

**Vocational Higher Secondary
Education (VHSE)**

Second Year

LIVESTOCK MANAGEMENT (LSM)

Reference Book



Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT),
KERALA
2016

List of Contributors

Participants

1. **Dr. Vinod. S**
Vocational teacher in Livestock Management
Govt. VHSS for Girls, Kottarakkara, Kollam
2. **Dr. Rajagopal. R**
Vocational teacher in Livestock Management
Govt. VHSS for Girls, Chengannur, Alappuzha
3. **Dr. Sreejaya. S**
Vocational Teacher in Livestock Management
Govt. VHSS, Poovachal, Thiruvananthapuram
4. **Dr. Preethymol Joseph**
Vocational Teacher in Livestock Management
Govt VHSS Thodupuzha, Idukki
5. **Adv. Sameer Sideequi**
Vocational Instructor in Livestock Management
Govt. VHSS, Poovachal, Thiruvananthapuram

Contributors

Dr. Gini George
Dr. Sajna. C. M
Dr. Fajre. P
Dr. Sabna. K

Subject Experts

Dr. P. V. Mohanan
Assistant Director
Department of Animal Husbandry, Kerala

Dr. Arun. S
Veterinary Surgeon
Department of Animal Husbandry, Kerala

Academic Co-ordinator

Dr. Sahaya dhas
Assistant Professor, SCERT

Foreword

Dear Learners,

This book is intended to serve as a ready reference for learners of vocational higher secondary schools. It offers suggested guidelines for the transaction of the concepts highlighted in the course content. It is expected that the learners achieve significant learning outcomes at the end of the course as envisaged in the curriculum if it is followed properly.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of this reference book has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. P. A. Fathima
Director, SCERT, Kerala

CONTENTS

1	<i>About the course</i>	05
2	<i>Major skills and sub skills</i>	05
3	<i>Syllabus</i>	06
4	<i>Overview of module 3</i>	14
5	<i>Unit 1: Introduction to poultry husbandry</i>	14
6	<i>Unit 2: Anatomy and physiology of poultry</i>	19
7	<i>Unit 3: Feeds and feeding of poultry</i>	26
8	<i>Unit 4: Management of chicken</i>	35
9	<i>Unit 5: Selection of eggs and hatchery management</i>	49
10	<i>Unit 6: Diseases of poultry</i>	61
11	<i>Unit 7: Rearing of duck, turkey and quail</i>	70
12	<i>Unit 8: Husbandry of pet birds</i>	79
13	<i>Unit 9: Management of dogs and cats</i>	87
14	<i>Unit 10: Rearing of rabbits and laboratory rodents</i>	104
15	<i>Extended activities</i>	118
16	<i>List of practicals</i>	118
17	<i>Overview of module 4</i>	119
18	<i>Unit 1: Milk and milk products</i>	120
19	<i>Unit 2: Wholesome milk production</i>	133
20	<i>Unit 3: Processing of meat and abattoir management</i>	140
21	<i>Unit 4: Egg and meat products</i>	151
22	<i>Unit 5: Zoonotic diseases</i>	158
23	<i>Unit 6: Animal welfare and food safety guidelines</i>	161
24	<i>Extended activities</i>	164
25	<i>List of practicals</i>	164
26	<i>List of references</i>	164

ABOUT THE COURSE

Agriculture forms a quintessential part of Indian culture and contributes the lion's share of Indian economy. About 3 per cent of Indians depend on livestock farming for their primary livelihood. Animal products *viz.*, milk, meat and egg form the staple diet of Indians and with the advent of sophisticated machinery the sector is rapidly evolving from small scale/individual ventures into high tech farming systems. Animal husbandry sector contributes to a lot of basic needs for a family like food, income, job, energy, manure, security and companionship.

In the wake of industrialization, live stock management (LSM) course provides students many employment opportunities in Government, Private and co-operative sectors, in addition to the enormous self employment potential of the field. In Kerala, currently many Government jobs are reserved for LSM students as Livestock Inspectors/Farm assistants in Animal Husbandry Department, Vocational Instructor/Laboratory Technical Assistant in VHSE department etc. It also enables students for a snatch of many blue collar/mid tier jobs in dairy, poultry and food processing industries. Even though the main aim of VHSE is to generate self employment, vertical mobility is also reachable with this course as five super numerary seats are reserved for LSM students for B.V.Sc & A.H course at College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University (KVASU) with effect from 2015. After completion of this course students can also undergo many diploma courses related to Dairy and Poultry Industry, available with KVASU, which will again further their chances of getting a job all over India and abroad.

It is imperative for our educational system to create awareness, generate increased interest in livestock farming leading to a self sufficient and proud community rooted in our culture, staying balanced with nature and contributing to the progress of our nation.

MAJOR SKILLS AND SUB SKILLS

MODULE 3: POULTRY, PET AND LAB ANIMAL MANAGEMENT

The module envisages imparting the following skills,

- Ñ Calculate the feed requirement for different age groups of chicken
- Ñ Identify various feed ingredients for poultry feed formulation
- Ñ Set up a brooder for chicks
- Ñ Differentiate good and poor layer for culling

- Ñ Select and assemble suitable equipment for each class of poultry in sheds
- Ñ Assess the quality of egg by candling
- Ñ Set the eggs for hatching in the incubator
- Ñ Perform fumigation as a method of disinfection in poultry farms
- Ñ Selection of good quality pups for dog breeding
- Ñ Handling and restraint of laboratory animals for experiments

MODULE 4: LIVESTOCK PRODUCTS PROCESSING AND FOOD SAFETY

The module envisages imparting the following skills

- Categorize the different traditional milk products
- Differentiate types of milk commercially available
- Prepare milk products like curd, cream, paneer, ice cream.
- Practice the methods of clean milk production in a farm
- Detect adulterants in milk using laboratory tests
- Assess the milk quality parameters like specific gravity using lactometer
- Explain the steps of animal slaughter
- Sketch the layout of a slaughter house
- Prepare meat products like cutlets, sausage
- Identify zoonotic diseases for prevention and proper healthcare
- Describe the guidelines related to animal transportation
- Practice preservation methods of livestock products

SYLLABUS

MODULE 3: POULTRY, PET AND LAB ANIMAL MANAGEMENT

Unit 1: Introduction to Poultry Husbandry (10 periods)

Poultry related terms-

- Poultry, broiler, chick, grower, layer, external morphology of chicken
Scientific names of different species of poultry
- Chicken, duck, turkey, quail

Trends in poultry Industry-

- Current scenario of poultry industry in Kerala and India
- Merits and demerits of poultry rearing

Unit 2: Anatomy and physiology of poultry (40 periods)

Major organ systems of chicken

- Digestive system- mouth, oesophagus, stomach, liver and pancreas, small intestine, caeca, cloaca
- Reproductive system - Male and female
- Respiratory system- syrinx, airsacs
- Skin and feathers - types of feathers

Egg formation

- Physiology of egg formation
- Effect of light on egg formation

Moulting and bleaching

- Definition
- Relation with egg production

Unit 3: Feeds and feeding of poultry

(20 periods)

BIS standards for poultry feeds

- BIS standards of crude protein and metabolisable energy for broiler and layer chicken feeds

Poultry feed ingredients

- Common ingredients used for the formulation of poultry feed

Feeding systems

- Adlibitum feeding
- Restricted feeding
- Mash feeding
- Pelleted feeding
- Phase feeding

Feed efficiency and feed additives

- Definitions
- Feed efficiency in layers and broilers
- Feed additives

Feeders and waterers

- Different types of feeders and waterers

Feed requirement for chicken

- Average requirement of total feed for chicks, growers, layers and broilers

Unit 4: Management of chicken

(70 periods)

Management of chicks

- Brooding – types of brooding, brooder set up

- Brooder management
- Debeaking, dubbing and sexing of chicks

Management of growers-

- Space requirement and general management

Management of layers

- Factors influencing egg production
- Culling of layer birds (differentiating good and poor layers), Standards of egg production, Managemental practices for producing good quality eggs

Management of breeders

- Mating methods, Artificial insemination in chicken
- Trap nesting

Management of broilers

- General guidelines for broiler management

Unit 5: Selection of eggs and Hatchery management (70 Periods)

Structure of egg

- Yolk, Albumen, shell membranes, shell

Abnormal eggs

- Double yolked egg, an egg within an egg, pale egg, soft shelled egg, blood spot, meat spot

Candling and grading of eggs

- method of candling and Grade as per quality

Selection of hatching eggs-

- Size, shape, shell quality and internal quality

Incubation

- Natural incubation
- Artificial incubation

Management of incubator

- Types of incubator
- Parts of incubator
- Physical requisites for incubation

Hatchery operations

- Collection of eggs, selection, fumigation, candling, setting, transfer, taking out of hatch, identification, sexing, vaccination, dubbing, debeaking, packing and despatch of chicks

Unit 6: Diseases of poultry

(50 periods)

Bacterial diseases of chicken

- Pasteurellosis
- Pullorum disease

Viral diseases of chicken

- New castle disease (NCD)
- Fowl pox
- Marek's disease (MD)
- Infectious bursal disease (IBD)
- Avian influenza

Fungal diseases of chicken

- Aspergillosis

Protozoan diseases of chicken

- Coccidiosis

Parasitic diseases

- Endoparasites - Round worm infection (*Ascaridia galli*), Caecal worm infection
- Ectoparasites – Lice, mites and ticks infestation

Nutritional deficiency diseases

- Rickets
- Vitamin A deficiency
- Crazy Chick disease
- Curled toe paralysis

Prevention of diseases

- Treatment
- Vaccination
- Litter management
- Disinfection
- Deworming
- Fumigation
- Biosecurity measures
- Screening tests

- Hatchery management for disease prevention

Unit 7: Rearing of duck, turkey and quail

(30 periods)

Husbandry of ducks

- Advantages of duck rearing
- Housing, feeding and management of ducks
- Sex differentiation

Diseases of ducks and health care

- Pasteurellosis
- Duck plague
- Duck hepatitis
- Aflatoxicosis

Husbandry of Turkey

- Housing, feeding and management of Turkey
- Sex differentiation

Diseases of turkey and health care

- Pasteurellosis
- Black head disease

Husbandry of quail

- Advantages of quail rearing
- Housing , feeding and management of quail
- Sex differentiation

Diseases of quail and health care

- Quail enteritis

Unit 8: Husbandry of pet birds

(10 periods)

Common types of pet birds

- Parrots (African grey parrot, Macaws, Budgerigars, African love birds, Cockatoos, Cockatiels, conures), Doves and Pigeons, Finches
- Fancy chicken breeds - silkie, polish cap and frizzled

Housing, feeding and management of pet birds

- Cages, aviary
- Types of feed required for different pet birds

Diseases of pet birds

- sour crop, egg bound, psittacosis

Unit 9: Management of dogs and cats**(20 periods)****Management of dogs**

- Important breeds of dogs - German Shepherd, Labrador, Doberman, Rottweiler, Japanese spitz, Pug
- Restraining of dogs
- Selection of pups
- Grooming
- Feeding of dogs
- Breeding of dogs
- Diseases of dogs - rabies, canine distemper, parvo viral enteritis
- Health care of dogs- vaccination and deworming

Management of cats

- Important breeds of cats – Persian, Burmese
- Restraining of cats
- Feeding of cats
- Diseases of cat - feline pan leukopenia

Unit 10: Rearing of rabbits and laboratory rodents**(20 periods)****Introduction to mouse, rat and rabbit management**

- Importance of rabbits and laboratory rodents
- Restraint and handling
- Different routes of inoculation of materials
- Precautions for blood collection

Husbandry of rabbits

- Breeds of rabbit-Angora, Soviet chinchilla, New Zealand white, Grey giant
- Housing, feeding and reproduction of rabbits
- Diseases of rabbits – Pasteurellosis, sore hock, mange

Husbandry of laboratory mouse

- Breeds/strains of lab mouse- Swiss albino, BALB/C
- Housing, feeding and reproduction of laboratory mouse

Husbandry of laboratory rat

- Breeds/strains of lab rat – Wistar, Sprague Dawley.
- Housing, feeding and reproduction of laboratory rat

MODULE 4: LIVESTOCK PRODUCTS PROCESSING AND FOOD SAFETY

Unit 1. Milk and milk products

(80 periods)

Nutritive value of milk

- Water, fat, protein, lactose, ash

BIS standards of milk and milk products

- Cow milk, buffalo milk, goat milk, toned milk, double toned milk, ice cream, whole milk powder, table butter, ghee

Preservation of milk

- Pasteurization, sterilization, chilling

Types of milk commercially available

- Toned milk, double toned milk, Homogenized milk, Condensed milk

Preparation of various types of milk products

- Acid Coagulated products - Paneer,
- Concentrated products - Khoa, Gulab jamun
- Fermented products - Dahi, Cheese
- Fat rich products – Ghee, Cream
- Byproducts from milk - Butter milk, Whey, skim milk
- Frozen products – Ice cream

Unit 2. Wholesome milk production

(40 periods)

Measures for clean milk production

- Sources of contamination and hygienic measures

Adulterants of milk

- Starch, Cane sugar, Water (specific gravity method)

Unit 3. Processing of meat and Abattoir management

(70 periods)

Terminologies of meat processing

- Abattoir, lairage, humane slaughter, carcass, meat, pork, chevon, mutton, veal, kara beef

Methods of stunning

- Physical, Mechanical, electrical and chemical stunning methods

Various steps in animal slaughter – (buffalo and cattle, pig, chicken)

- Flow chart and definitions – buffalo and cattle, pig, chicken

Ante mortem and post mortem examination

- Definition and purpose

Requirements for a slaughter house

- Space and light requirements of various rooms in an abattoir

Rendering of slaughter house waste

- Definition and importance of rendering

HACCP

- Definition and importance

Unit 4. Egg and meat products

(50 periods)

Nutritive value of egg and meat

- Water, protein, fat, carbohydrate, ash, vitamins

Preservation of egg

- Chilling, freezing, pickling, house hold methods (water glass method, lime sealing)

Preservation of meat

- Chilling, freezing, thermal processing, canning, curing, smoking, irradiation

Egg products

- Commercial egg products like Egg powder and egg pickle

Meat products

- Sausage, meat cutlet

Unit 5. Zoonotic diseases

(70 periods)

Definition of zoonosis and classification

- Anthroozoonosis, zooanthroponosis, amphixenosis

Common zoonotic diseases –

- Tuberculosis, anthrax, rabies, brucellosis, leptospirosis, bird flu

Important Food borne diseases originating from livestock products-

- Colibacillosis, botulism, cholera, taeniasis

Unit 6. Animal welfare and food safety guidelines

(30 periods)

Prevention of cruelty to animals (PCA) act

- Purpose, general cruelties to animals

Guidelines related to transportation of animals

- By foot, by road and by rail - cattle and chicken

Food safety and standards act (FSS act)

- Purpose, general provisions as to articles of food

MODULE 3**POULTRY, PET AND LAB ANIMAL MANAGEMENT****Overview**

This module provides the fundamental concepts of poultry husbandry and a general awareness on pet and laboratory animal management. This module will equip students to tap previously unutilized job opportunities in sectors of pet industry and laboratory research. Poultry sector in Kerala has not yet evolved into an industrial set up in par with other southern states and a huge amount of income and job opportunities are being drained to other states. Also in Kerala due to urbanization, shortage of land, change in social situations etc, people are showing more interest in rearing of exotic pet animals and birds. All pharmaceutical firms/research institutions where animals are used for study/experimental purposes compulsorily need the service of laboratory animal management expert or animal handler for safe guarding animal welfare. So a lot of job opportunities and income sources are arising in these sectors day by day in India and abroad. This module also favors the students for vertical mobility.

This module is comprised of topics which introduce the students to basic aspects of poultry husbandry, knowledge of poultry anatomy/physiology, management of different categories of poultry, hatchery management, common poultry diseases and their control, management of pet birds, dogs and cats, rearing of laboratory animals like rabbit, mice and rat.

UNIT 1**INTRODUCTION TO POULTRY HUSBANDRY****Introduction**

This unit provides fundamental concepts about poultry husbandry including common terms, scientific names and current trends in poultry industry. It also deals with the major constraints faced by the poultry industry.

Learning Outcomes

The learner;

- ❖ Differentiates and select different types of poultry
- ❖ Lists out the scientific names of poultry
- ❖ Analyses the present situation of poultry industry and apply in field conditions

Concepts**Poultry related term**

- Poultry – includes avian species like chicken, duck, quail, turkey etc which are domesticated for economic purposes

- Broiler – is a young chicken usually 6-8 weeks of age of either sex with tender meat, soft pliable smooth skin and flexible breast bone cartilage
- Chick – Young one of chicken of either sex from 0 – 8 weeks of age.
- Grower – chicken of 9-20 weeks of age
- Layer – chicken of 20-72 weeks of age

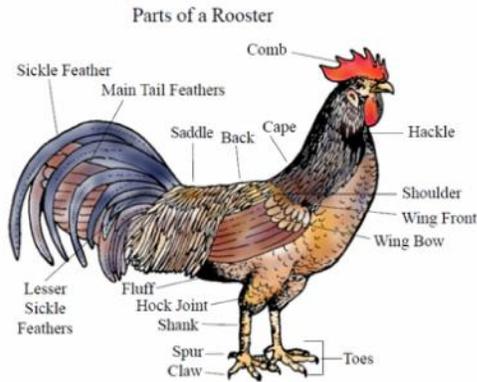


Fig. 1. Body parts of a rooster

Scientific names of different species of poultry

- Chicken – *Gallus gallus domesticus*
- Duck – *Anas platyrhynchos*
- Turkey – *Meleagris gallopavo*
- Japanese Quail – *Coturnix coturnix japonica*

Trends in poultry Industry-

Current scenario of poultry industry in Kerala and India - Refer current data from reliable sources like website of department of Animal Husbandry, Dairying and Fisheries ([http:// dahd.nic.in](http://dahd.nic.in)), Kerala Animal Husbandry Department (www.ahd.kerala.gov.in).

Livestock census 2012

According to the 19th livestock census (2012) of India the total poultry population in the country has increased by 12.39% over the previous census (2007) and the total poultry in the country is 729.2 million numbers in 2012. Out of this 95% are fowls, 3% are ducks and the remaining 2% are turkeys and other poultry. The poultry population is highest in Andhra Pradesh among the states of India in 2012 and the position of Kerala is 8th with a share of 3.33% of total poultry in India. The total poultry population in Kerala is 24.3 million numbers in 2012. The poultry population in Kerala has shown a growth of 54.8% of that in 2007.

Basic animal husbandry statistics 2014

According to the basic animal husbandry and fisheries statistics (2014) the total egg production in India is 69731 million numbers and the per capita availability of eggs reached 58 eggs per annum in the year 2012-13. Nearly 94% of the production of

egg is contributed by Fowl followed by Duck (3%) and other poultry birds (3%). The growth rate of egg production registered 4.9% during the year 2012-13. Kerala was the highest growth rate achiever among the States/UTs in the year 2012-13 with annual growth rate of 31.2%. The largest producer of egg is Andhra Pradesh which produces 32% of the total egg production in the country. West Bengal is the largest producer of duck eggs in the country. The per capita availability of eggs in Kerala is 63 eggs per annum in the year 2012-13. Nearly 45% of the meat produced in India is contributed by Poultry. The meat production from poultry is highest in the State of Andhra Pradesh with 0.499 million tonnes per year.

Merits and demerits of poultry rearing

Merits

1. Low capital investment
2. Easy to rear and handle
3. High demand and nutritive value of egg and meat
4. In terms of nutrient content of products
5. Possibility of making many value added products
6. Back yard rearing is possible with meager expense
7. Space and labour requirements are less
8. Religious taboos are not much affected
9. Early marketing age of broilers fetch quick returns

Demerits

1. Non availability of sufficient high quality chicks
2. High cost and low availability of feed ingredients
3. Lack of properly organized marketing channels. Even a single day's delay in marketing of broilers will lead to huge loss in profit.
4. Lack of organized modern abattoirs. Most of the chicken meat is sold in live form.
5. Risk of diseases including zoonotic diseases
6. Among poultry only chicken is reared commercially in large scale. Other species of poultry are under utilized.
7. Only a few people are involved in large scale poultry farming

Problems faced by poultry industry in Kerala

1. Lack of sufficient land for starting poultry farms – Kerala is a thickly popu-

lated state and poultry farms could be started only at sufficient distance from human dwellings.

2. High cost of labour – The labour cost is very high in Kerala compared to other states of India.
3. High feed cost – Chicken is simple stomached and most of the poultry feed ingredients are human food too. Being a consumer state the cultivation of crops is less in Kerala and so the feed ingredients are to be brought from outside. This naturally increases the feed cost.
4. Lack of interested farmers – The people of Kerala are generally highly educated and they prefer white collar jobs even at a lesser monthly income.
5. Under utilized duck population – Even though many inland water bodies suitable for low cost duck rearing are available in our state, rearing of ducks is not commercially developed.
6. Reducing numbers of backyard poultry units – The backyard poultry units which were the strength of poultry production in Kerala are also reducing fast in numbers with the reducing landholdings.
7. Lack of proper extension activities - People are not sufficiently aware about the modern methods to rear small numbers of chicken in partial confinement without causing serious damage to the vegetation. Such technologies are not easily accessible at low cost.
8. Reduced availability of quality cross bred chicks – Cross bred chicks suitable for profitable backyard rearing are not easily available from reliable sources.

Practicals

1. Body parts of adult chicken

Aim - To identify different body parts of chicken

Materials required - Live chicken, charts, pictures etc.

Procedure and demonstration - Illustrate the picture of chicken and label the body parts.

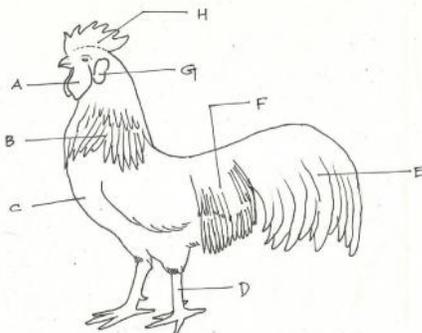
Activity - The students should identify the body parts of presented live chicken.

Assessment activities

Prepare a chart as assignment showing the pictures and scientific names of chicken, duck, turkey and quail.

TE Questions

1. Chicken of 9-20 weeks of age is called (1 score)
(a. chick b. grower c. layer d. broiler)
2. The scientific names of some birds are given wrongly. Make suitable corrections (3 score)
 - a. Chicken – *Meleagris gallopavo*
 - b. Duck – *Gallus gallus domesticus*
 - c. Turkey – *Anas platyrrhynchos*
3. Poultry industry in Kerala is not developed well compared to other southern states. Describe the reasons for this. (4 score)
4. The diagram of a cock is given below. Label the marked body parts.(4 score)



5. *Gallus gallus* is commonly known as..... (1 score)
6. Correct the following sentences if needed by making changes in the under lined part only (3 score)
 - a) Broiler is a chicken of 20-72 weeks of age
 - b) Pure bred chicken are suitable for profitable backyard rearing
 - c) The total poultry population in India in 2012 is 937.4 million numbers.
7. A debate is conducted in your class on the merits and demerits of poultry rearing. The group standing against poultry keeping raises points such as risk of diseases including zoonotic diseases, lack of interested farmers etc. State at least 6 points supporting poultry keeping for the debate. (3 score)
8. According to 19th livestock census (2012) of India the total poultry population in Kerala is _____million numbers. (1 score)
9. The per capita availability of eggs per annum in India in the year 2012-13 is — (1 score)
 - a) 63
 - b) 47
 - c) 58
 - d) 35

UNIT 2

ANATOMY AND PHYSIOLOGY OF POULTRY

Introduction

This unit deals with basic anatomy of digestive, reproductive and respiratory systems of poultry. Learners will understand the concepts of feather types and bones of chicken. The physiology of egg formation, moulting and bleaching are also dealt with.

Learning Outcomes

The learner;

- ❖ Illustrates and identify the structure of digestive and reproductive system of chicken
- ❖ Explains the function of digestive, reproductive, respiratory systems and skin and feathers of chicken
- ❖ Describes different stages of egg formation
- ❖ Practises proper light management in layers
- ❖ Assesses the production capacity of layers

Concepts

Major organ systems of chicken

Digestive system

Chicken has a simple digestive system which depends on enzymes for digestion.

Mouth - Mouth does not have lips and teeth. These parts are replaced by beak. Tongue has the shape of barbed head of an arrow.

Oesophagus - It connects pharynx and stomach. Crop is a diverticulum of oesophagus and has the function of storage of food materials.

Stomach - Oesophagus opens into glandular stomach called proventriculus which in turn opens into muscular stomach called gizzard. Glands in proventriculus secrete gastric juice that aid in digestion. Thick powerful muscles of gizzard help to grind or crush food particles. The process is aided by the presence of grit.

