh of fishes is (a) water 80%, (b) protein 15-25%, (c) mineral matter 1-2% and (d) other constituents 1%. The consumption of fish and fish products is continuously increasing. The nature has bestowed on India a wide variety of fishes. The aquatic endowment is supporting more than 2200 fishes, out of which nearly 1440 species are marine species, 143 species are brackish species, 544 warm water species and 37 are cold water forms. Let us know more about fish production, preservation and processing.

6.6.1 Growth rate

The country has witnessed a quantum jump in the fish production. The country occupies third position in the world and second position in the inland fish production. The fish production is the fastest growing sector in the agriculture. As compared to agriculture and animal husbandry, the fish production rate per unit area is much higher in terms of productivity as well as income. The growth rate of 2.5 percent and 8.0 percent has been proposed for marine and inland fisheries, respectively during the tenth plan. By the end of tenth plan, this will enable a total fish production of about 8.2 million tonnes with 3.3 million tonnes coming from marine sector and rest from inland sector.

Fish is a highly perishable food and therefore due importance be given for marketing, processing, preservation and keeping quality of fresh fish. Lowering, the temperature of fish from 10° C to 0° C, delays the growth phase of micro-organisms that are present and cuts the spoilage by a factor of 5 to 16. Therefore, the fresh fish should be refrigerated (near 0° C) immediately.

6.6.2 Culture Fisheries

The fish culture in ponds and paddy is an age old practice. A series of activities such as controlled breeding in captivity, production of quality seeds in sufficient quantities, rearing of spawn to fry stage, fry to fingerling stage and ultimately raising the table size are christened under the scientific fish farming. The induced breeding in captivity is widely used to get adequate quantity of quality seeds of major cultivated fishes. The process of releasing egg by female and milt by male is called spawning. The mature fishes are induced to breed by giving the pituitary injection. The hormone pellets are implanted into muscle during initial period of gender development for inducing maturation and spawning. Fishes having developed gonads are called brood stock. Hatchery management is an essential component under scientific fish farming. It involves supply of quality water, brood stock development, spawning operation, incubation of eggs, rearing of larvae from egg to post larval stage, nutrition and artificial feeding and health monitoring. The quality of water is very vital component for the survival and growth of larvae and post larvae. It is also important to maintain favourable temperature, water level, flow of water and adequate level of oxygen during larval rearing.

Construction of Fish Farm

The ponds are constructed to have high survival rate. The ponds are classified into nursery pond, rearing pond and stocking pond. The nursery ponds are used to nurse the spawn upto fry stage and are small and shallow. The rearing ponds are used to rear fry up to fingerling stage. The stocking ponds are used to grow the fish to marketable size. Generally, rectangular shape ponds are constructed with a depth of 0.5 to 0.10 m for nursery ponds, 0.6 to 1.5 m for rearing ponds and 1.0 to 2.5 m for stocking and brooder pond. An assured supply of good quality water free from pollution and turbidity is to be ensured. The pH of water should be in range of 6.5 – 7.5 and for correcting the pH liming is done. The optimum concentration of dissolved oxygen (above 5 ppm) is maintained by adequate aeration by means of aerator, paddle wheel aerators, surface agitators and air blowers. The practice of using composite fish culture has revolutionized the aqua food sector in the country. The feed management and health management also play an important role in productivity.

Aquaculture has mainly contributed to the high growth of inland fisheries (6.6% per annum) as compared to marine fisheries (2.2% per annum) during the nineties. Indian major carps/ *Labeo rohita* (rohu), *Catla catla* (catla) and *Cirrhinus mrigala* (mrigala) contribute about 78% of the total aquaculture production. The productivity has also gone up from about 600 kg/ha year in seventies to about 2000 kg/ha year.

6.6.3 Marine Capture Fisheries

We know that the country has a long coastline of 8118 km and an equally large area under estuaries, backwaters, and lagoons good for developing capture as well as culture fisheries. After declaration of the Exclusive Economic Zone (EEZ) in 1997, the area available to India is about 2.02 millions sq. km. The harvestable potential of marine resources in EEZ has been estimated at about 3.921 million tonnes. The marine fishing fleet comprises about 0.281 million traditional craft (including about 44578 motorized traditional craft), 53684 mechanized traditional craft and about 170 large fishing vessels of 21 m overall length (OAL) and more. The major fishing activities are concentrated in the

areas within 0 to 70-80 m depth zone. Fish production has increased over the years with the motorization of traditional craft and introduction of mechanized boats in the traditional sector as well as diversification of fishing effort beyond 50 m depth.

As spoilage of fish starts from the time it is caught, the proper storage, preservation and prompt disposal or transport services are essential. The wastage is acute during monsoon when upto 30% of the catch is lost. Therefore, strengthening of post-harvest infrastructure such as storage facilities, ice plants, cold chains, roads and transportation etc., as well as effective marketing system in identified areas are the key requirements for the development of this sector.