Liver and pancreas - Bile produced by liver helps in the absorption of fat. Pancreatic juice helps in enzymatic digestion of starch (pancreatic amylase), protein (trypsin and chymotrypsin) and fat (pancreatic lipase).

Small intestine - The small intestine has three parts namely duodenum (U- shaped loop), jejunum and ileum. Out of these only the first part can be distinguished easily. Enzymes produced in intestinal wall complete the digestive process. Minute projections called villi in the intestinal wall help in rapid absorption of nutrients. Digestion and absorption in small intestine are extremely rapid and take place in less than three hours.

Caeca - They are two blind pouches seen at the junction of small intestine and rectum on either side and are usually filled with faecal matter. In adult birds some digestion of fibre may take place in the caeca.

Cloaca - The large intestine is very short and consists of a short rectum leading to cloaca. Urine is discharged into cloaca and excreted with faeces. Cloaca opens out as an external opening called vent.

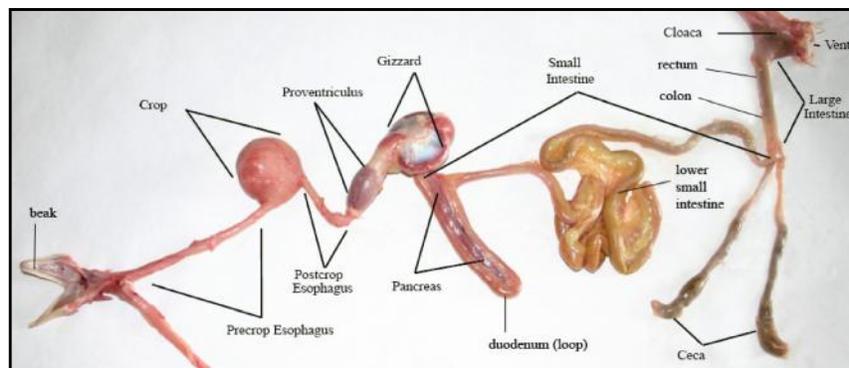


Fig. 3. Digestive system of fowl

Reproductive system

Male Reproductive system

The reproductive system of male consists of two bean shaped yellowish white testes situated high up in the abdominal cavity, vas deferens and papillae or rudimentary copulatory organ located in cloaca.

Female Reproductive system

Consist of ovary and oviduct, only left one develops and become functional.

Ovary- is like a bunch of grapes which contains immature ova called follicles

Oviduct-is a large folded tube occupying left side of abdominal cavity. Oviduct is divided into five regions viz infundibulum or funnel, magnum, isthmus, uterus/shell gland and vagina.

- Infundibulum - receives the yolk from the ovary
- Magnum - secretes the thick albumen or white (largest part of oviduct)
- Isthmus - secretes the shell membranes
- Uterus - secretes the shell and shell pigment, also called shell gland
- Vagina - hold the egg until it is laid

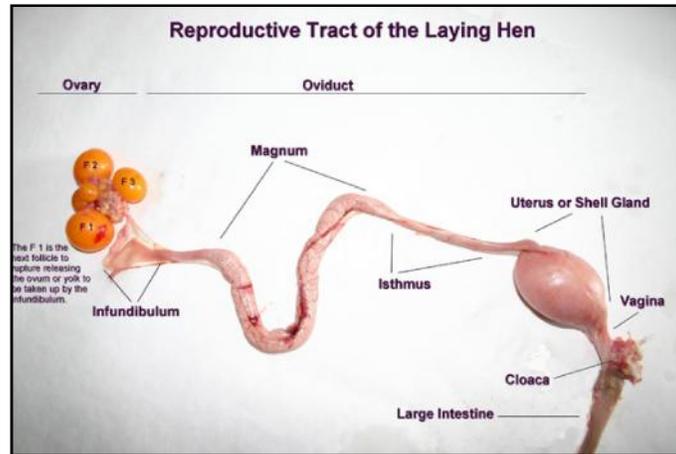


Fig. 4. Female reproductive system of fowl

Respiratory system - Consists of lungs, air passages and air sacs. The lungs are closely attached to the ribs in the upper portion of thoracic cavity. There are four pairs of airsacs and a single inter-clavicular airsac. Airsac helps in temperature control of the body and movement of air in the lungs. The sound producing structure in birds is syrinx. Birds have special types of bones called pneumatic bones which are hollow and connected to the air sacs of respiratory system. Eg - skull, humerus.

Skin – The skin is relatively thin and free of secretory glands except oil/preen gland/uropygial situated on the upper portion of tail. Chicken has no sweat glands. Comb, wattles, ear lobes, spur, scales on the legs and toes, claws and beak are specialized structures associated with skin. Yellow colour of skin is due to carotenoid pigment and black colour is due to melanin.

Feathers- feathers help to protect birds from external injuries keep body warm and help in flight. Feathers are arranged in definite rows called feather tracts or pterylae. Three types of feathers are present in birds

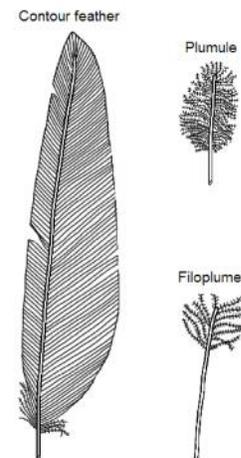


Fig. 5. Types of feathers

- a. **Contour feathers**- large feathers present on the body like flight feathers on the wing and body
- b. **Filoplumes** - intermediate type of feathers.
- c. **Plumules** - are small down feathers which function as insulative covering to retain body temperatures.

Egg formation

Yolk is formed inside the follicles of ovary from contents transferred from blood. The follicular membrane is well supplied with blood vessels except at a point called stigma, through which ovulation takes place. After ovulation the yolk is received by the infundibulum and it remain in the infundibulum for 15 minutes; fertilization takes place in infundibulum. In magnum albumen or egg white is secreted around the yolk. It is formed as different layers due to turning, twisting and addition of water. It takes around 3 hours in magnum. In isthmus, shell membranes are formed within 75 minutes. Inside uterus shell is formed around the albumen, mainly from calcium carbonate secreted by uterine glands. The posterior part of uterus secretes a thin covering over the shell called cuticle. The egg remains for long period in uterus; around 21 hours. Egg is then passed to vagina, turns 180 degrees so that when laid large end comes first where an air cell is formed as air enters into egg due to atmospheric pressure. The process of egg laying is known as oviposition.

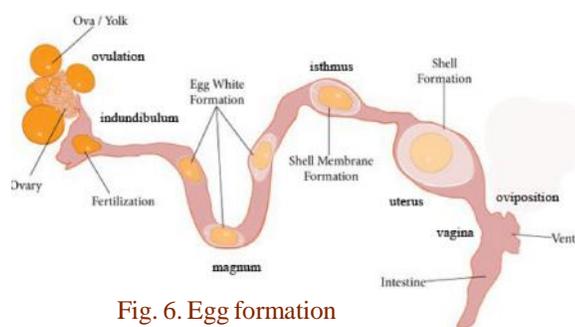


Fig. 6. Egg formation

Effect of light on egg formation

Birds are very sensitive to photoperiod. The photoperiod required for layer chicken is 16-17 hours per day. After transferring to layer house after 20 weeks of age the light can be increased at a rate of 15 minutes per week to reach 16 hours of total photo period. Grower birds should not be given increased photo period as it may cause precocious sexual maturity and lay poor quality eggs. When sunlight falls on the retina of the bird, there will be release of gonadotropins releasing hormones

(GnRH) from brain which will then release FSH and LH from pituitary. These hormones will help in the maturation of follicle and then ovulation. Following ovulation, ovum reaches oviduct where it will be transformed into a fully formed egg.

Moulting and bleaching

Moulting - The act of shedding and renewal of feathers in birds is called moulting. It normally occurs once in a year. Fowls lose their feathers in a definite order starting from head, neck, body, wing and tail. Good layers start moulting late in the season and complete moulting faster (late and fast moulters).



Fig. 7. Moulting

Bleaching - Pigments are lost in definite order mainly in yellow skinned birds starting from vent, earlobe, beak and shank, this is called bleaching. After the bird stops production the pigment reappears in the similar order. The pigments from body of chicken are used for forming egg yolk and so as more and more eggs are being laid, more pigments are lost and thus bleaching is the indication of production ability.

Practicals

Identification of digestive system of chicken

Aim- Dissect the chicken carcass and identify the body parts

Materials required- Deskinned chicken carcass without head and shank, scissors, bone cutter, dissection tray, surgical gloves

Procedure and demonstration

- a) Place the deskinned, head and shank removed chicken carcass in a dissection tray facing the breast bone upward and dislocate the hip joints.
- b) Cut open the breast bone by passing the scissors through its borders on either sides.
- c) Remove the breast bone with the help of a bone cutter
- d) Take out organs like heart, liver and gall bladder from the carcass for proper view of other organs.
- e) Identify the parts of digestive system starting from oesophagus, crop, proventriculus, gizzard, duodenum, pancreas, small and large intestine, double caeca, cloaca etc.

Assessment Activities

1. Collect the specimens of digestive and reproductive system of chicken from nearby slaughter house and label the parts.

TE questions

1. Draw the structure of digestive system of chicken and label the parts (6 score)
2. The sound producing structure in birds is called (1 score)
a. larynx b. syrinx c. pharynx d. trachea
3. Isthmus, infundibulum, uterus, magnum and vagina are parts of hen's reproductive system. Arrange them in structural order (2 score)
4. Describe the functions of infundibulum and magnum in egg production (3 score)
5. In a layer farm some birds are showing shedding and renewal of feathers. Identify the process and write about it. (3 score)
6. Select the gland which is not present in chicken.
(urophygial gland, sweat gland, preen gland, oil gland) (1 score)
7. How will you respond to a poultry farmer's question of "How an egg is formed". (5 score)
8. During dissection of a female chicken, after taking out the intestines, you happened to see a folded tube like organ occupying left side of the abdominal cavity.
(a) Identify the organ
(b) Describe its functions (5 score)
9. Match the following (5 score)

a) Caeca	- Storage of food
b) Gizzard	- Villi
c) Small intestine	- Bile
d) Liver	- Grit
e) Crop	- Two in number
	- Glandular stomach
10. In a layer farm you have observed that the birds are losing pigments from their skin.
a) What is this process called? (1 score)

- b) How it is related to production? (2 score)
11. During a farm visit you happened to see that the layer birds are given 10 hours of photoperiod.
- a) How will this affect the egg production of birds? (1 score)
- b) What is the normal photoperiod required by layers? (1 score)
- c) Write on the effect of light on egg production. (3 score)
12. While doing the dissection of a chicken carcass you came across two bean shaped yellowish white organs situated high up in the abdominal cavity. Which are these organs? (1 score)

UNIT 3 FEEDS AND FEEDING OF POULTRY

Introduction

Knowledge about BIS standards of poultry feed is necessary for formulating feeds for different categories of chicken. This unit fulfills this concept. It also comprises the topics of feeding systems, feed requirements and equipment.

Learning outcomes

The learner;

- ❖ Applies the feed standards for the preparation of poultry feeds
- ❖ Identifies the locally available poultry feed ingredients
- ❖ Selects and Practise suitable feeding system for poultry
- ❖ Assesses the feed efficiency and add appropriate feed supplements and additives
- ❖ Selects suitable feeders and waterers for different age groups of poultry
- ❖ Calculates the total feed requirement for different types of chicken

Concepts

BIS specifications for poultry feed (IS 1374: 2007)

Sl. No.	Characteristic	Requirement for						
		Broiler feed			Layer feed			
		Pre-starter	Starter	Finisher	Chick	Grower	Layer phase I	Layer phase II
Age of birds	1 to 7 days	8 to 21 days	22 days to finish	0 to 8 weeks	9 to 20 weeks	21 to 45 weeks	46 to 72 weeks	
1	Moisture % (Max)	11	11	11	11	11	11	11
2	Crude protein % (Min)	23	22	20	20	16	18	16
3	Metabolisable energy Kcal/kg (Min)	3000	3100	3200	2800	2500	2600	2400
4	Salt % (Max)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
5	Aflatoxin B1 (ppb) Max.	20	20	20	20	20	20	20

In addition to this, BIS standards also specify the amounts of crude fibre, ether extract, acid insoluble ash, various vitamins, minerals, essential amino acids and harmful substances in poultry feed. Extra calcium source in the form of shell grit or lime stone at about 4-5 g per bird per day is advised in layers both in phase I and II.

Poultry feed ingredients

Poultry feeds are commonly prepared by using feed ingredients like yellow maize, ground nut cake, gingely oil cake, rice polish, wheat bran, fish meal, unsalted dried fish, tapioca, soybean meal, mineral mixture, vitamin mixture and salt. These feed ingredients may be classified as energy, protein, mineral and vitamin rich sources.

Feed formulation is the mathematical exercise of establishing a blend of ingredients that meet the bird's nutrient requirements. The following points must be considered for doing this.

- The nutrient requirements of the type of bird (chick, grower etc) for which the ration is formulated.
- Available ingredients for feed production
- Nutrient levels and cost of these ingredients

Feeding systems and forms of feed

1. **Ad libitum feeding or full feeding** – In this system, feed is made available at all times in front of the birds so that they can consume as much as they want at all times.
2. **Restricted feeding** – This is a method of controlled feeding. This can be Practised in several ways: (I) The supply of total quantity of feed per day can be restricted (II) The feeding time per day can be restricted. (III) The birds may be fed on alternate days only (IV) Skip a day feeding in a week. (V) The content of major nutrients can be restricted quantitatively.

Restricted feeding is practised in growers and broiler breeders. Restriction of 20 % is commonly allowed for broiler breeders. For egg type growers 7-8% feed restriction is maximum. Never apply feed restriction during stress.

The advantages of feed restriction are: a) Delayed sexual maturity and thereby an increase in egg weight. b) Low fat deposition and so low body weight at laying c) Low feeding cost d) Feed restriction during growing period leads to better livability during laying period

3. **Phase feeding** – This is a system of feeding followed in layers. In this system, the entire laying period (21-72 weeks of age) is divided into two or three phases. In BIS standards for layers, feed requirements are given for two phases.

Phase I (21 -45 weeks of age) - During the first phase the nutrient requirements are more as the egg production and egg weight are increasing.

Phase II (46 -72 weeks of age) - As the bird continues laying, the egg production gradually reduces and the nutrient requirements reduces. So the nutrient content of feed can be regulated accordingly. Phase feeding does not improve the rate of lay. But it lowers the cost of producing eggs by reducing the feed cost in second phase.

Forms of feed

Poultry rations are available in mash or pellet forms.

1. **Mash form** – Birds find finely ground mashes unpalatable. So the feed ingredients are ground to a medium particle size to form mash feed. But some ingredients like rice polish will be in finely ground form only. So there will be selection of ingredients by the birds. They will pick out the larger cereal grain particles from the mash first, leaving the finer material.
2. **Pellet form** – The mash is compressed into cylindrical pellets by running through pelleting machine using heat, moisture and pressure. The advantages of pellets are,
 - a. Feed wastage is reduced
 - b. Reduce labour for feeding
 - c. Selective consumption of ingredients is eliminated.
 - d. Feed dustiness is reduced.
 - e. Pelleting destroys some bacteria in the feed.

The disadvantages of pellets are:

- a. It is expensive to pellet the mash feed.
- b. Pellet feeding increases chance of cannibalism.
- c. It cannot be fed to young chicks.

Feed efficiency and feed additives

Feed Efficiency or Feed conversion ratio (FCR)

(1) *Feed efficiency in broilers*

Feed efficiency or efficiency of feed conversion indicates the quantity of feed required to put up a unit live body weight in broilers. For broilers, a feed efficiency of 1.8-2.0 kg feed to put one kg live body weight is considered as optimal.

(2) **Feed efficiency in layers:** It can be told in two ways.

- a) Feed efficiency per kg egg mass – This is the quantity of feed in kilograms required for producing one kilogram of egg. This takes into consideration of the feed intake, egg weight and egg production.

$$\text{FCR (per kg egg mass)} = \text{Kg of feed consumed} / \text{Kg of egg produced}$$

A value of 2.2 or less is advantageous to the farm.

- b) Feed efficiency per dozen eggs - This is the quantity of feed in kilograms required for producing one dozen of eggs. This takes into consideration of the feed intake and egg production.

$$\text{FCR (per dozen eggs)} = \text{Kg of feed consumed} / (\text{Total eggs produced} / 12)$$

A value of 1.5 or less is advantageous to the farm.

Since feed involves 70 % of the cost of production, feed efficiency determines profit margin also. The factors influencing feed efficiency are genetic potential, quality of feed, growth promoters, climate, floor space etc.

Feed Additives

Feed additives are any intentionally added ingredient not normally consumed as feed by itself, whether or not it has a nutritive value, which affects the characteristics of feed or animal products. These feed additives improve physical appearance, consistency, nutritive quality, shelf life, sometimes nutrient availability and texture of diets. Feed additives can be of two types - nutritive feed additives and non-nutritive feed additives

Nutritive feed additives: Vitamins, trace minerals and amino acids are essential nutrients. However, the natural feed ingredients sometimes are not able to provide these essential elements in adequate quantity in the feed. Hence, it is needed to supplement vitamins, trace minerals and amino acids. These are called nutritive feed additives or sometimes feed supplements.

Non-nutritive feed additives: They are feed additives having no nutritive value. They include prebiotics, probiotics, acidifiers and pH optimizers, antioxidants, feed enzymes, toxin binders, herbal products, antibiotic growth promoters, anticoccidials, emulsifiers, flavours, carotenoids etc.

The use of antibiotic growth promoters are not recommended in poultry feed. The reasons are the presence residues of antibiotics in animal products and development of bacterial resistance.

Feeders and waterers

Different types of waterers

For young chicks, fountain type or pan and jar waterer is used. It is usually made of plastic. The jar is having a small hole at about 2cm from the edge to maintain the water level. After one week of age automatic watering systems may be used. They may be automatic troughs, hanging waterers, cup waterers or drip nipples. The trough is usually V-shaped, height adjustable and long with a valve fitted at one end. Hanging waterers are round waterers made of plastic that hang from the ceiling. A bell shaped dome encloses a valve to maintain a designated level of water in the circular pan. They may be raised or lowered by changing the length of the suspension cord. Cup waterers are small drinking cups attached to vertical or horizontal pipes. Drip nipples are small valves operated from below by the chicken. It allows the water to run down the throat as the bird extends its neck. A plastic basin with a detachable wire grill fitted over it is a common type of adult waterer seen in small farms in our country.

Different types of feeders

The first feed is spread over large, flat and shallow feeders. It may have a height of 2.5 – 5 cm at the edges. Chick box lids or feeder lids can be used for this purpose. This is used for chicks below 5 days of age. After that hand feeders or automatic feeders may be used. Hand feeders may be linear trough feeders with a reel or grill over it to prevent feed wastage. Trough feeders are usually used for chicks and young growers. Another type of hand feeder is tube feeder. These are large tubes with a pan at the bottom. The feed flows from the tube to the pan from which the birds eat. Tube feeders are usually suspended from the ceiling and are usually used for larger birds. Automatic feeders consist of a pan or trough from which the birds eat and a mechanism for automatically transferring feed from a central hopper to these pans or troughs. It may be of several types. As the flock grows the feeders should be raised to maintain level of the bottom of the feeder at the same height as the back of the chickens.

Feed requirement for chicken

Average requirement of total feed for chicks, growers, layers and broilers

Total feed consumption of broilers:

From 0 to 6 weeks of age - 3.5 kg / bird

From 0 to 7 weeks of age - 4.7 kg / bird

Total Feed consumption of layers:

During laying period (21 - 72 weeks of age) – 41 kg / bird

During growing period (9-20 weeks of age) – 6 kg / bird

During chick period (0-8 weeks of age) – 2 kg / bird



Fig. 8. Equipment for poultry houses

Practicals

Poultry feed ingredients

Aim- Identify common poultry feed ingredients and classify them as energy, protein and mineral rich sources.

Principle - Energy sources include carbohydrate rich ingredients like cereals (rice, wheat, maize, bajra), their byproducts (rice bran, wheat bran, rice polish, wheat polish), tubers (tapioca) etc. Protein sources include oil seed cakes (coconut cake, ground nut cake, gingely oil cake), animal protein sources, pulses etc. Mineral rich components include shell grit, mineral mixture, salt etc

Procedure

- a) Collect locally available poultry feed ingredients properly
- b) Sort and group them as energy, protein and mineral sources and prepare a table of contents
- c) Record the CP,ME and cost of the feed ingredients



Fig. 9. Poultry feed ingredients

Assessment activities

1. Collect locally available ingredients used for the preparation of poultry feeds in individual transparent plastic covers or bottles and label it

TE questions

1. Complete the following table showing the BIS specifications for layer feed (4 scores)

Sl. No.	Characteristic	Chick	Grower	Layer phase I	Layer phase II
1	Crude protein % (Min)	20	-	18	-
2	Metabolisable energy Kcal/kg (Min)	-	2500	-	2400

2. Your neighbour is running a layer farm. Now the birds are of 10 weeks age.
 - a) Which system of feeding you will suggest for these birds? (1 score)
 - b) What are the advantages of this system? (3 score)
 - c) Write any two ways to implement that system (2 score)
3. The optimum FCR for a profitable broiler farm should be between ———
 - a) 1.8 - 2.0
 - b) 2.0 - 2.2
 - c) 2.2 - 2.4
 - d) 2.4 - 2.5
 (1 score)
4. You are conducting a debate on forms of feed. The group opposing pellet feed raises points such as; it is expensive to pellet the mash feed, pellet feeding increases chance of cannibalism, it cannot be fed to young chicks etc. Write at least 4 points supporting pellet feed from your side. (4 score)
5. Expand the abbreviations. (a) BIS (c) FCR (2 score)
6. Compare the following terms (4 score)
 - a) Nutritive feed additives , non-nutritive feed additives
 - b) Adlibitum feeding , restricted feeding
7. Correct the statements without changing the structure of the sentence.

- (a) Coccidiostats are feed supplements added to poultry diets to prevent Salmonellosis.
 - (b) A 40 % feed restriction is usually practised in case of layer birds. (4 score)
8. Calculate the total feed requirement for rearing 100 day old layer chicks up to 72 weeks of age. (4 score)
9. Your neighbor is starting a poultry farm and wants to know about the different types of waterers that can be used. Give him a description about it. (5 score)
10. The use of antibiotic growth promoters are not recommended in poultry feed. Give reason (2 score)
11. Which is the common feeding system followed in layers? What is the advantage of this system? (2 score)
12. Which of the following is not a non-nutritive feed additive? (1 score)
- a) prebiotics
 - b) flavours
 - c) herbal products
 - d) amino acids

UNIT 4 MANAGEMENT OF CHICKEN

Introduction

This unit provides all the fundamental concepts of general management of different age groups of chicken *viz.*, chicks, growers, layers, breeders and broilers.

Learning outcomes

The learner;

- ❖ Designs and construct a standard brooder for chicks
- ❖ Practises debeaking in chicks
- ❖ Differentiates male and female chick
- ❖ Explains management of grower chicken
- ❖ Identifies good and poor layers for selection and culling
- ❖ Explains practices for producing good quality eggs
- ❖ Selects suitable mating system for chicken
- ❖ Describes the importance of artificial insemination in chicken
- ❖ Practises rearing of broiler chicken

Concepts

Management of Chicks

The chicks are transferred to the pen in the brooder house immediately after hatching and reared there for 6-8 weeks of age. Chick feed containing 20% protein can be given to the chicks.

Brooding is the period in which chicks are given warmth from day old to 4 - 5 weeks of age.

Rearing is the period from 5 to 8 weeks of age.

Brooding

Chicks require supplementary heat till they grow feathers. There are two methods of brooding.

- 1) **Natural brooding** - When the eggs are hatched out under a hen, she will take care of the chicks. Usually a broody hen can take care of 12-15 chicks. The natural method is used when only a few chicks have to be raised each year.

- 2) **Artificial brooding** - brooding without the use of a hen, using a brooder, where the heat is provided by electricity or kerosene or gas. Incandescent bulbs, Infra-red bulbs or Liquefied petroleum gas (LPG) are the usual sources of heat. A large number of chicks can be brooded at any time during the year. Artificial brooding can be done in two ways.

A) **Floor brooding** - in deep litter houses.

B) **Cage or battery brooding** - in electrically operated brooder batteries.