6.6.4 Post Harvest Care

As we know fish is a highly perishable and decomposes quickly. The problem is acute in our country as heat and moisture promotes deterioration. Bacteria of water and air attack the flesh slowly at first and more rapidly later. Chemical changes cause breakdown of protein and other nitrogenous matter leading to the production of substances like hydrogen sulphate and indol. The characteristics odour of stale or spoiled fish is due to trimethyl amine which is formed by reduction of tri-methyl oxide. Fishes are preserved by various methods such as drying, salting, pickling, smoking, canning, chilling and freezing. Before preservation, fishes are washed with clean water to remove saline, blood stains, mud and sand. Larger fishes are gutted (i.e. on the internal organs or vice-versa are removed) and the body cavity is washed.

To remove natural moisture from the fish tissues, fishes are cured by means of heat, sun dry air and salt all along the coast. Drying of small marine fishes such as ribbon fish, silver bellies and Bombay duck in sun or shade is a very ancient method of fish preservation. In this method fishes are spread on the open sandy beach, mats, bamboo platform or hung on ropes/rods. Mechanical drier are also used for this purpose and this method yields high quality products which retains the nutritive value and flavour. Salting is a form of pickling in which common salt is used to prevent bacterial growth and methods of dry salting and wet salting are employed. In the dry salting method, fishes are rubbed with salt powder and then packed in the plastic/cemented tanks. In between two layers dry salt is applied and after stipulated period these fishes are removed, washed in the salt water and then dried. In wet salting method, gutted and cleaned fishes are placed in the container containing concentrated salt solution and stirred properly. Wet salted fishes are sold in the market without drying. In smoking, wood smoke is utilized as a preservative. In this method, cleaned and gutted fishes are soaked in the salt or brine for a short period and then suspended on rod in the smoke house. In chilling, fishes are packed in ice and then saw dust or rice husk is sprinkled over it to prevent the melting of the ice. Freezing is the most modern method of preservation. Fish intended for long storage are frozen in large deep freezers. Individual quick freezing method is gaining popularity. Frozen fishes retain their nutritive values for a longer time.

Value added products: A number of value added products are available in the market, viz. battered and breaded products like fish fillets, fish cutlets, fish cakes, fish burgers, fish balls, fish sausages, fish noodles, fish rolls, fish patties, stuffed squids, etc. The switch over from block freezing to individually quick frozen (IQF) products has changed the profile of value added products.

IQF provides, lobster, imitation products like kamabaka, crab legs, imitation shump are becoming popular. The value added products like (i) prawn and fish pickle, (ii) fish and prawn papad, (iii) fish jhuri bhagra, (iv) fish noodles and (v) fish pulp can be prepared dry woven fishers also. The techno-economic advantages of the products are (i) wide acceptability (ii) greater shelf life, (iii) more palatability, and (v) stringent quality control. There is a good potential for export of preferred products.

By-products and other uses: Fishes are also source of numerous byproducts such as (i) Fish oil, (ii) Fish-meal, (iii) Fish flour, (iv) Fish proteins, (v) Fish glue and singlass. Two important fish oils are (i) Liver oil and (ii) body oil. Liver oil is popularly known as cod-liver oil. There are numerous by-products besides oil, which are economically useful. The most important are fish-meal, fish-flour, fish-protein, fish-ghee and fish-skin.

Check Your Progress Exercise 5



- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What is spawning?

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2. Enumerate the methods used for preservation of fish. Name a few value added products.

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3. Give the nutritional importance of fish.

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6.7 LET US SUM UP

The country has a considerable livestock population. Processing and production of value added products hold an important place in the national economy. We are the largest milk producers in the world. The quality of milk plays an important role in processing of milk and milk products. The important value added products from milk are butter, concentrated and dried milk products, ghee, cheese, frozen dairy products, *khoa*, *chhana* and a range of by products such as skim milk, whey, etc. The poultry provides us eggs and chicken. The major expenditure in poultry raising is feed cost. The methods used for preservation of shell eggs are based on retarding of microbial growth and sealing pores to minimize the evaporation of moisture and escape of gases. The meat production in our country is largely a byproduct system of livestock production utilizing spent animals at the end of their production life. Meat is a highly perishable commodity and methods to extend the shelf life are (i) chilling/refrigeration; (ii) freezing (iii) curing (iv) smoking (v) thermal processing (vi) canning (vii) dehydration and (viii) irradiation. The common indigenous popular products are meat curries with gravy, fry or *pulav* (with rice), *kababs* (*sheek kababs*, *shami kababs*, *boti kababs*), *tandoor* products (*tandoor* chicken), grilled products and pickles. Fish is a source of cheap animal protein. It is highly perishable and various methods adopted for preservation are drying, salting, smoking, canning, chilling and freezing. Cod-liver oil one of the important by-products.

6.8 KEY WORDS

Preservation	:	Aims to inhibit microbial spoilage and arrest physio-chemical changes which bring about deterioration in quality.
Lactose	:	A type of natural disaccharide consisting of glucose galactose present in milk.
Brooding	:	Rearing of chicks upto 6 to 8 weeks of age.
Milk	:	It is the lacteal secretion of the mammary lands of animals.
Milk separation	:	The separation of milk into cream and skim milk.
Pasteurization	:	A process of heating every particle of milk or milk product to specified temperature and holding at that temperature for specified period followed by immediate cooling and storage at low temperature.
Hatching	:	Production of baby chicks from fertile egg.
Abattoir	:	Premises that is approved and registered by the controlling authority in which animals are slaughtered and dressed for human consumption
Comminution	:	It refers to subdivision or reduction of raw meat into meat pieces or particles.

Processing	:	Treatment or unit operations which bring about a substantial chemical and physical change in the natural state of milk/meat/fish/egg.
Post-mortem	:	It is the systematic exposure and scientific examination of the tissue and organ of a dead body to determine the cause of death, the nature of lesions and illness.
Aquaculture	:	The term relates to the culture of fish in fresh water, backlash water and sea water.
Spawning	:	The process of releasing eggs by female and wilt by male is called spawning.

6.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES



Check Your Progress Exercise 1

1. The milk output during 2002-03 was 86.2 million tonnes and the per capita availability of milk during the period was 230 g per day.
2. Cattle population: 198.99 million and buffalo: 89.91million.
3. The livestock and fisheries sectors contributed 6.5 percent of total GDP (5.4 percent from livestock and 1.1. percent from fisheries) in 2003-03. The value of output livestock and fisheries sectors together was about Rs. 1,86,094 crores at current prices during 2002-03 (Rs.156, 080 crores for livestock sector and Rs. 30,014 crores for fisheries). Total export earnings from livestock, poultry and related products were Rs. 4734 crores in 2003-04. The sector provides large self-employment opportunities.

Check Your Progress Exercise 2

1. Milk contains on an average 87 per cent water, 3.9 per cent fat, 4.9 per cent lactose, 3.5 per cent protein and 0.7 per cent minerals, vitamin and other constituents.
2. The important steps involved in clean milk production are:
 - Clean and healthy animals.
 - The cow's body especially the udder, should be washed and brushed before milking. Diseased animals should be kept separately.
 - Clean Housing: Sheds, mangers, paddocks, water trough, floor should be clean and there should be good drainage.
 - Fly proof milking parlour.
 - Disease-free environment: milker with clean habits (nails well trimmed).
 - Clean Utensils, Milking pails.
 - Clean water.
 - Clean milking: Before milking, clean the udder with a cloth dipped in antiseptic solution such as potassium permagnate; wetting of hands with milk should be avoided.

3. The term pasteurization as applied to market milk today refers to process of heating every particle of milk to at least 63° C (145° F) for 30 minutes or 72°C (161° F) for 15 seconds (or the temp-time combination which is equally efficient) in an approved and properly operated equipment

Check Your Progress Exercise 3

1. Brooding is management of the chicks.
2. The composition is given in Table 6.9:

Table 6.9: Chemical composition of the white and yolk

Fraction	%	% of Constituents			
		Water	Protein	Fat	Ash
White	58	88.0	11.0	0.2	0.8
Yolk	31	48.0	17.5	32.5	2.0

3. The common methods of preservation of shell eggs include (i) thermal processing, (ii) immersion in liquid, (iii) oil-coating, (iv) cold storage, and (v) pickling.

Check Your Progress Exercise 4

1. The essential stage requiring applications of effective measures for production of quality meat are:
 - a) Animals should be given sufficient rest before slaughter.
 - b) Ample drinking water should be available to them and about 1 hour before slaughter, they should be given very little to eat but should not be starved.
 - c) The weak and diseased animals should not be slaughtered. Only those animals which produce carcasses of quality and nourishment should be slaughtered.
 - d) Slaughtering and bleeding of the animals should be done without causing excitement.
 - e) The carcass unfit for human consumption be destroyed.
 - f) Ensure environmental sanitation during transportation of meat and it is safe to the public.
 - g) Ensure personal hygiene of all those engaged in slaughtering, dressing and handling of meat.
 - h) Process equipment should be kept thoroughly clean and disinfected before use.
 - i) Meat and meat products should be stored in fly-proof containers. These must be refrigerated during summer.
2. Various methods to extend the shelf-life of meat are: (i) chilling/refrigeration; (ii) freezing; (iii) curing; (iv) smoking; (v) thermal/processing (vi) canning; (vii) dehydration, and (viii) irradiation.

3. The value added products prepared from meat products are sausages, cured and smoked meat products (ham, bacon), canned meat (canned beef, luncheon meat, canned hams) and cooked meat products (patties, kababs, meat balls, nuggets)

Check Your Progress Exercise 5

1. The process of releasing egg by female and milt by male is called spawning.
2. Fishes are preserved by various methods such as drying, salting, pickling, smoking, canning, chilling and freezing. A few value added products are battered and breaded products like fish fillets, fish cutlets, fish cakes, fish burgers, fish balls, fish sausages, fish noodles, fish rolls, fish patties, stuffed squids, etc.
3. Fish is a valuable food due to presence of high quality proteins, i.e. presence of essential amino acids and fat (high proportion of poly unsaturated fatty acids - PUFA); rich source of B group of vitamins namely thiamine, riboflavin, niacin and pantothenic acid and important minerals such as iodine, phosphorus, active iron and sodium.

6.10 SOME USEFUL BOOKS

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