Brooder set up

A) Floor Brooding

Units of 250 chicks are ideal for efficient management. A good litter is spread on the floor at 6-7 cm depth. Chick feeders and waterers are also placed on the litter. The food may be given for the first 2 or 3 days on paper spread under the hover. The size and number of the hovers depends on the number of chicks to be brooded. A hover with 1.0 m diameter is sufficient for 250 chicks. The hover can be placed at appropriate height from the floor either by hanging it from the roof or by placing it over bricks or stones so that chicks can go in and out easily. Hover is not necessary when infrared bulbs are used. For the first few days (one week) a chick guard may be placed around the brooder, 2 feet apart, to prevent the chicks from wandering away from the heated area. The feeder space requirements for chicks are as follows:

- 0- 2 weeks - 2.5 cm per chick
- 2-6 weeks - 4.5 cm per chick

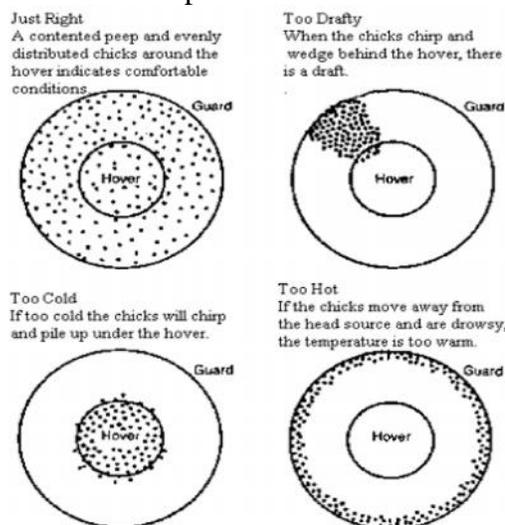


Fig. 10. Distribution of chicks in brooder

Clean cold water should be made available to chicks at all times.

Temperature in brooder: Temperature required for brooding is 1 watt/chick. The number of bulbs to be used depends on the number of chicks to be brooded. One Infra-red bulb of 250 watts is sufficient for every 250 chicks. Position the bulb 50 cm above the litter. A gas brooder is more useful at places where electric supply is not reliable. Brooding chicks require a minimum temperature (in degree celcius) of 35, 32, 29 and 26 during 1st, 2nd, 3rd and 4th weeks of age respectively. By about 4 to 5 weeks of age, the chicks usually do not require extra heat unless it is very cold. The warmth as measured by thermometer at 5 cm (2 inches) above the floor level should be checked every day. The distribution of chicks under the hover is a better indication of warmth than the thermometer. If the chicks are active, busy eating and drinking, it indicates that the temperature under the hover is comfortable. If they feel too warm they move away. If the temperature is below optimum, the chicks huddle together beneath the source of heat.



Fig. 11. Brooder set up

B) Battery Brooding

The brooding compartments are built in tiers, one above the other. Each compartment contains a brooder or hover. The floor of the compartment is of wire net and has a dropping board/tray. Removable feeding and watering troughs are attached to the compartments. The requirements, feeding, watering etc. are similar to floor type. The floor space is 1 square foot for 6 chicks up to 4 - 6 weeks of age.

Management Of Chicks In A Brooder:

- i) Adjust temperature as per requirement of chicks
- ii) Avoid dampness.
- iii) Provide balanced standard mash. Keep chick hoppers filled
- iv) Keep provision for entrance of fresh air
- v) Provide clean, fresh water. A chick requires a waterer space of 0.6 cm for the first 2 weeks, and 1.3 cm thereafter until 8 weeks of age.
- vi) Sanitation and hygiene- brooder house should be cleaned and disinfected before placing the chicks. Clean the brooders including feed hoppers daily.

A foot dip with disinfectant should be provided at the entrance of the brooder house.

- vii) Avoid overcrowding as this will lead to slow growth and mortality. On deep litter, chicks require 250-300 cm² upto 4 weeks of age, and 700 cm² from 4- 8 weeks.
- viii) Avoid entry of cold, wind and rain.
- ix) Inspect chicks daily for abnormalities, and contact a veterinarian if needed
- x) Follow a regular vaccination programme. Vaccination against common diseases like Marek's, Ranikhet, Fowl pox etc should be given at proper time.
- xi) Deworming is to be done at regular intervals.
- xii) Debeaking and dubbing can be done at day old age, if necessary. By about 5 weeks of age, the chicks do not require artificial heat and the brooder is removed from them.

Dubbing: The process of trimming or removing the comb and wattles of breeder males to improve their virility and vigour. Preferably done at day old age.

Debeaking: It is the trimming of the ends of the upper and lower beaks by a red-hot blade which cuts and cauterizes in one movement. If it is done at an early age preferably at 2 weeks of age, it reduces stress for life, caused by feather-picking and cannibalism. It is often done with the help of an electric debeaker - an equipment designed and constructed for debeaking poultry by means of an electrically heated steel blade which would cut and cauterize the beak at the same time, preventing haemorrhage. Some within the chicken industry claims that beak-trimming is not painful, whereas others argue that the procedure causes chronic pain and discomfort, and decreases the ability to eat or drink



Fig. 12. Electric debeaker



Fig. 13. Debeaked chick

Sexing of chicks: Chick sexing is the method of distinguishing the sex of chicken, usually by a trained person called a chick sexer. Chick sexing is practised mostly by large commercial hatcheries to separate female chicks from the male chicks. Different segments of the poultry industry, sex chickens for various reasons. In farms that produce eggs, males are unwanted; for meat production, separate male and female lines for breeding are maintained to produce the hybrid birds, that are sold for the table. The two chief methods of sexing chicks are feather sexing and vent sexing. Vent sexing, involves squeezing the feces out of the chick, which opens up the chick's vent slightly, allowing the chicken sexer to see if the chick has a small "bump", which would indicate that the chick is a male. Feather sexing can be done only in strains that would produce slow-feathering males and fast-feathering females.

Management of growers - (9-20 weeks)

The period after brooding till sexual maturity is referred to as growing period

Space requirement and general management

Provide additional floor space, feeder space and water space for growers. No artificial light is required during this stage. Grower mash containing 16% protein can be fed from 8 weeks of age. Linear feeders with grill or tube feeders can be used for growing chicken. The feeder space requirements for growing chicks is 10 cm per bird (considering both sides of the feeder). If tube feeders are used, provide 1 tube feeder of 25 kg capacity for 50 birds. The level of mouth of feeder should be in line with the back of the bird or slightly higher. Water can be given in basins with grill or in water channels constructed on the side walls. Fifty birds require two 4 litre basins for watering. The water space requirement is 2-2.5 cm per bird if linear waterers are used. Water should be available at all times. Birds are vaccinated and dewormed routinely. The growing pullets should be removed to laying house about 2 weeks before they start laying. The floor space requirements are as follows: For light breeds – 950 cm², for heavy breeds – 1350 cm²

Management of layers

At 18 weeks of age all under grown pullets are to be culled and disposed off. Careful selection at the time of housing enables better returns and fewer culls later. The birds can either be reared in the same house where it was grown or transferred to laying house. The space requirement of laying chicken is as follows:

Light breed - 1950 cm²; Heavy breed - 2300-2800 cm²

The laying starts at 20 weeks of age. Egg production is high and economical up to

72-75 weeks of age. A profitable poultry operation requires good stock, good feed and good management. For producing table eggs, never put or rear males. Only for producing hatching eggs males can be incorporated. Artificial light stimulates eggs production. A hen should have 16 hours light including the day light. A good quality layer mash should be provided to the laying birds. The feed may be given in linear feed troughs or in hanging feeders. Provide 5 hanging feeders, each 50 cm in diameter with 20-25 kg capacity for 100 layers. Shell grit in the form of oyster shell or ground lime stone must be available to layers at all times. Chopped green leaves can also be fed. It supplies vitamins. Fresh clean water should be given all times. Water space of 2.5 linear cm per bird should be provided. Layers on deep litter must be provided with nests. One box is sufficient for every 5 layers.

Summer Management

When the laying house temperature is above 32.3°C birds are uncomfortable and feed consumption is greatly reduced. Over 37.8°C the mortality rate is rather high. During summer, provide clean cool water at all times. Crushed ice may be provided in water. Plant shade trees around the poultry houses. Reduce thickness of old built up litter. Give vitamin supplement (ascorbic acid). Roof insulation and covering the walls of the houses with gunny bags soaked in cool water are other methods to reduce the poultry house temperature.

Factors influencing egg production

Typically, a layer's production cycle lasts just over a year (52-56 weeks). During the production cycle many factors influence egg production; therefore, the cycle must be managed effectively and efficiently in order to provide maximum output and profitability. The following factors influence egg production.

Breed. The breed of the laying bird influences egg production.

Mortality rate. Mortality rate may rise due to disease, predation or high temperature. The mortality rate of small chicks (up to eight weeks of age) is about 4 percent; that of growers (between eight and 20 weeks of age) is about 15 percent; and that of layers (between 20 and 72 weeks of age) is about 12 percent. The average mortality rate of a flock is from 20 to 25 percent per year.

Age. Birds typically begin producing eggs in their twentieth or twenty-first week and continue for slightly over a year. This is the best laying period and eggs tend to increase in size until the end of the egg production cycle.

Body weight. In general, optimum body weight during the laying period should be

around 1.5 kg, although this varies according to breed. Underweight as well as overweight birds lay eggs at a lower rate. Proper management and the correct amount of feed are necessary in order to achieve optimum body weight.

Laying house. The laying house should be built according to local climatic conditions and the farmer's finances. A good house protects laying birds from theft, predation, direct sunlight, rain, excessive wind, heat and cold, as well as sudden changes in temperature and excessive dust.

Lighting schedule. Egg production is stimulated by daylight; therefore, as the days grow longer production increases. In open houses, found commonly in the tropics, artificial lighting may be used to increase the laying period. When darkness falls artificial lighting can be introduced for two to three hours, which may increase egg production by 20 to 30 percent.

In closed houses, where layers are not exposed to natural light, the length of the artificial day should be increased either in one step, or in a number of steps until the artificial day reaches 16 to 17 hours, which will ensure constant and maximized egg production. Effective day length should never decrease during the laying period.

Feed. Nutritional status affects egg production. Fresh and clean water should always be provided, as a layer can consume up to one-quarter of a litre a day.

Culling. Culling is the removal of undesirable (sick and/or unproductive) birds, from the flock. Culling enables a high level of egg production to be maintained, prevents feed waste on unproductive birds and may avert the spreading of diseases.

Climate. The optimal laying temperature is between 11° and 26° C. A humidity level above 75 percent will cause a reduction in egg laying. When the temperature rises above 28° C the production and quality of eggs decrease. Seasonal temperature increases can reduce egg production by about 10 percent.

Management factors. Effective and efficient management techniques are necessary to increase the productivity of the birds and consequently increase income. This entails not only proper housing and feeding, but also careful rearing and good treatment of the birds.

Vaccination and disease control. Diseases and parasites can cause losses in egg production. Vaccinations are administered to birds by injection, water intake, eye drops and spraying. Clean and hygienic living quarters and surroundings may eliminate up to 90 percent of all disease occurrences.

Collection of eggs. Frequent egg collection will prevent hens from brooding eggs or trying to eat them and will also prevent the eggs from becoming damaged or dirty.

Culling of layer birds (differentiating good layers and poor layers)

Culling is the removal of undesirable (sick and/or unproductive) birds, from the flock, to optimize profits. There are two methods of culling:

- Mass culling, when the entire flock is removed and replaced at the end of the laying cycle and
- Selective culling, when the farmer removes individual unproductive or sick birds.

Culling enables a high level of egg production to be maintained, prevents feed waste on unproductive birds and may avert the spreading of diseases. Culling is practised on the basis of outward appearance or available records.

Culling on the basis of moulting: moulting refers to shedding and renewal of feathers. The pattern of moulting provides some indication about the laying capacity of the bird. Good layers moult late, complete moulting quickly, and may continue laying even during moulting. Poor layers start moulting early, take a long time to complete moulting, and do not lay eggs during the moulting period.

Culling on the basis of appearance: The main phenotypic characteristics to distinguish between a good layer and a poor layer are given below

Character	Good layer	Poor layer
Comb and wattles	Full, red, waxy, warm, and velvet-like	Dry, hard, cold, coarse and shrunken with white scabs
Beak	well curved, worn-out and less yellow	Very long, thin, sharp, pointed, yellow
Eyes	Bright and alert	Dull and sleepy
Ear lobes	Full, waxy and velvet-like	Shrunken, wrinkled and coarse
Pelvic bones	Usually spread apart more than 2 fingers, thin and pliable	Practically close together, thick and stiff
Abdomen	Large, spread 3-5 fingers, soft and less of fat	Small- usually less than 2 fingers, hard and more of fat
Crop	Nearly always full	May or may not be full
Vent	Full, large and moist	Small, dry and puckered

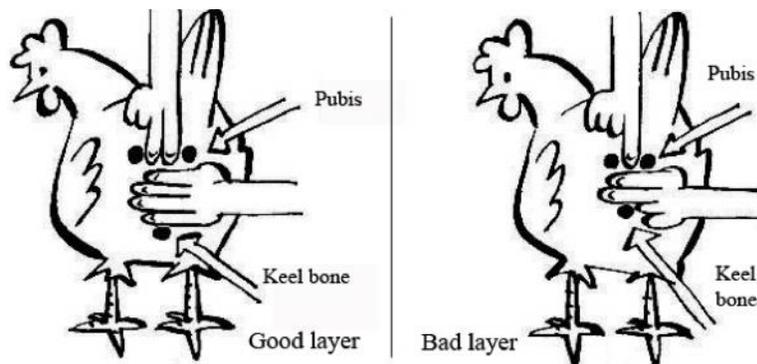


Fig. 14 - Differentiating good and poor layer

Standards of egg production

Standards for Weight Classification of Shell Eggs

Sl. No	Size	Weight per egg(g)
1	Extra large	60 and above
2	Large	53 to 59
3	Medium	45 to 52
4	Small	38 to 44

AGMARK standards for marketable eggs

Grade	Weight (g)	Shell	Air cell	White	Yolk
A-Extra large	60 & above	Clean, unbroken and sound, shape normal	Up to 4 mm in depth practically regular or better	Clear reasonably firm	Fairly well centred, practically free from defects outline indistinct.
A-Large	53-59				
A-Medium	45-52				
A-Small	38-44				
B-Extra large	60 & above	Clean to moderately, stained, sound and slightly abnormal	8 mm in depth, may be free and slightly bubbly	Clear, may be slightly weak	May be slightly off centred, outline slightly visible
B-Large	53-59				
B-Medium	45-52				
B-Small	38-44				

Layer Production Indices

- 1) **Egg production:** The egg industry has two principal methods of measuring daily, weekly, and total egg production i.e. the hen-day and hen-housed systems. Expected performance of layers: Egg production up to 72 weeks age– 320 eggs / bird

- a) **Hen-day production:** This is arrived at by dividing total eggs laid in the season or in a particular period by the average number of birds in the house. Due allowance is made for mortality and culling. HDEP is usually expressed in percentage. It reflects the production capacity of the available birds in the house. A farm average of 85% or more per year is desirable. This figure is higher than hen-housed average.
 - b) **Hen-housed average:** This is the figure derived from the total number of eggs laid by a flock divided by the number of birds in the flock at onset of lay. HHEP values of 80% or 295 or higher are desirable. From a cost of egg production standpoint, HHEP is good as it measures the effects of both egg production and mortality. If there is no mortality during a period, the HDEP and HHEP are equal.
- 2) **Feed efficiency (Feed conversion ratio – FCR):** Already dealt in unit 3.

Managemental practices for producing good quality eggs

Breed. The breed of the laying hen affects qualities of eggs. Though it may not always be possible, a consistent policy of selection for breeds by egg producers can bring noticeable improvements to quality.

Feed. Egg quality and composition derive primarily from what a layer is fed. A balanced ration has to be fed in adequate amounts to get good quality eggs. Yellow maize, alfalfa meal, and fresh grass provide good pigment sources for a normal yellowish-orange yolk colour.

Housing and Management. Good general management of the laying flock can improve egg quality. In deep litter system, use nest boxes. Provide dry, clean litter material and nesting material. Avoid over-crowding.

Disease control. Diseases have an effect on egg quality. Birds continue to lay poor quality eggs even after recovery from certain diseases. Effective vaccines should be administered. Isolate and treat sick birds promptly.

Handling/collecting eggs. Frequent collection is essential each day in order to limit the number of dirty and damaged eggs and also to prevent the hens from eating the eggs. Careful handling is necessary in order to avoid breakage. Cool eggs before packing. Store at proper temperature and humidity to preserve quality. Market eggs frequently.

Management of Breeders

Breeding flock are transferred from grower houses to breeder houses at 18-20 weeks of age

Methods of Mating

The most common methods of mating are pen mating and flock mating. Stud mating and artificial insemination are also used.

- a) **Flock mating:** also called mass mating. In this method, a number of males and females are bred together in a large poultry house. Pedigree records are not maintained. One male per 10-12 females for egg-type stock, and one male per 8-10 females for meat-type stock.
- b) **Pen mating:** a pen of hens is mated to a single male. If the birds are trap-nested, and the hen's leg-band number is recorded on the egg, it is possible to know the parents of every chick hatching from a pen mating. Male-female ratio is nearly the same as in flock mating.
- c) **Stud mating:** females are mated individually with a male in a coop or pen. The birds should be mated at least once every week to maintain good fertility. this method is used when hens are kept in laying batteries, or when a very valuable male is used as a breeder. This system involves more labour than flock mating.

Artificial insemination in chicken:

When birds are housed in cages, mating is done by artificial insemination. Although semen can be diluted, undiluted semen is very often used immediately after collection. Insemination is first done on first and second day, and thereafter, at 4-5 days interval. Insemination is usually done in the afternoon, when hard-shelled egg is not in the uterus.

Trap nesting: A trap-nest is a laying nest so arranged that after a hen enters it, it is confined until an attendant releases it. It provides opportunity to study egg size, colour, texture and shape, and production intensity and persistency.

MANAGEMENT OF BROILERS

A broiler or 'fryer' is a young chicken of either sex below 8-10 weeks of age weighing 1.5-2.0 Kg body weight, with tender meat, soft, pliable, smooth textured skin and flexible breast bone cartilage. Broiler chicken are bred and raised specifically for meat production.

General guidelines for broiler management

Provide 925 cm² floor spaces per broiler birds. Provision must be made for adequate ventilation. The basic principles of broiler raising are similar to the chicken farming for egg production. However, there are some differences as far as the birds

are used for broiler production, their feed, housing and other managerial requirements. Provide 5-10 cm linear feeder space per bird. Raise the level of the feeder as the birds grow. Do not fill the feeder more than half full. Debeak the birds in the first week if necessary. Provide for 100 chicks the following drinking space. 0-2 weeks, 2 x 2 liters capacity waterers. Three weeks to finish, 2 x 5 litres capacity waterers. Ensure clean fresh water always. Exercise extreme care and attention during the brooding period. If the losses in the first few days exceed 2%, carefully check brooding management and get the postmortem examination done.

Nutrient Requirements

Under intensive management, the birds are fed commercial mixtures containing cereal grains, oil meals, rice polish, salt, mineral supplements, vitamins, and other feed additives. Poultry feed pellets are also commercially available. Maize, soya bean meal and fishmeal combination are universally adopted in poultry feed mixtures. Some greens such as alfalfa may be additionally offered. Layers require additional calcium supplementation. An adult layer may consume about 100-120 g mash per day. Breeding stock may require 120 g daily. The starters require 20-50 g per day, while the growers require 50-80 g per day. Broiler starters require 60 g of commercial feed per day, and finishers require about 100 g feed per day. Nutrient requirement for broilers and layers as per BIS specifications are given below.

Practicals

1. Setting up a brooder using locally available materials

Aim - set up a brooder for 250 chicks and practise proper brooder management

Materials required- brooder house, chicks, litter material, chick feeder and waterer, brooder guard, hover, bulbs and connection materials, atmospheric thermometer

Procedure

In deep litter system provide 700 sq.cm per chick for 8 weeks. In a hover with 1 m diameter 250 chicks can be reared. The hover can be placed at appropriate height by hanging it from roof. The temperature required for brooding is 1 watt per chick. Five 60 watt bulb is enough for a unit of 250 chicks. Position of hover is normally 50 cm above the ground.

The requirement of temperature decreases as chick grows it can be measured using an atmospheric thermometer. In the first week it is 35°C, 2nd week 32°C, 3rd week 29°C and 4th week 26°C. Normally brooding is practised for first month only.

The distribution of chicks under the hover is better indication of warmth in the brooder.

If temperature is low chicks huddle together under the light source and move away from the light source if temperature is high. Uniform distribution of chicks under the hover indicate optimum temperature.

2. Poultry house equipment

Aim - Select suitable feeders and waterers for different age groups of poultry

Materials required - different types of waterers and feeders

Activity

1. Illustrate the different types of waterers and feeders with pictures. Also write the function and capacity of each equipment.
2. Prepare a table showing watering and feeding space for different age groups of chicken

Assessment Activities

1. Set up a brooder for 250 chicks with locally available materials.
2. Illustrate the distribution of chicks under the hover in high, low and optimum temperatures inside the brooder.

TE Questions

1. In a brooder house you noticed that chicks are standing near the chick guard away from the light source.
 - a. Comment on the temperature status in the brooder (2 score)
 - b. How can you rectify the temperature problem (2 score)
2. To increase the profitability of your poultry farm, you plan to cull the non-economical hens from the flock. How will you distinguish the poor layers from the high producing birds? (6 score)
3. State whether true or false. If false, correct the statement. (1 score)
Debeaking is recommended for grower between 20 and 26 weeks of age.
4. Studying the relationship of the first pair of words, fill up the following. (1 score)

Chick stage : 1 - 8 weeks
Grower stage :
5. A breeder wants to practise pedigree breeding. Suggest the most suitable mating method which can be employed. (1 score)
6. Prepare a leaflet on the different factors affecting the comfort of chicks in a brooder. (5 score)

7. The floor space requirement for broilers is _____ (1 score)
8. What are the management practices to be followed to produce good quality eggs? (5 score)
9. In a poultry farm the egg production has been reduced considerably during March – April. What all management practices can help to reduce this problem? (5 score)
10. List out the factors affecting egg production (5 score)
11. Differentiate dubbing and debeaking (2 score)
12. Which is the method of sexing that can be used in any strain of chicken at dayold stage? (1 score)
13. When the temperature rises above _____ the production and quality of eggs decrease.
a) 28°C b) 26°C c) 32°C d) 30°C (1 score)
14. List out the factors affecting egg quality. (3 score)

UNIT 5: SELECTION OF EGGS AND HATCHERY MANAGEMENT

Introduction

This unit deals with topics like structure of egg, egg quality, candling and selection of eggs. It also provides basic information about incubation of eggs and hatchery management.

Learning outcomes

The learner;

- ❖ Illustrates and identifies the parts of an egg
- ❖ Identifies abnormal chicken eggs
- ❖ Assesses the quality of chicken egg and grade as per quality
- ❖ Selects good quality eggs for hatching
- ❖ Selects the required incubation method
- ❖ Prepares the incubator for proper incubation
- ❖ Practises routine hatchery activities

Concepts

Selection of Egg and Hatchery Management

Structure of an egg

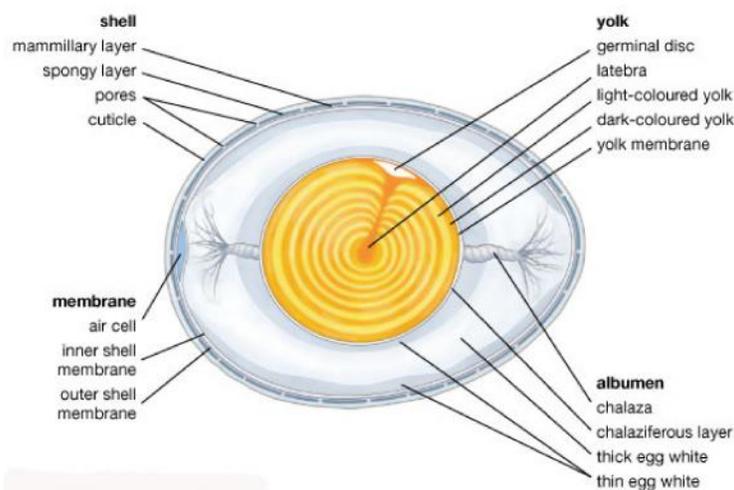
The chicken egg consist of the following parts viz., shell, shell membranes, albumen, yolk

Approximately, the shelled egg contains 11 % shell, 58 % albumen and 31 % yolk.

1. **Shell:** It is an outer hard covering of an egg and is made up of calcium carbonate. It provides protective covering to liquid protein. It helps in gaseous exchange of developing embryo through 6000-8000 pores present throughout the egg. Shell is loosely covered with cuticle which partially blocks the entrance of micro-organism in the egg. A shell thickness of 0.31mm is considered as optimum for chicken egg.
2. **Shell membrane:** There are two membranes, one surrounding inner surface of shell is the outer membrane and the other surrounding the albumen/white is inner membrane. These two membranes become separated at broad end soon after the egg is laid, to form the air cell.

3. **Albumen/ Egg white:** There are at least 4 layers of albumen viz-

- Chalaziferous layer
- Inner thin albumen
- Middle thick albumen
- Outer thin albumen



Immediately surrounding the yolk and adhering to Vitelline membrane (membrane covering the yolk) is a layer of very dense white called chalaziferous layer. This is prolonged towards either ends of the yolk to form two whitish convoluted strands, called chalazae. Surrounding this chalaziferous layer is inner thin albumen, which is covered by a layer of dense albumen referred as middle thick albumen, which form 40-60 % of total egg white. Surrounding the thick white is narrow fluid layer called as outer layer of thin albumen.

4. **Yolk:** It is yellowish ball like structure enveloped in egg white. Colour varies from light pale to reddish yellow in colour depending mainly on dietary pattern of hens. The yolk or the ovum is enclosed in a transparent membrane called Vitelline membrane. There are 7-9 concentric rings of light and dark yolk material. There is a neck like structure called latebra which holds the germinal disc (blastodisc in case of infertile eggs and blastoderm in fertile eggs) in place. Egg yolk contains carotenoid pigments which give colour to the yolk, but they do not contribute to the nutritional value of the egg.

Abnormal/ Defective eggs

Approximately 2 % of all chicken eggs have some defect ranging from minor, barely noticeable faults to alarming deformities. Some of the common defects are:

- Double yolked eggs
- An egg within an egg
- Pale yolk eggs
- Soft shelled eggs
- Meat spot
- Blood spot



Fig. 16 - pale egg, blood and meat spot

Double/ multiple yolk eggs: These are more common with pullets just coming into lay. This happens when more than two ova matures and gets released at the same time.

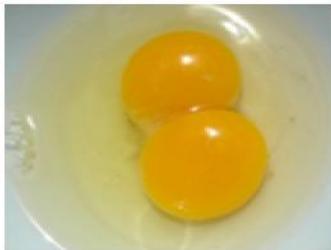


Fig. 17 - Double Yolk Eggs

An egg within an egg:- due to the reverse peristaltic action of the oviduct, the early formed eggs go back to the infundibulum and the oviduct will again secrete the egg white, shell membrane and shell over first formed eggs.

Pale yolk eggs: - Due to the lack of yellow to red pigments in the feed. Hens who have access to the outdoors or green food such as grass and hens who are fed with maize will have deeper coloured yolk.

Meat spot: blood clots in the albumen due to the bleeding in the oviduct. The colour of meat spot may vary from pale yellow to dark brown or red. This defect commonly seen in older birds.

Blood spot: It is a yolk quality problem. Blood spot can range from small spot of blood on yolk to a spoonful of blood mixed with egg content. Egg yolks forms and mature in the hen's ovary. Sometime the blood clots in the yolk due to the rupture of blood vessels in the ovary during ovulation.

Soft shelled eggs: These eggs are laid with incomplete shell or with a thin layer of calcium may be due to immature shell glands or due to nutritional deficiencies such as calcium, phosphorus, selenium and vitamins (E, B12 etc).



Fig. 18 - Egg within an egg



Fig. 19 - Soft shelled egg

Candling and grading of eggs

Candling is examination of eggs before a light source. It may be desirable to test incubated eggs for fertility or embryo mortality. Usually candling can be done twice during incubation. First candling is done on 7th day of incubation. Two classes of eggs can be removed on the basis of first candling- 'infertile' and 'early dead'.

The live embryo is spider like in appearance during the first few days, the body of embryo representing the body of spider and radiating blood vessels, its legs. The live embryo floats about freely in the content of the egg when the egg is rotated before the candling lamp. The early dead can be recognized by the absence of blood vessels, by its adhering to the shell or by the pink rings called the blood rings surrounding it. The infertile egg appears to be clear except for a floating shadow which is distinguished as yolk.

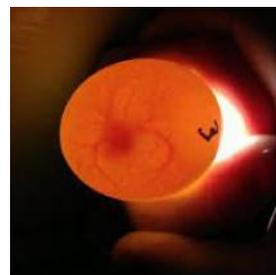


Fig. 20 - candling

Second candling is done on 18th day of incubation. The live embryo appears nearly to fill the egg. Blood vessels will be noticed and the chick embryo will frequently be seen to move when the egg is rotated.

Grading

Grading is the classification of eggs into different categories. It aids in reducing wastage and facilitates uniform packing, pricing and quality assurance to the consumers. Egg grading involves inspection of the shell for cleanliness and

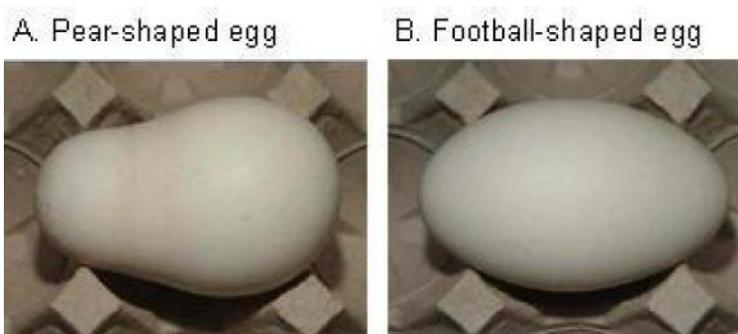


Fig. 21 - Abnormally shaped eggs

soundness; checking internal quality such as firmness of albumen, position of yolk, blood and meat spots and size of air cell and sorting them into categories on the basis of weight. Eggs can be individually flash candled to detect the above defects. The standard for table eggs is given below.

Based on quality of shelled egg

Quality factor	Grade A	Grade B
Shell	Clean unbroken and normal shape	Clean to moderately stained, abnormal shape
Air cell	4 mm or less in depth and regular	8 mm or less in depth may be free or bubbly
Albumen	Clear and firm	Clear slightly weak
Yolk	Well centered, free from defects	Slightly off centered

Selection of hatching eggs

Hatching eggs should be selected with care because certain abnormalities adversely affect hatchability. Therefore eggs that have characteristics associated with poor hatchability should be discarded. Some important characters for selection of hatching eggs are size, shape, shell quality and interior quality.

Size of eggs - Egg size is related to hatchability. Extremely large and small eggs do not hatch well. Therefore medium sized eggs should be selected for hatching (50-55 g). The portion of thick white is high in very large eggs and low in very small ones which interfere with normal hatchability.

Shape of eggs - The shape of hatching egg should be ovoid. Eggs of abnormal shapes do not hatch well. However, eggs that are only slightly off shape, ridged or wrinkled generally hatch as good as normal shaped eggs, though they are more prone to breakage during incubation. Therefore, preference is for eggs of normal shape.

Shell quality - Eggs with sound shell should be selected. The quality of shell is related to hatchability because the shell serves as a protective cover, provides a means of gaseous exchange and supplies necessary calcium for developing embryo. Calcium nutrition of the bird will affect the shell thickness; it also declines during the hot weather. Thin shelled eggs do not generally hatch well due to increased evaporative loss during incubation. Besides, there are more losses due to breakage of eggs having thin and weak shells. Therefore, care must be exercised in the selection of eggs for hatching and only those with strong and normal shell should be selected. Clean eggs hatch better than soiled eggs because soiling substances seal the pores of the shell, interfering with air movement through the shell to embryo. Dirt may harbor microorganisms, rendering eggs more prone to spoilage. Slightly soiled eggs could be dry cleaned and used for hatching while excessively soiled ones are not suitable.

Interior Quality - Interior quality can be assessed by candling. Eggs with good interior quality, showing an indistinct yolk shadow, small air cell and good albumen condition upon candling should be chosen for hatching to obtain good results.

Methods of Incubation

There are two methods of incubation usually practiced,

- Natural method - In this method eggs are incubated with the help of broody hens.
- Artificial method - Eggs are incubated in egg incubators.

Natural incubation method- This method is still popular with small poultry keepers in remote rural areas in many parts of tropics. Broodiness, the desire to hatch out young ones out of eggs is a natural instinct in female birds. This behavior is made use of in natural incubation. A broody hen used for incubating eggs should be healthy, quiet, a good sitter and have good body size. She may be tested with the help of dummy eggs for her interest to sit on eggs. She should be treated for internal and external parasites before allowing her to sit on eggs.

A saucer - shaped nest made of bamboo basket or wooden box filled with bedding materials should be provided at safe and comfortable place. Depending upon the size of broody hen, 10-15 eggs can be placed under one bird. The hen should be taken out at least twice a day for about 30 minutes to be fed and watered. During the hot summer days it may be necessary to sprinkle the eggs with small quantity of water to maintain the humidity. The hen will take care of newly hatched chicks, if they are left to hen.

Artificial incubation method - artificial method of incubation of eggs are known to man for more than 2000 years and the earliest record of artificial incubation are from China and Egypt.

Incubation periods of various species of poultry:

Chicken	- 21 days
Duck	- 28 days
Muscovy duck	- 35 days
Turkey	- 28 days
Guinea fowl	- 28 days
Quail	- 18 days

Types of Incubators

1. **Sectional type:** The sectional type incubator is usually of small capacity; from 50-500 eggs with single layer incubation. Depending on the air movement, they are known as still air type because there is practically no air movement in this type of incubators. In such units, heat is generally transmitted by conduction inside the egg chamber either through hot water tanks or hot air tubes. Temperature is controlled by a thermostat and humidity is maintained by water pan kept inside the incubator. Ventilation provided through air vents (which consist of air inlets and exhaust).
2. **Cabinet type:** They are also called as forced draft incubators because the air is evenly distributed with the help of mechanical draft (by a fan) inside the egg cabinet. The trays set with eggs are kept one above the other so that more eggs can be incubated in a limited space. The arrangements for temperature control, humidity and ventilation are by thermostat, humidistat and air inlet and exhaust respectively. The turning of eggs is either mechanical or automatically carried out. The arrangement of setter and hatcher trays could be made in the same machine or in different machines as per model of manufacturers.

Physical requisites for incubation

Five major functions involved in the incubation and hatching of poultry eggs. They are

- Temperature
- Humidity
- Ventilation (oxygen and carbon dioxide level)
- Position of egg
- Turning of eggs

Temperature - Control of temperature is the most critical single factor for the successful hatching of chicken. Developing embryos are extremely sensitive to temperature of environment. Temperature has an effect not only on hatchability but also on quality of hatch. It has a direct effect on time taken for hatching, embryo size, embryo mortality and viability of chicks produced. Species of birds vary in their temperature requirement for incubation. The optimum temperature for chicken egg in the setter ranges from 99.5 °F – 99.75 °F and hatcher 98.5 °F.

Humidity - Incubation humidity determines the rate of moisture loss from egg during incubation. In general humidity recorded as relative humidity by comparing humidity recorded in wet bulb and dry bulb thermometers. Recommended humidity in setter

is ranging between 55 - 60% and in the hatcher 65 - 75%. Higher humidity during hatching period is given to avoid dehydration of chick. Slight errors in maintaining humidity in either setter or in the hatcher will not be as detrimental as fluctuations in temperature.



- | | |
|-------------------------|--------------------------|
| 1. Wet-bulb Thermometer | 8. Work Light |
| 2. Dry-bulb Thermometer | 9. Air Cool |
| 3. Primary Heater | 10. Contact Thermometers |
| 4. Secondary Heater | 11. Control Panel |
| 5. Fan | 12. Air Outlet |
| 6. Gunny Curtain | 13. Glass Window |
| 7. Water Cooler | 14. Lock |
| | 15. Side Door |

Fig. 22 - Parts of an incubator

Ventilation (oxygen and carbon dioxide level) – Ventilation is important in incubators and hatchers because fresh oxygenated air is needed for the respiration of developing embryos from egg setting to removal of chick from incubator. The oxygen needs are lessened during the first few days compared to the latter stage of development. Generally the oxygen content of the air in the setter remains at about 21%. For every 1% drop in oxygen there is 5% reduction in hatchability.

Carbon dioxide is a natural by-product of metabolic processes during embryonic development and is released through the shell. The tolerance level of CO₂ for the first four days in the setter is 0.3%. CO₂ levels above 0.5% in the setter reduce hatchability and completely lethal at 5%.

Position of eggs- artificially incubating eggs should be held with their large ends up. It is natural for the head of the chick to develop in the large end of the egg near the

air cell. When the egg is incubated with small end up, about 60% embryo will develop with the head near the small end. Thus when the chick is ready to hatch, its beak cannot break into the air cell to initiate pulmonary respiration and frequently these embryos not hatch. Under normal cases eggs are set with broad end up for first 18 days and a horizontal position for the last three days.

Turning of eggs – Eggs are to be turned at least 8 times a day in artificial incubation. Turning of eggs during incubation prevents the developing embryo adhering to the extra embryonic membrane and reduce the embryo mortality. In large commercial incubators eggs are turned automatically in each hour. Turning is not required in hatcher.

Physical requirements of incubation

Temperature (°F)	Chicken eggs	
	Setter	Hatcher
	99.5-99.75	98.5
Humidity (%)	55-60	65-75
Turning	6-8 times a day	No turning
Oxygen (%)	21	21
Carbon dioxide (%)	Below 0.5	Below 0.5
Position of egg during incubation	Broad end up	Horizontal
No. of days eggs are kept in the incubator	18	3

Hatchery operations

The operation of a chick hatchery involves the production of largest number of quality chicks possible from the hatching eggs received in the hatchery. The sequences of hatchery operations followed in commercial hatcheries are,

Collection of eggs-frequency of hatching eggs collection is very important to maintain quality. Hatching eggs should be collected at least 4 times a day. Hatching eggs are susceptible to contamination and effort must be made to reduce the microbial load. So wash the hands and sanitize before collecting eggs from nest. The flats that eggs are placed on must be sanitized.

Selection of Eggs- Eggs that are cracked, dirty or misshapen are usually not used for hatching. Very small and very large eggs do not hatch. Eggs with thin or very porous shells do not hatch because of excess loss of water during incubation.

Fumigation- A desirable practice is to fumigate the incubator between hatches. Potassium permanganate method is commonly used. For this, 20 g. of potassium

permanganate is taken in a shallow pan and 40 ml. of formalin is added and door is closed for 3 hours while the incubator is working. This is sufficient for every 100 cubic feet (2.8m³) incubator space. Before fumigation, all egg trays should be cleaned with disinfectant solution and place inside the incubator. Humidity level of the Incubator should be maintained high at the time of fumigation. The air vents particularly exhaust of the incubator should be closed first before fumigation. After fumigation is completed the exhaust are opened to let out residual gas. Care should be taken in handling the formalin since it is irritating to the eyes and skin.

Cold storage - Important points to be considered during the storage of hatching eggs are

1. **Temperature:** The optimum temperature for holding hatching eggs is 10-12°C. Too high or too low temperature during storage results in poor hatchability.
2. **Humidity:** The optimum humidity for storage of hatching eggs ranges from 75-80 per cent.
3. **Handling:** Hatching eggs should be held small end down and handled carefully. Hatching eggs should not be held for more than a week, but if they are required to be held longer, they should be turned at regular intervals.
4. **Age of eggs:** Eggs held at 10-12°C can be stored for one week, thereafter, hatchability declines progressively.

Warm eggs prior to setting - Approximately 6 hours prior to placing eggs in the setter, they should be moved from egg cooler room to normal temperature.

Candling - Candling is examination of eggs before a light source. It may be desirable to testing incubating eggs to check fertility or embryo mortality. Usually candling can be done twice during incubation. First candling is done on 7th day of incubation. Second candling is done on 18th day of incubation.

Setting/Loading of eggs - placing eggs in the setter is called Setting/Loading of eggs. Eggs can be set in the setter either all-in all-out basis or batch basis. Most of the commercial hatcheries practicing batch system of loading eggs.

Transfer of eggs - In modern incubators eggs are transferred from setter to hatcher at 19th day of incubation or when approximately 1% of eggs are slightly pipped.

Taking out chicks - Chicks should are be removed from the incubator as soon as all hatched out and about 95% are dry.

Identification – can be done either by leg banding or by wing banding.

Sexing of chicks: Two methods of sexing are there.

1. Vent method: Squeeze the vent region of day old chicks, ever the cloaca examine the rudimentary process. Male chicks will have pin head size papilla in the vent.
2. Auto sexing: Done with the help of sex linked characters such as rapid/ slow feathering and barring/ non-barring.

Vaccination - most of chicks are vaccinated against Marek's disease in hatchery before the delivery. Most common method of vaccination of day old chicks is by subcutaneous method in the nape of neck.

Dubbing and debeaking –dubbing is the process of removal of comb. Sometimes the large combs of hens commonly used for egg production are injured, particularly when hens are housed in cages. This injury can be avoided by dubbing. Debeaking is the process of cutting of one-third portion of upper beak. Beak properly cut at hatching will usually not re-grow to the point where pecking can be serious

Chick delivery- Baby chicks should reach the customers farm early in the morning. Not only the weather is cooler during this period of the day but also the early arrival allows a full day for close observation of chicks by the care taker.

Washing and cleaning - cleaning the hatchery between hatches is of primary importance. For the setter and setter room, every piece of equipment must be thoroughly vacuumed, scrubbed, disinfected and fumigated.

Disposal of waste – Hatchery waste sinclude infertile and non-hatched eggs, dead and culled chicks that should be disposed in such a manner not create problem to the neighbours and also not to contaminate hatchery premises.

Practicals

Candling of eggs

Aim - evaluate the internal quality of eggs for selection.

Materials required - egg candler, clean eggs, dark room, egg trays.

Procedure

1. Place the egg candler in a dark room properly and switch on.
2. Hold the egg at the candling aperture with air cell upwards.



Fig 23. Individual candler

3. Examine the shell and air cell for any abnormalities.
4. Then give a quick turn of egg as the motion enables to identify any abnormalities in the internal contents of egg like meat spot, blood spot etc.
5. Candling helps to identify fertile eggs by the presence of germinal disc.

Assessment Activities

1. Select the good quality eggs for incubation from the given lot by candling method. (Assess the shell, air cell, albumen and yolk quality)

TE Questions

1. In a hatchery you are directed to select good quality fertile eggs for incubation
 - a. Write the name of the process used for this purpose (1 score)
 - b. Explain about the process (3 score)
2. Draw and label the parts of a chicken egg (5 score)
3. During candling of a table egg, you have noticed a red coloured spot in the egg yolk. What condition do you suspect and mention other such abnormalities of an egg. (5 score)
4. Prepare a point card on physical requisites for successful incubation.(3 score)
5. Differentiate the setting of egg in a setter and a hatcher (3 score)
6. As part of your school PTC project, you are going to candle a few hatching eggs. Explain the criteria you will look into for assessing the quality of those eggs. (5 score)
7. In an organized farm, birds are provided with minced green grass. What may be the scientific reason behind this practice? (2 score)

UNIT 6 DISEASES OF POULTRY

Introduction

This unit provides basic awareness about bacterial, viral, fungal, protozoan, parasitic and nutritional deficiency diseases of chicken. It also deals with basic concepts of health care management.

Learning outcomes

The learner;

- ❖ Identifies major bacterial diseases from symptoms for proper health care
- ❖ Identifies major viral diseases from symptoms for proper health care
- ❖ Identifies major fungal diseases from symptoms for proper health care
- ❖ Identifies major protozoan diseases from symptoms for proper health care
- ❖ Identifies major parasitic diseases from symptoms for proper health care
- ❖ Identifies major deficiency diseases from symptoms for proper health care
- ❖ Describes the control and preventive measures for diseases under field conditions
- ❖ Performs vaccination of poultry
- ❖ Disinfect the poultry shed, hatchery and equipment

Concepts

Bacterial diseases

1. **Pasteurellosis (Fowl cholera)** - Caused by *Pasteurella multocida*.

Symptoms - High mortality rate, with good body conditions and no signs in per acute cases. In acute cases symptoms include depression, anorexia, mucus discharges from orifices and fowl smelling greenish diarrhoea. Chronic cases are seen in birds that had survived the acute form. Symptoms include depression, dyspnoea, conjunctivitis, swelling of wattle.

Prevention and control - Medication, vaccination, rodent control etc.

2. **Pullorum Disease**- Caused by *Salmonella pullorum*

Young chicks are commonly affected with high mortality rate.

Symptoms – Depression, tendency to huddle, respiratory distress, weight loss, soiled vent, white viscous chalky diarrhea and sudden death.

Prevention and control – Slaughter of carriers, routine serological testing of breeding stock, hatchery hygiene, rodent control.

Viral diseases

1. **New Castle Disease (Ranikhet disease)** - It is an acute highly contagious rapidly spreading viral disease caused by Paramyxo virus type 1.

Symptoms - In acute cases birds die without any visible symptoms. In sub acute form symptoms include depression, greenish diarrhea, cyanosis of comb, paralysis of wings, neck and legs. Birds adopt a peculiar posture with head beneath their wings, drop in egg production etc. Prevention and control – Vaccination

2. **Infectious Bursal Disease (IBD)** - It is also called Gumboro Disease.

It is an acute contagious disease caused by Birna virus. Bursa-a lymphoid organ situated above the cloaca is severely affected.

Symptoms - Depression, white watery diarrhea, soiled vent, anorexia, ruffled feathers, reluctance to move. Prevention and control - vaccination.

3. **Fowl pox** - It is caused by Fowl pox virus. It is largest virus known in birds.

Symptoms - Nodular proliferative skin lesions in non feathered parts like head, neck, feet, and legs, poor weight gain and poor egg production.

Prevention and control-Vaccination prevents the disease. Control of mosquitoes is necessary to check the spread.

4. **Marek's disease** - It is a highly contagious disease caused by Herpes virus. Symptoms are vague. Affected birds show depression before death. A transient paralysis syndrome with a characteristic posture of one leg held forward and the other backward is seen. Enlargement of feather follicles is also noted. Tumor may develop in liver, gonad, skin, kidney, eye and bursa. Prevention and control - vaccination.

5. **Avian influenza (Fowl Plague)** - Caused by Orthomyxo virus.

Symptoms - Low pathogenic avian influenza virus causes respiratory signs such as ocular and nasal discharge, sinusitis etc.

Mortality increases by secondary bacterial infections, other viral infections and stress. High pathogenic avian influenza virus causes high mortality. In per acute conditions no signs are seen. In acute cases cyanosis and edema of head, comb and wattle, blood tinged oral and nasal discharges are seen. In severely affected birds greenish diarrhea is common. Survived birds show torticollis and incoordination

Prevention and control - vaccination.

Fungal diseases

Aspergillosis (Brooder pneumonia) – Caused by *Aspergillus fumigatus*. Infection is not transmissible, but acquired by inhalation of spores, contamination of equipment result in hatchery infection.

Symptoms – laboured breathing, gasping, yellow to greenish nodules (saucer shaped lesions) are seen in lungs and airsacs.

Prevention and control

- a. Proper sanitation of hatchery, egg holding room, incubator and chick holding room.
- b. The litter should be always dry. Built up/caked litter should be removed to prevent fungus.
- c. Fresh feed should be given; feed wastage in litter and old feed in feeders should be avoided.
- d. Copper sulphate at the rate of 1 : 2000 concentrations can be used in drinking water as a preventive measure.

Protozoan Diseases

a. Coccidiosis

It is a host specific disease caused by a group of intracellular parasites mainly affecting intestinal tract of chicken. 9 species of coccidial parasites in chicken produce 9 distinct diseases. Disease occurs after ingestion of sporulated oocysts by birds. Recovered and infected birds shed oocysts in their droppings.

Symptoms - In young birds bloody droppings and high mortality. In adults drop in feed consumption, egg production, emaciation etc.

Prevention and control-

- a. Vaccination
- b. Anti coccidial drugs.
- c. Better management including proper hygiene and sanitation.

Parasitic diseases

1. Endoparasites

- a. **Ascariasis** - caused by *Ascaridia galli*. It is the largest nematode of poultry. Symptoms - high parasitic load causes unthriftiness, poor growth and lower productivity.

- b. **Caecal worms** - *Heterakis gallinae* is common caecal worm in chicken. They are small round worms 1.2-1.9 cm long found in tip of caeca. No obvious symptoms are produced. But they larvae of *H. gallinae* act as carriers of the organism causing blackhead disease in turkey which is a serious disease of turkeys. So it is not advisable to rear chicken and turkey together.

Prevention and control - anthelmintics can be used.

2. **Ectoparasites** - They are mites, ticks, lice etc. Some of them act as vectors and others cause irritation and suck blood.

Prevention and control - good management and sanitation, insecticides can be sprayed or dusted over surroundings and birds.

Nutritional deficiency diseases

1. **Nutritional roup** - due to Vitamin A deficiency. Symptoms include mucoid discharge from eyes and nasal passages, decreased growth in chicks and lowered egg production in layers. Cod

Liver oil, fish oils, liver meal, green grasses etc. are good sources of Vitamin A.

2. **Rickets** - due to deficiency of Vitamin D, calcium and phosphorus. Symptoms include lameness, stiff leg, swollen hocks, rubbery beak, drop in egg production etc. Fish oils, sunlight, ultra violet light, synthetic Vitamin D are good sources.

3. **Nutritional encephalomalacia (crazy chick disease)** – due to Vitamin E deficiency. Symptoms include incoordination of movement, convulsions, paralysis of legs and death. Green grass, vegetable oil, liver meal, legumes, synthetic Vitamin E are good sources.

4. **Curled toe paralysis** - due to Riboflavin (Vitamin B2) deficiency. Symptoms include poor growth, paralysis of legs, inward curling of toes, and tendency to walk in hocks. Liver meal, milk byproducts, young grasses, rice bran, molasses. Synthetic Vitamin B2 are good sources.

Prevention of diseases

Vaccination

No single vaccination programme can be regarded as ideal which will provide a high degree of protection under all circumstances.

Precautions at vaccination

- Sound management practices should be followed to minimize vaccination stress.

- Vaccination should be done only when the flock is perfectly healthy
- Use freshly obtained vaccine that has been stored properly.
- Keep all vaccines under refrigeration and follow the directions of manufacturers.
- All the birds in poultry house should be vaccinated at the same time.
- Vaccination should be done during cool hours of the day.
- Keep proper record of vaccines used.



Fig 24. Automatic vaccinator

Vaccination schedule

Age of vaccination	Vaccine used	Route of administration*
0 th day of hatch	Marek's Disease vaccine	i/m or s/c
5-7 days	RDF	Intraocular or intranasal
12-14 days	IBD	Intraocular or intranasal
28 th day	IBD	Drinking water
35 th day	Fowl cholera	s/c
6 week	Fowl pox	i/m or s/c
8 week	R2B	s/c

* i/m – intramuscular, s/c – subcutaneous

Deworming - The birds should be dewormed starting one week prior to Ranikhet disease vaccination *ie.*, before 8 weeks of age. Then it should be repeated at three weeks interval so as to give a total of 4 deworming before housing at 20 weeks of age.

Treatment - Proper treatment of affected flock should be done as per the instructions or under the supervision of qualified veterinarian.

Litter management - Total height of the litter should optimum, maintained dry turned frequently and mixed with lime.

Biosecurity Measures

Bio-security denotes all measures designed to prevent the spread of disease onto your farm.

The following bio security measures can be adopted to ensure better prevention and control of diseases.

- Fencing.
- Keep visitors to a minimum.
- Limit visits to other poultry farms.
- Keep all animals and wild birds out of poultry houses.
- Practise sound rodent and pest control program.
- Inspect flocks daily and recognize disease symptoms.
- Good ventilation and relatively dry litter.
- Keep areas around houses and feed bins clean.
- No exchange of feed and equipment.
- Disinfection and sanitization of poultry house and equipment.
- Fumigation of poultry houses using formaldehyde and potassium permanganate.
- Use foot baths before entering hatchery and poultry sheds.



Fig 25. Foot bath

Screening tests - Periodic screening of birds as per the instructions of qualified veterinarian for better flock health.

Hatchery management

- Only clean eggs should be collected for hatching.
- Hatchery should not be located near poultry farms, poultry processing units and other hatcheries.
- Incubators should be located in a separate room with “no admittance” sign at door.
- Each year before the season starts all the equipment should be thoroughly cleaned and fumigated.
- Hatchery should be designed to permit one way flow of traffic from egg room to incubators to hatcher to chick holding room.

Practicals

Immunization of poultry against prevalent diseases

Aim- (1) Practise subcutaneous vaccination in poultry under the supervision of veterinary surgeon (2) Prepare a table showing vaccination schedule of chicken.

Materials required- chicken, 2ml syringe, vaccines, cotton, antiseptic solution

Procedure

1. Hold the bird properly and expose the medial side of wing to prepare the vaccination site.
2. Take required quantity of vaccine in a sterile 2 ml syringe.
3. Rub the antiseptic solution with cotton in the wing web.
4. Place the needle parallel to the skin and Insert it into the subcutaneous area avoiding blood vessels.
5. Inject the required dose of vaccine and a bleb is formed under the skin. Take out the needle slowly and release the bird.

Vaccination schedule

Age of vaccination	Vaccine used	Route of administration*
1 st day of hatch	Marek's Disease vaccine	I/M or S/C
1-7 days	RDF	Intraocular or intranasal
12-14 days	IBD	Intraocular or intranasal
28 th day	IBD	Drinking water
35 th day	Fowl cholera	S/C
6 week	Fowl pox	I/M or S/C
8 week	R2B	S/C

* I/M – intramuscular, S/C – subcutaneous

Assessment Activities

1. Prepare a chart showing the vaccination schedule of chicken from 0-8 weeks of age

TE Questions

1. Match the following (4 score)

a. Crazy chick disease	-	Vit A
b. Rickets	-	Vit B
c. Curled toe paralysis	-	Vit D
d. Nutritional roup	-	Vit E
2. There is an outbreak of Ranikhet disease in a nearby farm. Describe the various bio-security measures to be adopted to prevent the spread of disease into your farm? (4 score)

3. Choose the odd one (RD, IBD, MD, Pullorum disease) (1 score)
4. Pick the odd man out. Also state the reason. (2 score)
(Salmonellosis, Mareks disease, Coccidiosis, Curled toe paralysis)
5. Data on vaccination schedule of poultry are shown below. Match accordingly. (5 score)

Vaccine	Route of vaccination	Age of vaccination
Fowl pox vaccine	Intramuscular	day old
Mareks vaccine	Intranasal	7 days
R.D.F	Pin prick	6 weeks
Pigeon pox vaccine	Intravenous	8 weeks
R2B/R.D.V.K	Skin swabbing	2 weeks
	Subcutaneous	6 months

6. Identify the disease from given symptoms
 - (a) Young birds showing depression, huddling, white chalky diarrhoea
 - (b) Nodular proliferative skin lesions in non feathered parts of fowl, poor weight gain and egg production.
 - (c) Birds show a posture of one leg held forward and other backward, greenish diarrhoea and depression before death
 - (d) Young birds show bloody dropping, high mortality (4 score)
7. Match the disease and causative agent correctly

Fowl cholera	-	Orthomyxo virus	
IBD	-	Aspergillus flavus	
Fowl plague	-	Birna virus	
Brooder pneumonia	-	P. multocida	(4 score)
8. Name any two endoparasites of poultry (2 score)
9. is a common protozoan disease of young chicken (1 score)

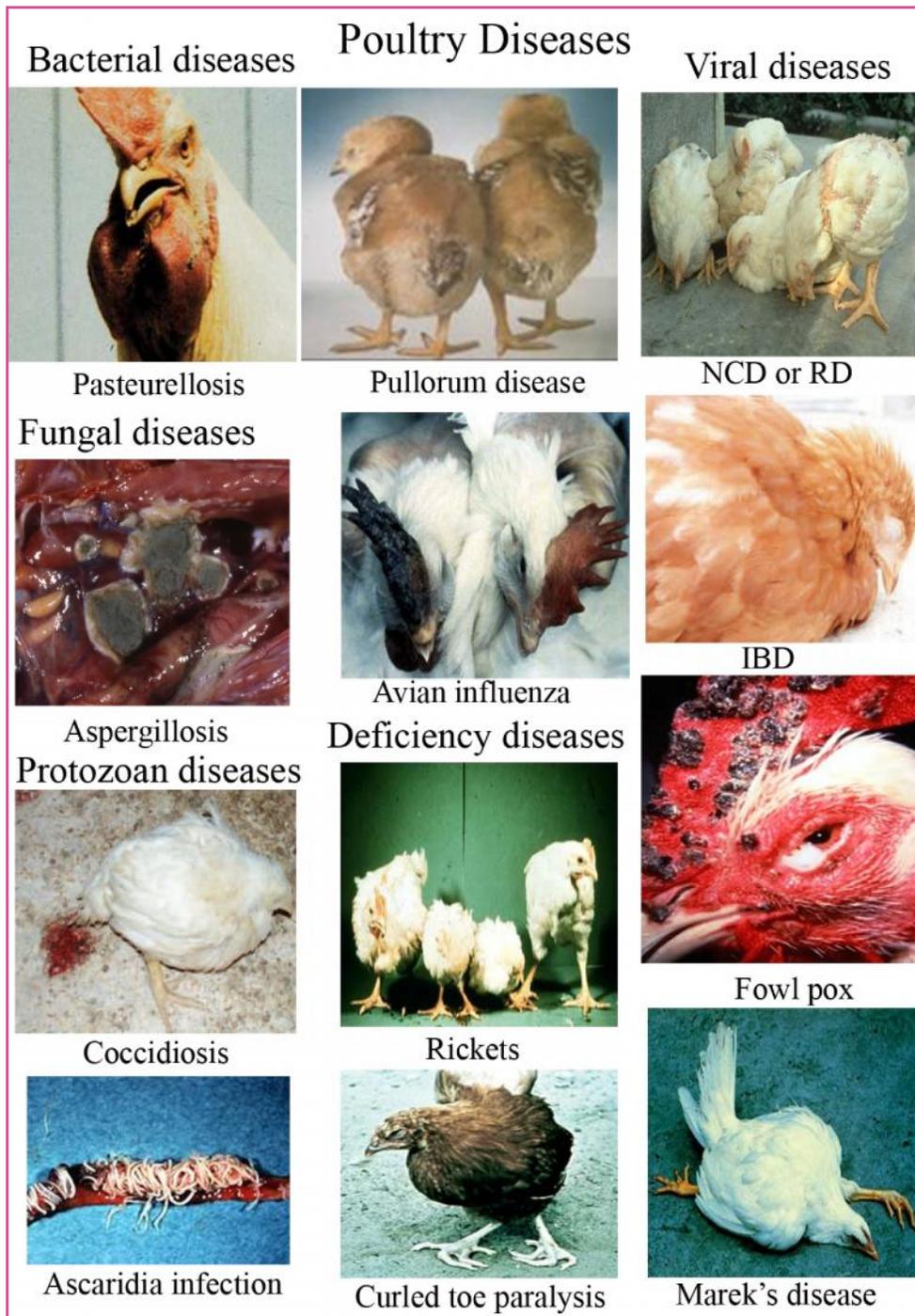


Fig. 26. Poultry diseases

UNIT 7

REARING OF DUCK, TURKEY AND QUAIL

Introduction

This unit includes fundamental concepts of husbandry, disease control and health care of duck, turkey and quail.

Learning outcomes

The learner;

- ❖ Explains the rearing of ducks
- ❖ Identifies major duck diseases from symptoms
- ❖ Explains the rearing of turkey
- ❖ Identifies major turkey diseases from symptoms
- ❖ Explains the rearing of quail
- ❖ Identifies quail disease from symptoms

Concepts

Husbandry of ducks

Popular duck breeds:

Meat purpose – White Pekin, Muscovy, Aylesburry

Egg purpose – Khaki Campbell, Indian runner

Dual purpose – Kuttanadan ducks – Chara and Chemballi

Advantages of duck rearing

1. Ducks lay around 50 eggs more than that of chicken in one year of production.
2. Duck eggs are 10-20 g heavier than chicken eggs and hence fetch better price.
3. Ducks can be maintained economically even during second year of laying.
4. Easy management.
5. Ducks can be reared in marshy and swampy areas.
6. Cannibalism is not pronounced in ducks.
7. Ducks lay eggs before 6 am.
8. Ducks do not require elaborate housing.
9. Ducks are resistant to many diseases of chicken.

10. Ducks feed on natural feed sources like snails, water plants etc and so feed cost is less.
11. Ducks are quiet intelligent and can be trained to go to the fields and come back in the evening of their own.
12. Ducks are well suited to many integrated farming systems.

Housing, feeding and management of ducks

Brooding - Due to their rapid growth, ducklings will need heat a shorter period of time, and floor space requirements will increase more rapidly. The temperature under hover should be 30°C for the first few days. It can be reduced by about 3°C in every 2-3 days till it reaches room temperature. Confine the birds to the heated area with a chick guard for the first 3 to 4 days. Watch the actions of the ducklings as a clue to their comfort. If they are too hot, they will move away from the heat. If too cold they may pile up and be noisy. High temperatures may result in slower feathering and growth. By 4 weeks of age, the ducklings should be feathered enough to be outdoors.

Housing - Ducklings may be brooded either on litter or in battery brooders. At about 4 weeks of age they can be let out if to be reared on semi intensive system. Under intensive system ducks can be reared on litter or slat floor or a combination. The waterers should be deep enough to enable the ducks to immerse their head. A depth of 13-15 cm will suffice for this purpose.

Egg production - Ducks start lay at the age of 20 weeks and peak production is obtained 5-6 weeks after commencement of lay. An average duck egg weighs 65-70 g. A photoperiod of 14 hours is considered optimum for inducing high egg production. Layer ducks require nest boxes at the rate of one box for every three layers. Provide floor level nest boxes. Eggs may be collected as soon as they are laid to prevent excessive loss of moisture and to avoid microbial load.

Feeding - Ducks are voracious eaters and hence restricted method of feeding is common. Layer ducks can be fed with mash or pellets. Wet mash feeding is practised as there is difficulty in swallowing dry mash. They waste great deal of dry mash by swilling in drinking water. Pellet feeding is most ideal for ducks. Ducklings may be provided a feed having 20 % protein for the first 3 weeks. The protein content may be reduced to 18 % thereafter.

Breeding - Breeding drakes should be 4 - 5 weeks older than females for maximum fertility. The male: female ratio may be 1: 8 in layer type ducks and 1: 5 in meat type. Normally they mate in water and so it is better to provide a small pond for the

breeder ducks. Eggs for hatching should be collected from flocks that are in lay for about 6 - 8 weeks. Collection of eggs may be started 10 days after introduction of male.

Incubation of duck eggs

The ducks do not brood and so duck eggs can be placed under broody hen for natural incubation. Artificial incubators can be also used. To improve hatchability dirty eggs can be washed using warm water at 27- 38°C to which a detergent sanitizer and disinfectant are added. Washed eggs should be dried and fumigated immediately. Hatching eggs should be stored at a temperature of 14 - 16°C with a relative humidity of 80 %. Eggs can be incubated in forced draft incubator with the same temperature for chicken. However the humidity requirement is higher. This can be achieved by sprinkling lukewarm water from the 2nd to 23rd day of incubation. Eggs should be turned at least 4 times daily up to 24th day of incubation. On 24th day eggs should be transferred to hatcher. The incubation period of duck egg is 28 days except in Muscovy where it is 35 days.

Sex differentiation

1. Drake will be larger in size than a female duck.
2. Drakes will have an upwardly and inwardly curled feather above the tail called drake feather which is absent in females. This feather will become noticeable in male ducks when they are 2 - 4 months old.
3. In some breeds like Chara, the drakes will have distinct lustrous greenish black feathers on head, while females have uniform dull colour.
4. Male ducks produce a soft sound whereas females produce a harsh sound.
5. Vent sexing may be done in ducklings by experienced person.

Diseases of ducks and health care



Fig 27 - Male and female duck



Fig 28. Drake feather in males



Fig 29. Drake feather

1. Pasteurellosis

Causative agent – The bacteria *Pasteurella multocida*

Adult birds are more affected than young stock. In per acute form of the disease large numbers of birds in a flock are found dead in good body condition. In acute form loss of appetite, mucus discharge from orifices and diarrhoea may be seen. In dead birds pin point haemorrhages are seen in internal organs. Vaccination is the effective method for the control of this disease.

2. Duck plague / Duck viral enteritis

Causative agent - Herpes virus.

The mortality rate is more than 90% in 1-5 days. Death occurs rapidly in previously healthy appearing birds. Symptoms include droopy head and wings, blood around the vent or bills, pasted eyelids and watery diarrhoea. In dead birds multiple tissue haemorrhages and free blood in body cavities or intestine may be seen. Once exposed, birds can become carriers. Vaccination is effective for control.

3. Duck viral hepatitis

Causative organism – Duck hepatitis virus type I of Picorna family.

Young ducklings of 2 days to 3 weeks age are mostly affected. Mortality may be over 90% in ducklings. Affected ducklings become lethargic, fall on their sides, paddle the legs and die. The head is usually stretched upwards and backwards. Death usually follows within an hour of the onset of symptoms. In the liver haemorrhages are seen. Vaccines are available for the control of this disease. The disease is not stated to be prevalent in India.

4. Aflatoxicosis

It is a condition caused by aflatoxin produced by the fungus *Aspergillus flavus* in the feedstuffs such as groundnut, maize and other tropical feeds on storage. Improper drying of grains, rain and warm humid weather favour the mould growth. Ducks are very susceptible to aflatoxin content in the feed. Out of the four types of aflatoxins commonly found B1 is the most toxic. The minimum toxic dose for ducks is 0.03 ppm in feed. Aflatoxin affects liver and results in death when present in high concentration. Lower doses produce chronic effects such as poor growth, poor feed efficiency, decreased resistance to other diseases and delayed death. There is no specific treatment for aflatoxicosis. When the source of aflatoxin is removed from the feed, birds make rapid recovery. Aflatoxicosis can be prevented by eliminating fungal growth in feeds. As far as possible ground nut cake in duck rations should be avoided as it is more prone to the growth of this fungus.

Vaccination schedule for ducks

Age	Vaccine	Dose & Route	Revaccination
4 weeks	Duck Pasteurella vaccine	0.3ml I/M in leg muscle	0.5ml I/M in leg or breast muscle at every 6 months interval
6 weeks	Duck plague vaccine	0.5ml S/C in wing web	--
12 weeks	Duck plague vaccine	0.5ml S/C in wing web	Annual

Husbandry of Turkey

Housing, feeding and management of Turkeys

Turkeys are mainly reared for meat. Broad breasted bronze, Beltsville large white and Beltsville small white are the common varieties of turkey. Turkeys can be reared in deep litter or range system. In deep litter system floor space requirement is 1m²/ adult bird for large varieties and 0.81m² for small varieties. The general management remains more or less same as that for chicken. Turkey poults require special care during the first few days of brooding. They require double the space compared to chicken. Turkeys attain 4kg body weight at 12 - 14 weeks of age and by 20 - 24 weeks it reaches 8 - 9 kg. Optimum marketing age is 12 - 14 weeks as the feed efficiency reduces thereafter. Due to their fast growth turkey poults need almost 28 % protein initially. Turkeys similar to chicken lay their eggs during the day time.



Fig 30. Turkey egg

- The average age at first is around 30 weeks.
- The average egg production is 70 - 100eggs /hen turkey /year.
- The average egg weight is 85 g.
- Incubation period is 28 days.

Under natural mating fertility is usually low and hence artificial insemination is commonly employed in turkeys. Breeding birds need a 13- 15 hour light per day during laying season. Turkeys are vaccinated against New Castle disease and fowl cholera usually.

Sex differentiation

- Males are heavier than females
- Mature males have black beard below the neck in the upper breast region.

- Dewbill or snood (fleshy appendage near the base of beak) is relatively large, plump and elastic in males. It is small, thin and non-elastic in females. Also the red fleshy protuberances called caruncles are well developed in males.
- The sexes can be separated by vent system of sexing at the time of hatching.



Fig 31. Male and Female White Turkey

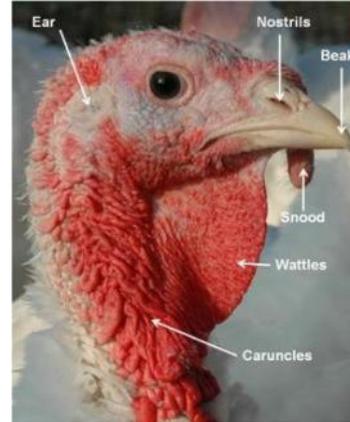


Fig 32. Head of male turkey

Diseases of turkey and health care

Pasteurellosis / Fowl cholera

Causative agent – The bacteria *Pasteurella multocida*
 Adult birds are more affected than young stock. The disease is sudden in onset and the mortality may be 50% or more. In turkeys acute pneumonia of one lung is seen with the affected lung becoming solid and dark. Affected flock may be slaughtered if possible. Otherwise antibiotic therapy along with vaccination is done.

Husbandry of quail

Advantages of quail rearing

1. Short generation interval (3 - 4 generations per year)
2. Early maturity (start egg production by about 6 weeks of age)
3. Low feed requirement (about 25 g of feed per quail per day)
4. Very low floor space requirement (8 -10 quails can be housed in the place for one chicken)
5. High rate of lay (280 eggs / quail / year)
6. Early marketing age for meat purpose (5 weeks of age)
7. High nutritive value of egg and meat.

Housing, feeding and management of quail

Quails can be grown both under cage and deep litter systems of management. Brooding is almost similar to that of chickens. Day old quail chicks weigh around 7 g. During brooding water should be given in shallow dishes to prevent quail chicks

from drowning. The floor space suggested is 75 cm² / chick under the hover and 75 cm² / chick as run space. Quails reach sexual maturity at around 6 weeks of age and weigh around 150 g. Adult quails can be housed in multi bird colony cages providing a floor space of 150-200 cm² / bird. For laying flock a photo period of 16 hours is desirable for good egg production. Most of the eggs are laid between 3 – 7 pm. Quail eggs weigh around 10g. The incubation period is 18 days. Eggs have a variety of colour pattern with white or buff mottled with black, brown and blue. The egg shell is very thin and therefore breaks easily. Good fertility can be obtained with a male: female ratio of 1: 2 or 3. Optimum fertility is obtained when the age of breeding flock is 6 months or less.

Feeding – Quail chicks can be fed with a mash containing 27 % protein upto the end of 3 weeks of age and 24 % protein from 4th week of age. The layer quails should be fed with a ration containing 22 % protein from 6th week of age. Feed required upto 5 weeks of age is about 400 g per chick.

Adult quails require about 25 g feed per day.

Sex differentiation

1. Females are slightly heavier than males
2. Females have black speckles on the throat and upper breast while males have rusty brown throat and breast feathers.
3. Male quails produce a peculiar sound which is absent in females.
4. Males produce a white foamy secretion from their cloacal gland. This is not seen in females.



Fig 33. Male and female Quail



Fig. 34. Breast feathers of quail



Fig. 35 - Male cloacal foam

Diseases of quail and health care

Quails are resistant to many diseases of chicken and so no vaccination or deworming are done in quails.

Quail disease / ulcerative enteritis

Causative agent – The bacterium called *Clostridium colinum*.

Ulcerative enteritis affects quails, chickens and other gallinaceous birds. The disease is characterized by ulcers of the intestines and caeca. Predisposing factors include coccidiosis, IBD and overcrowding. Symptoms include watery white faeces, loss of appetite and huddling. It can cause high mortality in bobwhite quails.

Practical activities

Sex differentiation in duck, quail and turkey

Aim - to differentiate male and female birds for the flock

Principle

Sex differentiation in ducks

1. Drake will be larger in size than a duck.
2. Drakes will have an upwardly and inwardly curled feather above the tail called drake feather which is absent in females. This feather will become noticeable in male ducks when they are 2 - 4 months old.
3. In some breeds like Chara, the drakes will have distinct lustrous greenish black feathers on head, while females have uniform dull colour.
4. Male ducks produce a soft sound whereas females produce a harsh sound.
5. Vent sexing may be done in ducklings by experienced person.

Sex differentiation in quails

1. Females are slightly heavier than males.
2. Females have black speckles on the throat and upper breast while males have rusty brown throat and breast feathers.
3. Male quails produce a peculiar sound which is absent in females.
4. Males produce a white foamy secretion from their cloacal gland. This is not seen in females.

Sex differentiation in turkeys

1. Males are heavier than females.

2. Mature males have black beard below the neck in the upper breast region.
3. Dewbill or snood (fleshy protuberance near the base of beak) is relatively large, plump and elastic in males. It is small, thin and non-elastic in females.
4. The sexes can be separated by vent system of sexing at the time of hatching.

Activity

Differentiate male and female poultry (duck, quail, turkey) based on above characters

Assessment Activites

1. Collect the pictures of male and female poultry (duck, quail, turkey) and prepare a chart.

TE Questions

1. Your neighbour decides to start a quail farm. How can you help him for differentiating male and female quails? (3 score)
2. Mould growth in ground nut cake leads to the production of _____ which causes liver damage in ducks. (1 score)
3. Name a protozoan disease of turkey? (1 score)
4. In Kuttanad area of Kerala, lots of unused marshy places are seen. Duck rearing is a possible opportunity in such places. Enumerate the natural advantages that make ducks the suitable species. (2 score)
5. List out the characteristics of quail which makes them commercially more popular than chicken (4 score)
6. Match the following

a) Fowl cholera	-	Herpes virus	
b) Duck plague	-	<i>Clostridium colinum</i>	
c) Duck virus hepatitis	-	<i>P. multocida</i>	
d) Ulecerative enteritis	-	picorna virus	(4 score)
7. Prepare a chart listing the characters for sex differentiation in turkey. (3 score)
8. Mention the requisites for successful incubation of duck egg. (3 score)

UNIT 8 HUSBANDRY OF PET BIRDS

Introduction

Ornamental/Pet birds are those birds reared in houses for fun and companionship. They are very colourful, playful and fanciful as some of them can mimic human sounds and can even memorize words from many languages. They are expensive too which makes them a source of money for farmers as a full time business.

Learning outcomes

The learner;

- ❖ Identifies and differentiate common pet birds for suitable purposes
- ❖ Describes the management practices used for pet birds
- ❖ Identifies major diseases of pet birds from symptoms

Concepts

Common types of pet birds

- (1) **Parrots/Parakeets:** Parrots are beautiful, playful and some mimic human sounds. They are characterized by long life span. Parrot group is composed of African grey parrots, Macaws, cockatoos, budgerigars, love birds, cockatiels, conures etc.
 - (a) **African grey parrots:** Originated from central Africa and have a size of about 36 cm. They are very intelligent and very talented in mimicing human speech. They are very close to their owners and cannot stand rejection. Life span is 50 years. Incubation period of eggs – 28 -30 days.
 - (b) **Macaws:** Macaws are characterized by large area of essentially bare facial skin on either sided of the head. They don't mimic but can be trained in small tasks. Macaws show a strong tendency to become one-person pets, and this can present a great problem when purchasing a tame adult bird that is used to its surrounding. Blue and gold macaws are popular in Kerala. Originated from Argentina and have a size of 89 cm. Incubation period of egg is 28 days. Life span: 50 - 60 years.
 - (c) **Cockatoos** are large birds which can be instantly recognized by their crests, which are raised when



Fig. 36. Facial skin

the birds are excited or alarmed. They have extremely strong, heavy bills. They have a life span of about 100 years. Popular ones are sulphur crested cockatoo.

- (d) **Cockatiels** are gentle birds from Australia with melodious whistling sound, colourful crests and great speech imitation capacity. Many varieties are there like grey, pearl, white faced and cinnamon cockatiel.
- (e) **Conures** are from South America and can be easily domesticated. They cannot stand rejection and can turn aggressive. They are intelligent birds with good capacity to mimic. The most popular one in Kerala is Sun conure with yellow plumage and green feathers under the tail and wings.
- (f) **Parakeets** are small parrots with long tail. Indian ring necked parakeet, Malabar parakeets and Plum headed parakeets are from India and are popular.

- (g) **African love birds:** Very colourful and similar to budgies. Originated from Australia. Love birds are small parrots with short tail. Size is about 13-15 cm. Very difficult to differentiate sexes. Despite their name lovebirds can prove extremely aggressive, especially when breeding, and for this reason it is safer to keep pairs on their own. Popular breeds are peach faced love bird, blue masked love bird.



Fig 37. African love birds

- (h) **Budgerigars/budgies:** Most popular pet birds all around the world. Budgies are super colourful parrots with long tail, originated from Australia. Their length comes around 18 cm. They have pale violet markings on cheek. Below that marking there will be three black markings on each side. Females will fight with other females but not with male who they pair for life. Life span is around 5 - 8 years. Incubation period of eggs is 21 days. Male budgies can mimic human sound to a great extent.



Fig 38. Throat spots in budgerigars

- (2) **Doves and Pigeons:** Doves and pigeons belong to the family columbidae. Pigeons are larger in size while doves are smaller. Popular varieties are,

- (a) **Diamond dove.** Originated from Australia. They have grey colour, white spots on wings. During breeding season, male doves develop red rings around eyes. Length: 13.5 cm. incubation period: 13 days. Other varieties of doves include red turtle doves, laughing dove with sound like a laugh, mourning dove etc. Among different varieties of pigeons, popular ones are fantails, kings and pouters.



Fig. 39. Diamond dove

- (b) **Fantail pigeons** are most popular for shows and as pets. The tail resembles a fan and so the name.
- (c) **King pigeons** are from Germany. They may grow up to 0.5-0.75 feet in height. Most expensive too.
- (d) **Pouters** are characterized by their air filled crop region which appears like a “bulb”. Several varieties are there like English pouter, Saxon pouter etc. Female pigeons lay eggs by 8th month and the incubation period is usually 18 days.



Fig.40. English pouter

- (3) **Finches:** The birds of this particular group are categorized by their dependence on seed as a major item in their diet. Thus they are described as ‘hardbills’ possessing beaks able to crack seeds. These birds do not become tame or learn to talk like parrots. Finches ranks among the least expensive and most freely available birds.
- (4) **Fancy chicken breeds:** Fancy breeds of chicken are smaller in size and have peculiar feathers which amuse people with their beauty. Both the birds and their eggs are costly. Although there are many fancy chicken breeds worldwide, only a few breeds are popular in India viz., Frizzled, Silkie, Polish, Bantams, Sultan etc.
- (a) **Frizzle** is of Asian descent and is purely an exhibition breed. It is docile, poorly mobile and not a good layer. The plumage of the Frizzle curls tightly backwards towards the head.
- (b) **Silkie** is an Asian bird that makes a great pet due to its stunning appearance with distinctly fluffy feathers and great gentle nature. Need shelter as

their feathers are not waterproof. They have five toes on each foot and outer two toes feathered. Their skin, beak, bones and meat are atypically bluish-black in colour. Various colours are available like black, white, blue, grey, white etc.

- (c) **Polish** originated from Netherlands. The Polish have a magnificent crest of feathers, which often resembles a hat/cap that covers almost the entire head of the bird. In addition to the crest, they have a small V – shaped comb and white ear lobes. They may be bearded or non-bearded. They also lay few white eggs and do not display broodiness. Black, blue, buff, golden, white, silver varieties are there.



Fig. 41. Different types of pet birds

Housing, Feeding and Management of Pet Birds

Preparation of Cages/aviary

Cages should be constructed according to the requirements of each species of bird. The following factors should be considered while caging of pet birds,

- Proper ventilation.
- Shade.
- Protection from natural enemies.
- Spacious and group housing: Commercial cages are available but it is not good for permanent habitation. Such small cages will not be having enough space for group housing of birds and it will lead to boredom due to loneliness.
- Away from street: In places near streets, headlights of vehicles may cause discomfort to bird which should be avoided.
- Avoid problems to neighbors as some birds are chatter boxes.
- Smoke/foul smell should be avoided.

Caging requirements

Cage can be made entirely of wire. It provides visibility but less protection for birds from draft and disturbances. For Small parrots 2×3×4 ft per pair and for larger parrots, 4×4×4 ft per pair are required. Box cage is an opaque box constructed with thin wood or metal with the front fitted with bars. Such a cage provides security for the bird and is simple to construct. In the case of pigeons wooden cages with small doors kept at a height on stands or hanging baskets can be used. The cage should have a floor that is easy to remove and clean without danger of the bird escaping during the procedure. The cages should be cleaned once in a week. Birds should be shifted to another small cage and cages cleaned using bleaching powder or 1 % formalin. After this the cages again washed in clean water and should be kept in direct sunlight for atleast 4 hours. To prevent caged birds from getting bored, toys can be provided. The only thing that can be put in with large parrot-type birds is stainless-steel chains with bells; anything else will be destroyed. Mirrors, chains with bells, and ladders can be put in with smaller birds such as budgerigars, canaries and finches. The cage should be inspected for sharp points or edges that can cut or injure the bird's tongue or feet.

Currently, instead of cages, aviaries with large spaces for the birds to freely fly around are constructed in gardens. In aviaries different compatible species of birds

can be reared in groups which are helpful for breeders with different varieties of pet birds. This also facilitates easy cleaning. Such an aviary consists of a flight space and a shelter. The frame for flight space can be made of wood or of metals such as angle iron or pipes. Wire netting can be fixed to this frame. Eight feet or more is a good height for an aviary. The door into the flight space should be only about 4 feet height to avoid persons entering suddenly and frightening the birds. Concrete floors are preferred for aviaries. Perches should be provided in aviaries. Perches should be placed at a height, the same height as far as possible and should not be placed one above the other. Perches should have rough surfaces. Perches made from natural twigs or branches cut from non toxic trees are much better than the artificial ones. Parrots could destroy wooden perches and should be replaced. Plastic perches are available which are hard but uncomfortable for birds. Finches should have rectangular cages to allow long horizontal flight as flying in a circular pattern is unnatural to the finch and may cause undue stress. Aviaries can be beautified using creeping plants which also attract small flies/insects thus serving as food for the birds.

Feeding of Pet Birds

Depending on the nature of feed material preferred pet birds are divided into three groups (1) grain eaters like doves/pigeons and parrots (2) honey drinkers like myna (3) insect/worm eaters like finches. Common grains used to feed birds are ground nut, linseed, pine seed, pumpkin seed, maize, sunflower seed, millet, rice etc. Feed can fed up to 15 % of body weight of birds. 85 % of feed should be constituted of grains. Feed should also contain enough fat, protein, vitamins, minerals and greens. Amino acids, vitamins and minerals are important for good body conformation and colourful plumage. Vegetables are rich in these nutrients and should be included abundantly especially carrot (rich in vitamin A), pomegranate, banana, cucumber, green chillies, pumpkin and papaya. Raw fruits especially raw bananas impair digestion. Juicy fruits and acidic fruits like passion fruit should be avoided. Small pebbles, marble chips, shell grit, gravel etc. will be eaten by birds for facilitating the grinding of feed materials in gizzard. Rich sources of minerals like cuttle fish bone, shell grit, coriander leaves, thulasi leaves and papaya leaves should be included.

Diseases of Pet Birds

Sour crop: A chick's crop must empty completely once every twenty-four hours. If it doesn't there is good chance that a sour crop could be developing in the chick. Food remains in the crop and will get sour. Causes may be (1) feeding of too thick feed (2) over feeding the chick resulting in overstretching of crop, the crop loses its

ability to push the feed into digestive tract (3) bacterial, viral and fungal infections (4)
foreign body impaction of crop.

Egg bound: Egg binding refers to a common and potentially serious condition where a female bird is unable to pass an egg that may be stuck near the cloaca or further inside the reproductive tract. It is most common in smaller birds such as love birds, cockatiels, budgies and finches. Breaking of egg inside the reproductive tract can lead to infection, if untreated can lead to death. Low calcium levels or hypocalcaemia, limited sunlight, malnutrition/protein deficiency, sedentary life style can lead to this condition. Clinical signs are loss of appetite, depression, abdominal straining, sitting fluffed at the bottom of the cage.

Psittacosis: Psittacosis (Parrot fever/Ornithosis) is caused by a bacterium called *Chlamydia psittaci*. The disease is usually seen in parrots such as macaws, cockatiels, budgerigars, pigeons and many other species of birds. This disease is a zoonotic disease which can spread from birds to aviculturists. Signs in birds include inflamed eyes, difficulty in breathing, watery droppings and green urates. Treatment using antibiotics.

Practicals

1. Identification of different types of pet birds

(a) **Aim-** To identify different types of pet birds

Materials required- photographs, pictures, videos, PowerPoint presentation

Procedure - Spotting

The student should identify the bird and write the salient features.

(b) **Aim-** To differentiate and categorize different groups of pet birds

Materials required- photographs/ pictures, videos

Procedure

The student should categorize the photographs of birds into different categories like parrots, doves/pigeons, budgies, African love birds, finches etc.

Assessment activities

1. Collect the pictures of pet birds and categorize them into different groups

TE Questions

- In which breed of dove during breeding season, males develop red rings around eyes. (1 score)
- Describe the feeding of pet birds in less than half a page (4 score)

3. Arrange the following birds into different categories of pet birds. (3 score)
(Sulphur crested cockatoo, English pouter, Silkie, Blue and gold macaws, Frizzled, King)
4. Identify the breeds of fancy chicken from the following statements. (3 score)
 - (a) Bird with fluffy non water resistant feathers, feathered shank and 5 toes instead of the usual 4.
 - (b) Bird with a magnificent crest of feathers, which often resembles a hat/cap that covers almost the entire head.
 - (c) Bird with Asian descent, plumage curls tightly backwards towards the head.
5. Studying the relationship of first pair of words, fill up (1 score)
 - (a) Psittacosis – *Chlamydia psittaci*
 - (b) Egg bound -
6. Match the following (4 score)

African grey parrot- Black throat markings

Macaws - Mimic human speech

Cockatoos - Large areas of bare facial skin

Budgerigars - Movable head crests
7. Comment on the caging requirements for pet birds in general. (5 score)
8. List out the causes for sour crop in pet birds (3 score)
9. Give reason (4 score)
 - (a) Finches require rectangular cages
 - (b) Small commercial cages are not preferred for pet birds

UNIT 9 MANAGEMENT OF DOGS AND CATS

Overview

A pet is an animal kept for companionship and enjoyment or a household animal. Keeping pets has been shown to help relieve stress to those who like having animals around. Walking a dog can provide both the owner and the dog with exercise, fresh air, and social interaction. Now a day pet rearing has evolved into a business opportunity and is an organized sector with lot of newer and exotic animals being introduced. Dogs and cats still remain as the most popular pet animals.

Learning Outcomes

The learner;

- ❖ Identifies and select suitable dog breeds according to purpose
- ❖ Controls different types of dogs according to purpose
- ❖ Explains the different managemental practices of dog rearing
- ❖ Identifies major diseases of dogs from symptoms
- ❖ Assists vaccination in dogs
- ❖ Identifies important cat breeds
- ❖ Controls different types of cats according to purpose
- ❖ Explains the different managemental practices of cat rearing

Concepts

The dog, *Canis familiaris*, is the only member of the Canidae family that is fully domesticated. Their long association with people has allowed dogs to be uniquely attuned to human behavior as well as thrive on a starch-rich diet. Dogs perform many roles for people, such as hunting, herding, pulling loads, protection, assisting police and military, companionship and, more recently, aiding handicapped individuals. This impact on human society has given them the nickname “man’s best friend” in the Western world. In China and South Vietnam dogs are a source of meat for humans. Worldwide over 400 pure dog breeds are recognized.

Breeds of Dogs

Name	Origin	Type/ Class	Important characteristics	Utility
<p>German shepherd (GSD)</p>  <p>Fig. 42. GSD</p>	Germany	Herding	<p>Large sized, gentle, intelligent, agile. A domed forehead, long square-cut muzzle and black nose. The ears are large and stand erect. The tail is bushy and reaches to the hock. They have a double hair coat. Colour: The German Shepherd dog varies in color, and most colors are permissible. Mostly Tan with black saddle. Pale and faded colors are serious faults and white dogs are disqualified. Life span: 7-10</p>	<p>Also called Alsatian. Fearless, but not hostile. A keen sense of high vigilance, laid the foundation as a “police dog”. One among the best working dogs. Can be trained to do anything. Guide and assistance work for the handicapped, police and military service, herding, search and rescue, drug detection and as faithful companion/family dog</p>
<p>Labrador retriever</p>  <p>Fig. 43. Labrador</p>	Canada and England	Sporting	<p>Medium to large sized, gentle, intelligent, good-tempered and agile. Need exercise. Color: Black, chocolate, or pale cream. Any other color or combination of colors is a disqualification. The body should be strong and muscular with a level top line. The head should be broad with slightly pronounced eyebrows. Short dense hair coat which is water resistant. Typical kind temperament and otter-like tail are characteristic. Life span: 10-13 years</p>	<p>Also called St. John's dogs. A dog bred to perform as an efficient Retriever of game birds while hunting. Most popular breed. Ideal assistance dog for handicapped. Also suitable for tracking and detection, water rescue works and recently therapy work in hospitals, schools. Labradors like to eat, and without proper exercise can become obese. Also become lazy.</p>

Name	Origin	Type/ Class	Important characteristics	Utility
<p>Rottweiler</p>  <p>Fig. 44. Rottweiler</p>	Germany	Working	<p>Medium to Large size. Alert, Good-natured, Obedient, Courageous, Fearless and Confident. Colour: Tan, Black On the chest, a Rottweiler will have two downward-facing triangular marks. A thin strip of black should be present on each of the Rottweiler's toes. Life span: 9-10 years</p>	<p>Rottweilers are now used as search and rescue dogs, as guide dogs for the blind, as guard dogs or police dogs. Have a natural instinct to protect their families and can be ferocious in their defense. If not properly trained and socialized, Rottweilers can become dangerous to everyone.</p>
<p>Doberman Pinscher</p>  <p>Fig. 45. Doberman</p>	Germany	Working	<p>Medium to large, Highly intelligent, energetic and obedient dog with a noble temperament, needs a lot of exercise. Colour: Fawn, Black, Red, Blue, White. Body is square, compactly built, muscular and powerful. Hair coat is short, thick and smooth. Doberman has markings on the chest, paws/legs, muzzle, above the eyes, and underneath the tail. Life span: 10 -14 years</p>	<p>Suited for police and military work, canine sports, excellent guard dog and companion. Suitable for city life, heat and cold. The hair is short, and does not require frequent combing, easy to train, but not easy to get along with other dogs.</p>

Name	Origin	Type/ Class	Important characteristics	Utility
 <p>Fig. 46. Japanese spitz</p>	Japan	Toy , Non-Sporting	Small size, proud, playful, affectionate, obedient and intelligent dog. They are always larger than their smaller cousins, the Pomeranian. Colour: sparkling white hair coat. Pointed muzzle. Erect ears, high set tail is carried curled over the back. Hair coat is double, with a short, soft and dense undercoat, and a straight outer coat that is long and abundant. Life span: 10-14 years	Companion dog. Keen perception and loyal to the master. Ideal companion for older people. Bark of strangers and known for their courage, thus reliable watchdogs. They are a low maintenance breed as dirt does not stick to the coat; do not have the common "doggy odour".
 <p>Fig. 47. Pug</p>	China	Toy, Non-Sporting	Gentle, lazy nature, playful and eager to please the owner; love to be the center of attention. Wrinkly, short-muzzled face, dark eyes and curled tail (The double curl is perfection), compact square body with well-developed muscles. Muzzle is black, with a clearly defined "thumb mark" on the forehead and a black trace down the center of the back Colour: variety of colours like Fawn, Black, Apricot, Silver Fawn, hair coat is fine, glossy. Life span: 12 -15 years	Companion dogs. Pugs are strong willed but rarely aggressive, and are suitable for families with children Obesity is common if not controlled.

Restraining of Dogs

Behaviour of dogs

- The behaviour of dog varies with breed, type of training, previous disagreeable experience and degree of human association. The stray/free roaming dog that has little association with people may bite at the slightest provocation.
- The well-cared-for pet/working dogs are generally docile. The extremely nervous, frightened dog which shows anxious expression, rapid movement of head, constant pricking of the ears to every sound response/movement, pulling of lips back etc can bite the handler.
- The vicious, aggressive dogs will keep their head low and will not look directly to the handler. See the figure for signs of aggression in dogs.
- Rough handling may provoke adverse responses even in most friendly dogs. Dogs should be handled gently. Confidence and calmness are necessary for successful control
- Temperament of a dog may change drastically when it is sick or injured. Such dogs may bite more than a healthy dog.
- Many times the owners may not prove a satisfactory assistant to the handlers.

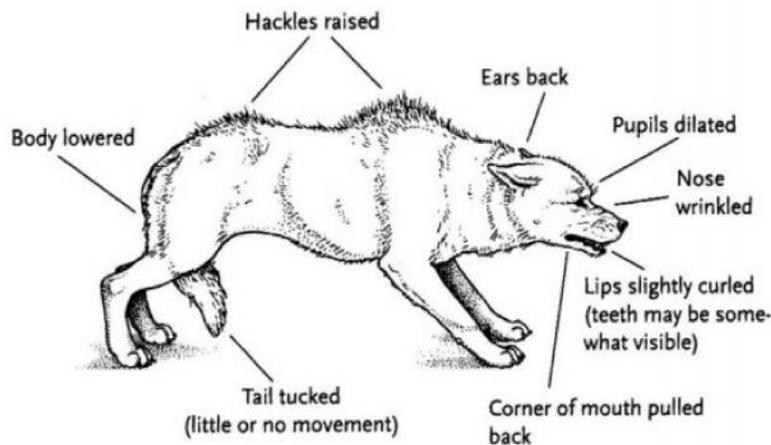


Fig. 48. Signs of aggression in dogs

Approaching and handling

- Always talk to a dog while handling
- The operator should approach from the side rather than directly from the front.
- The frightened or nervous dog should be distracted/confused before handling.

- The operator should sit close to the dog and after calming the dog can proceed further.
- Apply a muzzle or place a towel over the dog to partially blind it.

Using collar and leashes

- Dog collars in addition to restraining can facilitate many functions like identification, kill ticks etc.
- It is virtually impossible to prevent a determined dog from slipping out of the collar.
- The only collar that is truly safe for restraint is a choke chain.



Fig. 49. Dog leash and collar

A nylon cord of 3mm diameter may serve as a leash and used along with choke chain.

- The aggressive, vicious dog may be subdued to administer a sedative by threading the leash through an eye bolt embedded in the wall and pulling the head up tight. Another person grabs the tail or the hind leg and makes a quick intramuscular injection.
- The leash should not be wrapped around a table or chair leg; because a medium sized or larger dog can easily upset a table.
- If an eye bolt is not available, the leash may be slipped through a partially opened door, which is then tightly closed on the leash. The dog is pulled up tightly to the door, which is held shut by the handler outside the door while the second person administers the sedative.



Fig. 50. Choke chain for dogs

Muzzling

- A muzzle can be constructed from a piece of 5 cm gauze bandage or a small cord.
- A loop large enough to cover over the mouth of a dog should be formed with this cord.



Fig. 51. Muzzling - stage 1



Fig. 52. muzzling - stage 2



Fig. 53. muzzling - stage 3

- The loop is applied around both the jaws, rotate so that the knot comes under the lower jaw.
- The free ends of the muzzle should be tied at the back of the neck with a quick release knot.
- With the muzzle properly in place, the dog cannot bite. Snug the knot sufficiently tight to prevent partial opening of the mouth. If the loop is anchored too close to the nostrils, the dog may paw the loop off or the nostrils may be clamped shut. If the dog collapse from hypoxia or vomit while muzzling, quickly release from muzzle.



Fig. 54. Commercial dog muzzle

- During hot environment muzzling for long period should be avoided because the dog's thermoregulatory mechanism involving panting will get prevented by muzzling.
- Commercial muzzles are now available in the market

Elizabethan collars

- Elizabethan collars are broad sheet like collars fitted on the neck to prevent self mutilation.
- Similar collars can be made from sheet of plastic or buckets.



Fig. 55. Elizabethan collar

Selection of pups

1. First it should be decided which type of dog is required - large, medium or small.
2. Choose the breed after giving due consideration to:

- The space available i.e., a backyard or lawn
 - Compound wall
 - The temperament of neighbors
3. Check that the chosen pup has all the breed characteristics.
 4. A healthy pup should have bright eyes, elastic skin, and glossy hair coat.
 5. Watch the litter for the way in which the individual pups behave. Choose the boldest and the loveliest pup. Do not select the one that lags behind or hides.
 6. Avoid pups with discharge from the eyes or nostrils, discharge from ears, pot belly, less than average body weight, those having congenital deformities.
 7. The teeth should be opposed and clamp down on top of each other when the mouth is closed. The gums should be pink in colour. Paleness indicates poor condition.
 8. Examine all the four limbs, count the digits (should be equal in number). Accessory digits, if present, should be removed. Tail should not be broken or crooked.
 9. Pass your hand along the chest region of the pup. Presence of beads at the junction of ribs and sternum is suggestive of rickets.

Grooming: Dog grooming refers to both the hygienic care and cleaning of a dog, as well as a process by which a dog's physical appearance is enhanced for shows or other types of competition. A dog groomer (or simply "groomer") is a person who earns their living by grooming dogs. Grooming is a vital part in the well-being of a dog which can improve their lifespan. All Breeds require daily grooming, how much depends on the breed, age, or health of the pet. It is important to note that while many dogs shed, others such as the Poodle do not shed hairs and so require grooming by a groomer every 6–8 weeks. Tools for grooming include curry brush, Shedding blade, Scissors and clippers, Slicker brushes etc. **Curry Brush:** A tool made of rubber or plastic with short "teeth." The tool is rubbed (or "curried") over the dog's coat to loosen dirt, hair, and other skin debris, and stimulate the skin into producing natural oils. **Shedding blade:** A metal shedding blade with short, dull teeth is used to remove dead hair from certain types of harsh coats. The shedding blade is not used to cut the hair. **Scissors and clippers:** Cutting tools used to remove/shorten hair on certain types of coats or in sensitive areas. **Slicker brushes** are used to smooth the coat and to take out mats and tangles.



Fig. 56. Shedding blade



Fig. 57. Curry combs



Fig. 58. Slicker brush

Feeding of Dogs: It is always better for the individual dog owners to maintain dogs on the food materials ordinarily prepared in the house rather than preparing special food for dogs. Pups are weaned from the dam at 6-8 weeks of age. After weaning, a combination of cow's milk (250 ml), egg yolk (one), glucose (half teaspoon) fed at regular intervals as a substitute for the dam's milk. For two to three days after weaning, the pups will be crying and this crying should not be misunderstood for hunger. They should not be overfed to avoid indigestion. Rusk, fresh bread, good quality dog biscuits, eggs etc. can be fed in early puppyhood. Gradually, change over to the dietary articles by the third month. Feeding frequency is as follows,

1-2 months	-	6 times
2-3 months	-	5 times
3-4 months	-	4 times
4-5 months	-	3 times
5-7 months	-	2 times

Avoid feeding the so called 'dog meat' available from the market or slaughter house as far as possible or at least up to six months of age. Feeding rice in early puppyhood gives pot belly appearance and hence rice should be fed only after three months of age. An adult animal requires one full meal a day. Give the main meal in the afternoon than at night, as the dogs have a tendency to sleep after a heavy meal. The feed shall contain 30% meat and the rest cereals, vegetables, milk, egg, bread etc. Chicken and fish may be fed but the bones should be removed. It is necessary to supplement minerals and vitamins, even from the pre-weaning period. Provide a large bone for the pup to gnaw at. It provides calcium and phosphorus. It also helps to keep the teeth clean and to prevent indiscriminate biting tendency till the permanent teeth erupt. Pregnant bitches will eat more and the diet has to be offered several times each day. For lactating dams, the nutrient requirement depends on number, size and age of pups. The diet should be rich in protein and easily digestible. Feed her 3-4 times a day. Supplement minerals and vitamins to meet the additional requirements

of lactation. Energy requirement is 3 times the maintenance requirement, and protein requirement is 10 g/kg body weight. Fresh drinking water should be made available at all times for pregnant and lactating animals.

Breeding of Dogs

The female dogs will come to 'season' first between 6 and 12 months of age. There are only two heat periods in a year.

Signs of heat

- Swelling of vulva
- A clear discharge through the vulva. During this period, even though a number of male dogs are attracted towards the female, the female will drive them away.
- After wards the discharge becomes pinkish or watery for 8-10 days. The dog stands with the tail raised and tilted to one side and is receptive to the male.
- The heat period lasts for about 21 days, and it recurs after about six months. Dog will stain the floor with drops of blood which can be noticed.

Breeding

- It is always advisable to breed dogs after one year.
- When a female dog comes to heat take her at the right time to the male dog of choice. It is better to take the female dog earlier and leave her with the male dog for getting settled. Mating takes place one or two days after the discharge of blood stops. This may be by the 10th to 13th day after the onset of oestrous cycle, in larger breeds and earlier in smaller breeds.
- The gestation period is 60-63 days.
- Immunization for Distemper and Hepatitis during mid-gestation period will give the pups passive immunity up to an age of 6-9 weeks.
- Deworming with suitable drugs is also advisable during the mid-gestation period.
- Ultrasound scanning could be employed for early pregnancy diagnosis in female dogs starting from 25th day after last mating.

Whelping: Signs of whelping include swelling of vulva, mammary glands become turgid and milk will exude on squeezing. The bitch will seek a safe and calm place for whelping. When the uterine contractions start (first stage) it behaves abnormally due to pain, will be restless, growling and refusing to eat or drink. The discharge is

greenish in colour and is thin. The pup may be presented either alone or with the placenta attached to the umbilicus. The bitch will bite it off and may eat it. At times the whole bag is presented and the bitch may not care to open it. In such instances open up the foetal bag and save the pup by clearing its nostrils and swinging it to and fro by holding its hind limbs. After the littering of one or two pups the bitch may be inactive for some time and it will start straining again for more pups to come out. Whelping is completed in 18 hours.

Diseases of dogs

Rabies: Causative agent is a virus of Rhabdo virus family. Most rabies cases in dogs develop within 21–80 days after exposure. **Clinical symptoms:** sudden anorexia, nervousness, hyperexcitability, altered barking, uncharacteristic aggressiveness (a normally docile animal may suddenly become vicious). Animals lose their fear of people. Two forms are there in dogs. *Furious Form:* “mad-dog syndrome,” the animal becomes aggressive, very alert, show photophobia and characteristic altered bark. They attack other animals, humans and any moving object. Noise may trigger attack. Rabid dogs may chew the wire and frame of their cages, breaking their teeth and gum. Even young pups will bite when petted. Later muscular incoordination and death results. *Paralytic Form (Dumb form):* ataxia and paralysis of the throat, salivation and inability to swallow, dropping of the lower jaw. These animals may not be vicious and rarely attempt to bite. The paralysis progresses rapidly to all parts of the body, coma and death follow in a few hours. **Control:** Transmission almost always occurs via introduction of virus-laden saliva into tissues, usually by the bite of a rabid animal. No treatment for rabies. Site of bite can be washed with running water and soap. Tincture iodine can be used on wounds. The main control measure is prophylactic vaccination (anti-rabies vaccination) and post exposure immunization.

Canine Distemper: Causative agent is a virus of Paramyxovirus family. **Clinical signs:** fever, discharge from the nose and eyes, loss of appetite. Secondary bacterial infections also occur. Signs of central nervous system like localized involuntary twitching of a muscle/group of muscles, paralysis of legs and convulsions called “chewing-gum fits” are seen. **Control:** Treatment is designed to limit bacterial invasion. Supportive therapies can be given to stabilize the condition. Even with intensive care, some dogs do not make a satisfactory recovery. Vaccination is the best available prevention for canine distemper.

Parvo Viral Enteritis: causative agent is a virus of parvo virus family. Incubation period: 5–7 days. **Clinical Signs:** lethargy, anorexia, fever, vomiting, hemorrhagic

diarrhoea within 24–48 hr, dehydration and animal will collapse due to shock.

Control: isolation, environmental decontamination using disinfectants, foot baths etc. Most important measure is prophylactic vaccination. Virus can remain for an extended period in the environment. In a kennel/shelter, cages and equipment should be cleaned, disinfected, and dried twice before reuse.

Health care of dogs

Vaccination: dogs are usually vaccinated against the diseases viz., canine distemper, infectious canine hepatitis, rabies, leptospirosis and canine parvo virus

Deworming: Dogs are infected usually by roundworms, tapeworms, hookworms, and whipworms. A simple faecal examination can reveal the type of worms infecting the dog. Accordingly specific anthelmintics or broad spectrum anthelmintics can be used. First deworming can be done when the dog is 8 weeks old.

Management of Cats

Important breeds of cats

Persian: The Persian cat originated from Iran and is characterized by extremely long, glossy and thick coat, short legs, a wide head with the ears set far apart, large eyes, and an extremely shortened muzzle. It is also known as the Shiraz or Shirazi, particularly in the Middle East. Persian cats can have any color or markings. It is a quiet and gentle cat, well suited for apartment life. They are close to owner, friendly towards strangers, clean and less vocal. Weight: 4–6 kg. Life span: 14–15 years. High maintenance grooming.



Fig. 59. Persian cat

Burmese: The **Burmese** originated from Burma/South East Asia but developed in the United States and Britain. They have slender, muscular, long body with a wedge-shaped head, large pointed ears, long tapering muzzle and moderately large eyes. Very short fine satin like hair coat. Original colour is solid brown (called as sable) with no markings/spots, but various colours are now available. Burmese are people-oriented breed with kitten-like playfulness even in adulthood. They are very vocal, intelligent and dependant on humans (more dog-like) than other cats and so cannot be left alone. Weight: 3.5–5 kg. Life span: 15–16 years. Low maintenance grooming.



Fig. 60. Burmese cat

Restraining of cats

Among the domestic animals the cat is one of the most difficult animals to handle. The cat defends by biting with its need sharp canine teeth and scratching with its retractable claws. Both fore feet and hind feet should be secured properly when restraining a cat. Cats are not tolerant like dogs for manipulation. They are not so close to owners as dogs. They have territorial characteristics and so don't like to get picked up from its cage. Below are some guidelines for restraint of cats

- Always introduce yourself to the cat before performing any procedure.
- Most domestic cats will allow handling by the owner and usually will permit a stranger to approach if it feels that no danger is present. For assuring a cat, talk gently but confidently to the animal. Extend your hand palm down, and allow the cat to sniff it. Gently stroke beneath the chin or beside ears.
- Sometimes just Scruffing a cat will be all the restraint that is required.
- Permit the cat to come out of the cage and can be approached in a calm manner.
- Signs of agitation in a cat: their pupils may become more dilated or their ears may rotate backward. As their agitation increases, they will flick the end of their tail, then more forceful flicking to the point where it can be heard tapping on the examination table. Some cats will emit a low-pitched growl or hiss.
- The handler must work quickly. Unusual surrounding may cause depression in cats which will quickly turn to hostility if handled roughly.
- All means of escape need to be considered when a cat is handled. Doors and cabinets need to be closed.
- Tapping the cat on the top of the head may put its mind on something else. If that doesn't help, sometimes simply placing a towel over the cat's head will quiet the cat.
- For cats that are particularly fearful, dimming the lights in the examination room may help.

Picking up a cat

- Pick up the cat by placing a hand over the top of the animal and around the opposite side, with palm of the hand supporting the sternum or chest.
- Alternatively, grasp the cat by the loose skin over the back of the neck close to the head (scruff). This is a natural handhold for lifting a cat.



Fig. 61. Picking up a cat

Other methods of restraint

Wrapping in a towel

- A cat can be controlled by wrapping it in a towel. The extended claws entangles in the towel keeping the paws within the wrap.
- A single limb may be withdrawn for examination or for exposure of a vein to administer intravenous medication or to withdraw blood.
- The head is controlled equally well and may be exposed for examination or treatment in the same manner as the legs.



Fig. 62. Restraint using towel

Cat bags

- A cat bag is a very satisfactory tool when restraining a cat for uncomfortable manipulations.
- The cat can be picked up by nape and placed inside the bag.
- After that the head or limb may be left outside for various manipulations.



Fig. 63. Cat bag restraint

Feeding of cats

Cats are carnivorous animals. Feed should be rich in proteins of animal origin like cooked meat, fish and milk. Cooked rice, wheat, potatoes etc. can also be fed in small quantities. Cats eat green grass in very small quantities to avoid digestive disturbances and to expel fur balls from their gastro intestinal tract. Cats should be given plenty of drinking water.

Feeding frequency

2-3 months	:	4 meals/day
3-5 months	:	3 meals/day
6-8 months	:	2 meals/day
Adult	:	2 meals/day

Carbohydrates are not essential for cats. They cannot tolerate high starch diet, as they have a low pancreatic amylase activity. Fibrous foods should not be fed to cats. Cats have a higher requirement for protein than dogs since cats are obligate carnivores

and so feed should contain 28% protein. Energy requirement is mainly met from protein.

Other peculiarities of cats regarding nutrient requirements

- Requirements of amino acid arginine and vitamin niacin are higher
- Sulphur containing amino acid, Taurine is dietary essential, which can be derived only from animal proteins especially fish. Taurine is absent in plant proteins.
- Cats require vitamin A as they cannot convert beta-carotene to vitamin A in their body.
- Vitamin D requirement is low and dietary vitamin D supplementation is not necessary.

Diseases of cats

Feline panleukopenia virus (FPV), also known as Feline infectious enteritis/feline distemper/cat plague. It is a viral infection caused by feline parvovirus. It is highly contagious and fatal. The name panleukopenia comes from the low white blood cell count (leucocytes) exhibited by affected animals. **Clinical signs:** profuse bloody diarrhea, severe dehydration, malnutrition, anemia, and often death. Immune system is compromised. Other symptoms like depression, fever, dehydration, self biting of tail are also seen. Affected cats may sit for hours at their water bowl, although they may not drink much. Most panleukopenia deaths are due to secondary infections or dehydration resulting from diarrhea. **Control:** Panleukopenia is primarily spread through contact with an infected animal's bodily fluids, feces, fleas etc. FPV is extremely resistant to inactivation and can survive for longer than one year in a suitable environment. Commercial feline distemper vaccines are available. Supportive treatment, antibiotics, blood transfusion can be tried..



Fig. 64. Feline panleukopenia – emaciation and dehydration

Practicals

Breeds of dogs and cats

Aim- To identify different breeds of dogs and cats

Materials required- photographs, pictures, videos, PowerPoint presentation

Procedure - Spotting

The student should identify the common breeds of dogs and cats from their salient features

Assessment activities

1. Collect the pictures of common breeds of dogs and cats. Prepare power point slides with salient features and present in the class.

TE questions

1. A German Shepherd dog is presented at the hospital for vaccination. Suggest a restraining method for proper control of the dog. (2 score)
2. Select the brachycephalic dog from the following breeds
(a. Doberman b. Pug c. German shepherd d. Labrador) (1 score)
3. Your friend wants to buy a pup. Give him some directions for selection of good quality pups (3 score)
4. Cats are small but very difficult to restrain. Explain some restraining methods for cats (5 score)
5. The sable coloured cat which requires low maintenance and is attached to owners like dogs. (1 score)
6. Name a popular and long haired breed of cat which is very suitable for apartment life (1 score)
7. Name an important viral disease of cats.
8. Identify the breed from the characters given below:
Tan coloured dog with black saddle, long square-cut muzzle, black nose, erect ears and excellent as police dog.
9. Mention the special nutritional requirements for cats. (3 score)

Breeds of dog and cat



Pug



GSD



Doberman



Rottweiler



Labrador



Spitz



Burmese cat



Persian cat

Fig. 65. Breeds of dogs and cats

UNIT 10

REARING OF RABBITS AND LABORATORY RODENTS

Overview

Rabbits and laboratory rodents including rats and mice are have been central to the advancement of knowledge that has led to a vast array of benefits to both human and animal health. Worldwide, new drug research as well as tests meant for assuring the quality and efficacy of pharmaceutical products /vaccines/cosmetics are based on experiments involving animals. Rabbit belongs to the order lagomorpha while rodents belong to rodentia. They are small animals, easy to handle, short generation cycles, easy to breed and similar to human beings in many respects.

Learning outcomes

The learner;

- ❖ Controls and handle lab animals for different purposes
- ❖ Identifies and select suitable rabbit breeds according to purpose
- ❖ Explains the different managerial practices of rabbit rearing
- ❖ Identifies major diseases of rabbit from symptoms
- ❖ Identifies important breeds of mouse
- ❖ Explains the different managerial practices of mouse rearing
- ❖ Identifies important breeds of rat
- ❖ Explains the different managerial practices of rat rearing

Concepts

Importance of rabbits and laboratory rodents

Human biology is very much like that of other animals. That is why results from animal experiments apply to people. Most laboratory animals have the same set of organs heart, lungs, liver and so on, which work in the same way as they do in humans. Research involving animals will contribute significantly to present and future knowledge, which may eventually lead to the protection and improvement of the health and welfare of both humans and animals. Laboratory animals are mainly used for,

- **Fundamental biological and medical research:** We can study the structure and function of different tissues of animal body which will be helpful for understanding human tissues.

- **Developing new treatments for diseases:** There are many diseases which are yet to have a proper cure like many cancers, AIDS, Alzheimer disease, genetic disorders etc. We can produce animal models for such diseases and research for better medicines/vaccines/measures to prevent such diseases using animal models.
- **Preparations of natural products used in medical research/treatment -** Animals can produce useful medical substances in their blood or milk, like antibodies etc. Eg. Rabies immunoglobulins, polio vaccine, monoclonal antibodies.
- **Safety testing of chemicals and drugs -** A wide range of chemicals and medicines which are used in day-to-day life as household products, cosmetics, chemicals used in farming/industry etc., need to be tested for their safe use in humans as well as in animals. Eg. testing of cosmetics, insecticides, disinfectants, newer drugs
- **Development of new diagnostic tests for diseases -** If the treatment of a disease is to be effective, an accurate and quick diagnosis is essential. Animal tests have paved the way for many blood tests for the diagnosis of infectious diseases.
- **As pets:** These laboratory animals are easy to maintain and handle, so many of them are used as house hold pets especially rabbits and white rats.
- **Rabbit farming for Meat/Fur/Hide:** Rabbit farming in India can also be a great source of income and employment especially for women and unemployed youth. Rabbit meat is lower in cholesterol and fat and higher in protein. Aged people can consume and digest rabbit meat easily. They grow and reproduce faster – reach about 2 Kg weight in 12 weeks and there will be 2-8 bunnies per litter. They have excellent feed conversion efficiency and can thrive on materials not used by human beings like grass, leaves etc. Rabbit breeds like Angora yield fur. Required capital/investment for starting rabbit farming business is very low. Rabbits are small sized animal. So, they require less space, feed, care and management. You can easily raise rabbits in your farm, backyard, terrace and even at home.

Restraint and Handling

Handling of mouse

While handling mouse do not use jerky/sudden movements. Mouse will bite always if improperly handled, but the bite is not painful. Approach the mouse with gentle confidence.

Tail Restraint: Mice may be picked up by grasping the base of the tail. Do not grasp the tip of the tail, as this may cause the skin to be stripped off. This method is only used for brief restraint; for example transferring animals from cage to cage.

Forceps Restraint: Mice may also be picked up with rubber-tipped forceps by gently grasping the animal by the scruff of the neck or the base of the tail. The forceps should be dipped in disinfectant between cages. This method of restraint should only be used for short-term procedures such as transferring animals to a new cage.

Scruff Restraint: Restraining the mouse by the scruff at neck region will allow you to perform many technical procedures such as examination, injection and blood collection. There is a one-hand and a two-hand variation of this technique. One hand technique will allow the handler to inject the mouse at the same time. One hand technique is described here. Use cage top for providing proper grip to mouse. Grasp the mouse at the base of the tail with one hand and gently pull back the tail so that the mouse grips onto the cage top. With the other hand, grasp skin around nape with forefinger and thumb. Tail secured between ring and little fingers. If you do not grasp enough of the scruff, the animal will be able to turn and bite. If you grasp too much skin, the airway will become restricted and the mouse will not be able to breathe. Monitor the condition of the animal the entire time. If color of the ears, nose or oral cavity changes from normal pink to blue colour, animal is not able to breathe and should be released immediately.

In case of a mouse bite, do not fling the animal from your hand as a fall can hurt the animal and cause death. The best way to remove a mouse that is hanging on to your finger is to lower your hand back into its cage and the mouse will quickly jump off your finger. Wash the injured site with soap and water for at least 5 minutes; ointment/sprays are not recommended. Cover wound with clean bandage. Antibiotics, tetanus



Fig 66. Mouse restraint using forceps

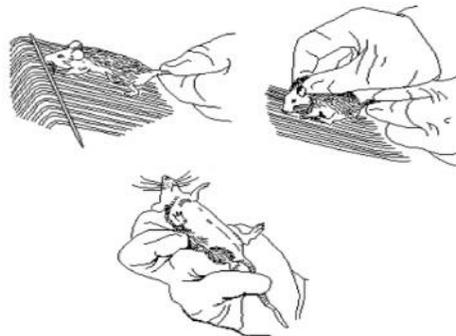


Fig. 67. Scruffing of mouse

vaccination, and anti-inflammatory medications for pain can be used, if necessary. Rodent bites rarely cause tetanus, but tetanus vaccination is recommended.

Handling of rat

Rats are docile animals if regularly handled with correct techniques. Rats will sense your nervousness very fast and can become a handling nightmare. They can inflict severely painful bites. Restraint techniques for rats need some experience and regular handling of animals.

There are many methods for handling rats. **V-hold:** Grasp with the index and middle fingers along the sides of the head and the thumb and remaining fingers under the axilla. Use the other hand to support the lower body and hold the tail. **Thoracic hold:** Alternatively, circle your thumb and index fingers under the jaw to control the head while rest of the fingers support the chest behind the forelegs. Use the other hand to support the lower body and hold the tail. **Scruffing:** Scruff technique can be used. Rats object strongly to being restrained by the scruff. Technique is similar to that of mouse. Easier for handler, in case of aggressive animals.



Fig. 68. Perfectly restrained mouse



Fig. 69. Thoracic hold



Fig. 69a. V hold



Fig. 69b. Scruffing

Handling of rabbit

Rabbits can get stressed easily and so always approach the animal with confidence. Never grab the ears. **Neck Hold:** Using one hand, grasp the loose skin at the neck region. Always support the back with the other hand as rabbits will kick violently which is harmful to the animal as well as the handler. **Football hold:** The rabbit



Fig. 70. Foot ball hold



Fig. 71. Neck hold

should be held its head tucked under the handler's arm and with the back and hindquarters supported by the handler's forearms.

Devices used for restraint

Mechanical restrainers are available in market for mice and rats which are made of plexi glass and have a securing device to prevent the animal from exiting the apparatus. They allow the user to have both hands free for manipulation. Restrainers are used while performing tail vein injections and blood collection from tail. Restraint devices cannot be used simply as a convenience in handling/managing animals. Animals should be adapted to the restraint devices. More than 15 minutes is a non-routine restraint. Animals in a restraint device should be regularly monitored. Plastic bag restrainers or decapicones are another option for short-term restraint of mice. For rabbits, rabbit restrainer boxes are available.



Fig. 72. Mechanical restrainer



Fig. 73. Decapicone/bag restrainer



Fig. 74. Rabbit restrainer

Different routes of inoculation of materials

Oral gavage: Gavage is the administration of fluids directly into the lower esophagus or stomach. The maximum volume that can be delivered is 10 ml/kg. Special ball tipped metallic needles are used for gavaging.

Parenteral routes: The main parenteral routes are subcutaneous, intradermal, intraperitoneal, intramuscular and intravenous.

Subcutaneous (SC) - article injected to skin penetrating all layers of skin

Intradermal (ID) – article injected to skin penetrating only the outermost layer or epidermis

Intraperitoneal (IP) – article injected into the peritoneal cavity

Intramuscular (IM) - article injected to muscle

Intravenous (IV) - article injected to superficial vein



Fig. 75. Oral gavage



Fig. 76. Sub cutaneous inj.

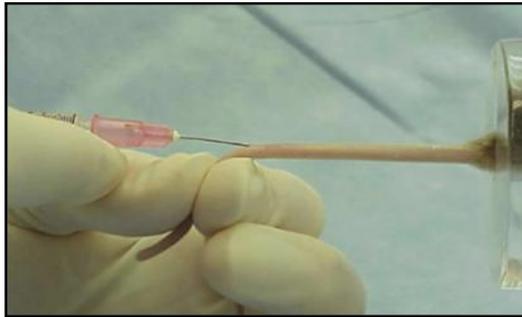


Fig. 77. Intravenous injection

Precautions for blood collection

Points to ponder before blood collection

- Before starting collection, it should be ensured that all materials are available at the site.
- The method employed should not cause stress to the animal. Not more than two to three attempts should be done on an animal.
- One per cent of body weight is the maximum amount of blood that should be collected at one time.
- Immediately following blood collection, always observe the mouse for signs of distress or anaemia.

HUSBANDRY OF RABBITS

Common terminologies of rabbit

- Kit - Young one of a rabbit whose eyes are not opened
- Fryer - Young rabbit which has attained the marketable weight.
- Bunny - Young rabbit which is below 20 weeks of age
- Buck - Adult breeding male rabbit
- Doe - Adult breeding female rabbit
- Kindling - Act of parturition in rabbits

Breeds of rabbit

Soviet Chinchilla

This breed was evolved in erstwhile USSR. Adults weigh 4.5 to 5 kg. Though this breed is reared for meat its fur is a fancy in fur crafts.



Fig. 78. Soviet Chinchilla

Grey Giant

This breed is also a native of erstwhile USSR. Adults weigh 4.5 to 5 kg. Due to the resemblance of its fur with that of hare, it is often mistaken as hare. It is also reared for meat and fur skin.

New Zealand White

This breed was evolved in England. It is an albino animal with white fur. The eye colour is red due to the absence of melanin pigment. Adult weight is 4.5 to 5 kg. Meat and fur skin are the main products.

Angora

Angora is a very ancient breed of small rabbit weighing around 3 kilograms. It is a wool type rabbit with white fur. Annual wool yield recorded is between 300-1000g in 3 to 4 clippings.



Fig 79. Grey Giant



Fig 80. New Zealand White



Fig 81. Angora

Housing, feeding and reproduction of rabbits

Housing

Rabbits are housed in wire mesh cages kept in shed.

Cages

Cages of does and bucks should be of 60 cm length, 60 cm breadth and 45 cm height. The cages should be made of wire mesh. The size of wire mesh should be 1 cm x 1 cm for the bottom and 2.5 cm x 2.5 cm for the sides. From the ground to bottom of the cage should be 75 cm to 90 cm high. The legs of the cages should be in such a manner that rats and snakes could not cause nuisance. PVC pipe can be used as legs for cages. Cages can be kept in single or two tier system.

Cages should be placed in a shed that is constructed in cooler surroundings.

Nest box: Nest boxes are required for pregnancy does. They vary in size and design but in general the size is 50 cm long, 30 cm broad and 15 cm high. Nest boxes are made out of wood with sieve wire mesh bottom. During last week of pregnancy a nest box lined with wood shaving, hay or coir fibre should be placed inside the cage.

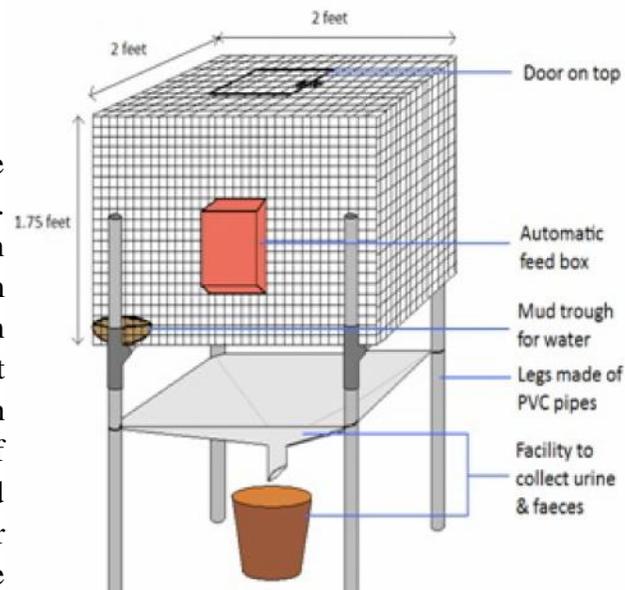


Fig. 82. Rabbit cage

Feeders and waterers

Feeders are generally made out of aluminium or galvanised iron sheets. Feeders may be designed in such a way that they can be attached to the front panel of the cage and can be filled from outside without opening the doors of the hutch or cage. Automatic commercially available waterers are used widely in commercial rabbit farms. Glazed earthenware pots can be used for watering in cages.

Feeding of rabbits: Rabbits primarily are monogastric herbivorous animals. They consume common type of grains (wheat, yellow maize, jowar etc) and pulses (Bengal gram, horse gram, etc.) and either green legumes/grass or hay. Rabbits can be raised

by giving concentrate feed, but supplementing with some greens is always good for their digestive system. An ideal rabbit feed should contain 12-18% crude protein, 7% minerals, 14% fiber and 2700 kilo calorie/kg metabolic energy. Rabbits should be fed with either compounded mash mixture or pelleted feed. Rabbit pellets should be of 3 mm size. Pelleted feed reduces wastage and prevents respiratory troubles caused by dust from the conventional concentrate rations. For 1 kg body weight of rabbit, feed them about 40 grams of concentrate food and 40 grams of green food. Provide them with fresh and clean water *ad libitum*. During lactation, the doe should continue to receive feed *ad libitum*. They drink approximately 10 ml/100g body weight per day and up to 90 ml/100 g body weight if lactating. If there is a deficiency of fibre, protein or some minerals in the feed, rabbits will resort to eating their fur. If too much fur is eaten, there is a danger of gastro intestinal obstruction due to hair ball formation and can cause death.

Breeding: Rabbits become suitable for breeding within their 5 to 6 months of age. You should use male rabbits for breeding purpose at their 1 year of age to get quality young rabbits. Always use healthy rabbits for breeding with proper age and body weight. Always bring female rabbits to the cage of male rabbits. Female rabbits will attack males if brought to their territory.

Sex differentiation in rabbit: To determine the sex of the rabbit, press down the vent area just in front of the anus. In both the doe and buck, the area will protrude. The doe will display a slit while the buck will display a white tube like structure that is the penis. Older bucks will present scrotal sacs which can be easily seen while holding particularly during breeding season.

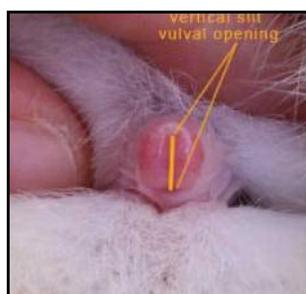
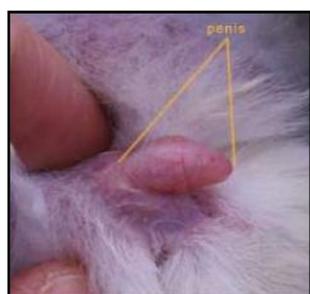


Fig. 83. Penis of male rabbits Fig. 84. Vulva in females Fig. 85. Scrotal sacs in older males

Reproductive Trait	Details
Oestrus cycle	Polyestrus (any time of season).
Male female ratio	1 male for 10 females
Breeding age	5-6 months; male rabbits are better to be used after one year.
Signs of heat	Congested, purple and moist vulva, restlessness, rubbing the chin on the sides of the cage, lying in mating posture and lifting the tail.
Ovulation	Induced ovulator; Ovulation occurs 10 - 13 hours after copulation.
Mating behavior	The doe is always taken to the buck's cage for mating, if reverse, doe will attack the buck. Mating is very quick and will be over in seconds. Male will show certain signs if successful mating like buck falls to one side or backwards, shaking of ears, stamping of foot on the floor of cage.
Gestation period	28 -34 days (average 30 days).
Litter size	6-8 kits.
Weaning	4-6 weeks (depending on weight of bunnies).
Kindling interval	2.5 to 3 months; it may be as short as 1 month if bred immediately following kindling.
Breeding style	Cross breeding.

Diseases of rabbits

Disease	Causative agent/ cause	Symptoms of the disease
Pasteurellosis	Bacteria called <i>Pasteurella multocida</i>	Clinical forms that occur are snuffles /upper respiratory tract disease - watery nasal discharge, snoring sound, conjunctivitis, head shaking, scratching, ear infection, twisting of neck, disorientation, circling or inability to stand, later they develop pneumonia. Antibiotics can be given.

Disease	Causative agent/ cause	Symptoms of the disease
Sore hock	Pressure sores - limbs of the rabbit become lodged or trapped between hard surfaces. Too much friction. Exposure to constant moisture Bad management and exposure to urine Obesity Bacteria like <i>S. aureus</i> , <i>P. multocida</i> and <i>E. coli</i>	Ulcerative pododermatitis/ bumble foot - affects the skin of the back feet and hocks the part of the back leg that rests on the ground when a rabbit sits. So it is called sore hock. Severe inflammation with pus filled lesions (pyoderma), cellulitis, later synovitis and osteomyelitis. Better management and antibiotics can be given.
Mange	<i>Sarcoptes scabiei</i> and other <i>Sarcoptes species</i> (mite).	Hair loss from the ears and nose, itching, scratching the ears and face with forelimbs, whitish crusts, crusts often have an unpleasant, musky smell, especially in the ears. Ivermectin injection is the best treatment available.

Husbandry of Laboratory Mouse

Breeds/strains of laboratory mouse

BALB/c: BALB/c is an albino inbred strain of mouse extensively used in research. Characteristics are easy breeding and minimal weight variations between males and females. Extensively used for hybridoma and monoclonal antibody production. BALB/c mice are useful for research in cancer therapy and immunology.



Fig. 86. BALB/c mouse

Swiss albino: originated from Switzerland, outbred mouse, versatile and used in all areas of biomedical research and general studies.

Housing, feeding and reproduction of laboratory mouse

Housing: Cages for laboratory mice should be made of a nonporous, non-opaque (for ready viewing of the mice), easily sanitizable material. Mouse can be housed in

ordinary shoe box cages made of plastic base and metallic grill top or individually ventilated cages (IVC) made of polypropylene/styrene or polycarbonate which is the trend in modern animal houses. In IVC system, each cage has its own air supply of filtered air and exhaust, both controlled centrally by the ventilator. Mouse can group housed or kept singly. Litter or bedding material should be provided like rice husk or corn cob. Cage tops contain a holder for feed and that may have a slot to put water bottle. Glass bottles with stainless steel screw tops are used for watering. Automatic watering systems are also available now. Temperature (65-85°C), relative humidity (40-60 %), light-dark ratio (14 hours light: 10 hours dark) are important parameters while housing mice. Examples for cages are shown under rat's section.

Feeding: Mice are usually fed with commercially available concentrate feed. Pelleted feed are available which will reduce wastage and can be formulated according to various research needs as well. Immuno-compromised strains of mouse should be fed with radiation sterilized feed (irradiated) which are expensive or with feed after autoclaving. Mouse usually eats 3-5 g of feed daily. Water is provided *ad libitum*. Mouse will drink 5-8 ml of water per day.

Reproductive characters of mouse

Reproductive Trait	Details
Life span	12-36 months
Adult body weight	20-60 g
Terminologies	Adult female is called doe, adult male is buck and young ones called as pup
Oestrus cycle	Continuously polyestrus, spontaneous ovulators, duration: 4-5 days
Sexing	The male and female mice are differentiated by looking at the ano-genital distance. The ano-genital space is almost twice as long in the male as it is in the female. Male mice also lack nipples while it is very evident in females especially the posterior most nipples.
Age at puberty	For both male and female – 6 weeks or 35 days
Gestation	19-21 days
Weaning age	18-21 days
Litter size	7-11 pups
Breeding style	Cross breeding or inbreeding depending on the type of strain

Husbandry of Laboratory Rat

Breeds/strains of lab rat

Wistar: The Wistar rat is an outbred albino rat. It has the distinct honor of being the first rat strain developed to serve as a model animal. The Wistar rat is currently one of the most popular rats used for laboratory research. It is characterized by its wide head, long ears, and having a tail length that is always less than its body length. The Sprague Dawley rat was developed from Wistar rats. Wistar rats are more active than others like Sprague Dawley rats.

Sprague-Dawley rat: The Sprague Dawley rat is an outbred multipurpose breed of albino rat used extensively in medical research. It has high reproduction rate and main advantage is its calmness and ease of handling. The average litter size of the Sprague Dawley rat is 11. These rats typically have increased tail to body length ratio compared with Wistar rats and longer head.

Housing, feeding and reproduction of laboratory rat

Housing and feeding practices of rat are similar to mouse.



Fig. 87. Shoe box cages



Fig. 88. IVC



Fig. 89. IVC System with ventilator

Reproductive characters of rat

Reproductive Trait	Details
Life span	26-40 months
Adult body weight	225-500 g
Terminologies	Adult female is called doe, adult male is buck and young ones called as pup
Oestrus cycle	Continuously polyestrus, spontaneous ovulators, duration: 4-5 days
Sexing	Anogenital distance, larger genital papillae in males
Age at puberty	For both male and female - 4-5 weeks
Gestation	21-23 days
Litter size	6-14 pups
Breeding age	50-60 days

Practicals

Handling and restraint of laboratory animals

Aim - Control and restraining of mice, rat and rabbit for various purposes

Principle

- Always approach the animal relaxed and with confidence.
- Handle the animal on a regular basis in non-threatening situations like weighing, petting etc. Animal should be acclimatized before handling.
- Do not make loud noises or sudden movements that may startle them.
- Handle animals gently but firmly.
- Keep your fingers away from the mouth of animal.
- Can use restraint devices and an assistant, if available.
- Animals do not like to be placed on slippery surfaces. So can use cage top for rodents or a non-slippery cloth/cover for rabbits.
- Never suspend the animal in air for a prolonged period of time.
- Chemical restraint should be considered for any prolonged/potentially painful procedure/very vicious animals.
- Always use personal protective equipment (PPE) like gloves, face masks, lab coat/coverall

Procedure

- a. Restrain the mouse using scruff method
- b. Restrain the rat using V-hold method
- c. Restrain the rabbit using neck hold method

Assessment activities

1. Restrain the presented rabbit by neck hold method

TE questions

1. Name any two commonly used inoculation sites in mouse for injecting articles (2 score)
2. Pick out the restraining methods for rabbit from the following (a. foot ball hold b. V-hold c. thoracic hold d. muzzling) (1 score)
3. Rabbits are commonly used as laboratory animals. Substantiate the statement (2 score)

4. How will you differentiate a male and a female rabbit (3 score)
5. Write a commentary on the importance of laboratory animals for human kind (5 score)
6. Pick the odd man out. Mention the reason for selection
(Wistar, New Zealand white, Grey giant, Soviet chinchilla) (2 score)
7. Identify the breed of rat from the following
(Angora, Swiss albino, BALB/c, Sprague Dawley) (1 score)
8. The modern method of housing for housing or laboratory rodents
(Shoe box cages, Individually ventilated caging system, Free range system, Aviary) (1 score)
9. Describe in detail the housing and feeding of rabbits (5 score)
10. Identify the relationship of first pair of words and fill up (1 score)
 - (a) Rat : pup
 - (b) Rabbit :

Extended activities

Farm visits, field visits ,hatchery visit, expert classes, visit in pet shops, exhibitions of products, pet shows, camps associated with animal husbandry department, OJT.

List of Practicals

1. Body parts of adult chicken
2. Identification of digestive system of chicken
3. Poultry feed ingredients
4. Setting up a brooder using locally available materials
5. Poultry house equipment
6. Candling of eggs
7. Immunization of poultry against prevalent diseases
8. Sex differentiation in duck, quail and turkey
9. Identification of different types of pet birds
10. Breeds of dogs and cats
11. Handling and restraint of laboratory animals

MODULE 4

LIVESTOCK PRODUCTS PROCESSING AND FOOD SAFETY

Overview

Animal products namely milk, meat and egg are excellent sources of nutrients especially essential amino acids. The use of these products by the common man is increasing day by day. Many people cannot even imagine a day without a cup of tea / coffee. As a fast developing country, the living standards of Indian citizens are also boosting up leading to overwhelming demand for animal products which are delicious as well as nutritious. As far as the farmer / producer is concerned, the perishability of animal products especially milk and meat is a major problem. In order to enhance their shelf life many preservation techniques have been employed. Knowledge about these techniques helps them to substantially reduce the losses. It also enables efficient utilization of milk, meat and egg in surplus season thereby eliminating profound price fluctuations in the market.

Value addition of animal products provides tremendous job opportunities to the unemployed youth of our country. Practical knowledge on preparation of some of these value added products will help the learner to build up confidence for preparing a variety of milk, meat and egg specialties. Food business is ofcourse directly related to the health of people. When it comes to animal products the chances of contamination are also more. So a basic knowledge about the hygienic production and processing of animal products is inevitable for providing safe and wholesome animal source foods to the consumers. The increasing demand, high price and low shelf life of animal products increase the chances of malpractices in this sector. The Government is vigilant about this and so many rules and regulations have been brought with a view to abolish such practices. Persons operating food business should have an up-to-date knowledge about such regulations to provide standard products to the consumers and to avoid penalties. A basic know-how about zoonotic diseases will help all the animal handlers as well as animal product processing plant workers to take appropriate precautions.

With increased use of animal products the animal husbandry sector has grown far from a mere household enterprise to a huge business. Any business has only one motive - 'the profit' and so animal welfare is often forgotten. Animals are living creatures and so need to be handled humanely. This module emphasizes on the humane and welfare aspects of animal husbandry sector too.

UNIT 1. MILK AND MILK PRODUCTS

Overview

Milk is a complete food and forms the staple diet for human beings. The value of milk can be enhanced by converting it into various products (value addition). This chapter deals with the various categories of milk products and byproducts, their preparation and the nutritive benefits of milk. The various standards and guidelines pertaining to the manufacture of these products are also included.

Learning outcomes

The learner;

- ❖ Describes the chemical composition and nutritional value of milk
- ❖ Assesses and differentiate the standards of various milk products in the market
- ❖ Chooses the suitable preservation method of milk according to purpose
- ❖ Identifies and select appropriate type of milk as per need
- ❖ Prepares required milk products for commercial and household purposes

Concepts

MILK

Milk is defined by chemist as emulsion of fat in a watery solution of lactose and mineral salts with protein in a colloidal solution. Milk may also be defined as the whole, fresh, clean, lacteal secretion obtained by the complete milking of one or more healthy milch animals excluding that obtained within 15 days before or 5 days after calving.

Chemical Composition of milk

Component	Percentage
Water	87.25
Dry matter	12.75
Fat	3.80
Protein	3.50
Lactose	4.80
Ash	0.65

- Lactose is the milk sugar which is a disaccharide containing glucose and galactose.
- Milk protein contains all 9 essential amino acids required by humans. There

are two types of protein - casein and whey protein. Casein constitutes 80 % of milk protein. Whey protein consists of lactoglobulin, lactalbumin, immunoglobulins etc.

- Milk contains water soluble vitamins like thiamin, riboflavin, niacin, pantothenic acid, pyridoxine, cyanocobalamin, vitamin C and folic acid.
- Also contains fat soluble vitamin A, D E, and K.
- Milk is a good source of major minerals like calcium, phosphorus, magnesium, potassium and many trace minerals.

Nutritive value of milk

- Biological value of milk is 90%. It is an almost complete food.
- It is a good source of high quality protein, calcium, and phosphorus in addition to riboflavin and other B vitamins.
- It supplies body building proteins, bone forming minerals health giving vitamins and essential amino acid in fairly large quantities.
- Milk fat adds specific odour and palatability. It is easily digestible.
- It contains calcium and phosphorus in the ratio of 1:2, which is most favorable for bone development.
- It is a poor source of iron.
- Lactose provides energy. Milk contains significant amount of essential fatty acids, and provide smooth texture to the products. Lactose decreases intestinal pH which favours calcium absorption and non survival of pathogenic microorganisms.

PFA and BIS Standards for Milk and Milk Products

Product	FAT % (Min)	SNF % (Min)
Cow milk	3.5	8.5
Buffalo milk	5.0	9.0
Goat milk	3.5	9.0
Toned milk	3.0	8.5
Double toned milk	1.5 (Max)	9.0
Standardized milk	4.5	8.5
Skimmed milk	0.5 (Max)	8.7
	Fat % (Min)	Total solids (Min)
Ice cream	10.0	36.0
	Fat % (Min)	Moisture (Max)
Whole milk powder	26.0	5.0
Ghee	99.5	0.5

Table butter

According to PFA Rules (1976) Table/Creamery Butter should contain not less than 80 % fat, not more than 1.5 % curd and not more than 3% common salt.

PRESERVATION OF MILK

Chilling: Milk has to be collected and transported from production points in the milk-shed areas to processing and distribution points in cities. The main objective is to preserve the quality of raw milk. Milk contains micro organisms which increase during further handling mostly at temperatures of 20 - 40 °C. So it is chilled to 5 °C or below and stored cool till used, to prevent deterioration due to bacteria.

Importance of chilling

If the growth of micro-organisms in milk is not checked it will result in the spoilage of milk. The most effective means of controlling the growth of microorganisms without affecting the physico-chemical properties and nutritive value of milk is chilling. Here microorganisms are neither killed nor milk made safe for human consumption. Only keeping quality is increased. Milk should be transported to the collecting or processing centres within 4 hours of milking.

Pasteurization: The term pasteurization as applied to market milk today refers to the process of heating every particle of milk to at least 63 °C for 30 minutes, or 72 °C for 15 seconds. After pasteurization the milk is immediately cooled to 5 °C or below.

The objectives of pasteurization are,

- To render the milk safe for human consumption by destruction of most pathogenic microorganisms.
- To improve the keeping quality of milk by destruction of almost all spoilage organisms. (85-99 per cent.)

Methods of Pasteurization

1. **Low temperature long time (LTLT) system:** also known as vat or batch or holding system of pasteurization. The milk is heated to 63 °C for 30 minutes and cooled to 5 °C.
2. **High temperature short time system (HTST):** Also known as continuous flow or flash pasteurizers. The HTST pasteurizer gives a continuous flow of milk, which is heated to 72 °C for 15 seconds and cooled to 5 °C or below. Plate heat exchangers are used here for heating, cooling, regeneration and holding.

3. **In-bottle pasteurization:** Bottle filled with raw milk and tightly sealed with special caps is held at 63-66 °C for 30 minutes. Then the bottles pass through water sprays for decreasing temperature, which cools both the product and the bottle.
4. **Vacuum pasteurization (vacreation):** This refers to pasteurization of milk/cream under reduced pressure by direct steam. The equipment used in this process is called “vacreator” and the process is called “vacreation.”.

Sterilization

Here all the micro organisms, spores and the vegetative forms are destroyed, so that bacterial spoilage cannot occur under any storage conditions. This ensures preservation of milk at room temperature for a period of not less than 15 days from the date of manufacture.

Types of sterilization

1. **In-Bottle Sterilization:** Good quality milk, after filtration is standardized to the prescribed percentage of fat and solids-not-fat content. Milk is then pre-heated to 60 °C followed by homogenization and filled into clean sanitized bottles and then sealed with crown corks. The bottles are sterilized at 108 -111°C for 25 - 30 minutes. Then cooled slowly to room temperature. Resultant milk acquires brownish colour and cooked taste.
2. **Ultra High Temperature Sterilization:** Milk is heated to a temperature of 135-150 °C for 1- 8 seconds. Here the resultant product has less change in colour, flavor and other chemical properties.

Types of Milk commercially available

1. **Homogenized Milk:** Homogenized milk is produced by mechanically forcing milk through a small passage at high velocity. This breaks down the fat globules in milk into much smaller ones and creates a stable fat emulsion. The effect of homogenization upon milk may be described as follows. The fat globules in normal milk are usually in sizes varying from 1 to 20 microns, average being 4 - 6 microns depending upon the breed of cow and various other factors. By means of homogenization, the fat globules are broken up into numerous smaller ones and all the fat globules are under 2 microns in size. The fat globules no longer rise to the top to form a cream layer, as normal milk, for they are so small that few of them have the power to rise against the pull of gravity. This results in an increase in viscosity of the milk, and an apparent increase in creaminess and richness. The machine used for homogenization is called homogenizer.

2. **Condensed Milk:** Condensed milks are the milks obtained by evaporating part of water of whole milk, or fully or partly skimmed milk, with or without the addition of sugar. The term 'condensed milk' is commonly used when referring to "full cream sweetened condensed milk". Sweetened condensed milk should contain not less than 9.0 percent milk fat and not less than 31 % milk solids and 40.0 per cent cane sugar.
3. **Toned Milk:** Toned milk (single toned milk) refers to milk obtained by the addition of water and skim milk powder to whole milk. Usually, whole buffalo milk is mixed with reconstituted spray dried skim milk for its production. Toned milk should contain a minimum of 3.0 % fat and 8.5 % SNF.
4. **Double toned milk:** Here double toned milk should contain a minimum of 1.5 % fat and 9.0 % SNF

Preparation of Milk products

1. **Acid coagulated products: Paneer** is an acid coagulated product made usually from buffalo milk. Other milk can also be used. It forms the base for sweets, snacks, vegetarian dishes like paneer butter Masala, palak paneer etc.
2. **Concentrated products:**
 - (a) **Khoa** is an example for partially dehydrated whole milk product. Buffalo milk is preferred as it yields a whiter product with a soft, loose body and a smooth granular texture. Milk is taken in an open, shallow iron pan. It is directly heated over a non smoky fire by slow constant agitation and scrapping on the sides. Continuous evaporation takes place and milk thickens. At a concentration of 2.5-2.8 times, heat coagulation of protein begins. Now concentration occurs faster and colour changes. The heating is turned down to 82-87°C and stirring and scrapping intensified to avoid browning of milk solids due to scorching. The viscous mass begins to dry up. When the khoa mass begins to leave the sides and bottom of the pan, heating is shut off. The final solid content is 65-70 %. Cow milk usually yields 18 % and buffalo milk 20 %.
 - (b) **Gulab Jamun:** It is a khoa based sweet, round or cylindrical in shape and dark brown in colour it has a firm body and smooth texture soaked in thick sugar syrup. Khoa and maida/rava are mixed in about 3:1 ratio with about 1 % baking powder and kneaded into a uniform dough. Dough is then rolled into small balls and deep fried in ghee or cooking oil in a shallow pan till the balls acquire golden brown colour. The balls are then soaked in 60 % sugar solution and allowed to soak for few hours before serving.

3. Fat rich products

- (a) **Cream:** According to the PFA rules (1976), cream, excluding sterilized cream, is the product of cow or buffalo milk or a combination thereof, which contains not less than 25 per cent milk fat. Cream is rich in energy giving fat and fat-soluble vitamins A, D, E, and K, the contents of which depends on the fat level in cream. **Classification:** Table cream/Light cream contains 20-25 % milk fat. Coffee cream/Whipping cream contains 30-40 % milk fat, and Heavy cream/Plastic cream contains 65-85 % milk fat.

Method of cream production

Gravity method: When the milk is allowed to stand undisturbed for some time, there is a tendency for the fat to rise which can be removed from the top. Basic principle is that milk fat is lighter than skim milk portion. This is a very slow process and requires time. The rate of rise of fat globules in gravity method is affected by size of fat globules: as the size of fat globules increases, the rate at which cream rises also increases. Temperature: As temperature increases, viscosity decreases and hence the velocity increases.

Centrifugal method: The instrument used is called cream separator. When milk enters the rapidly revolving bowl of the cream separator, it is subjected to centrifugal forces, which is 3000-6000 times greater than gravitational force. The difference in density affects the heavier portion (skim milk) more intensely than the lighter Portion (cream). So skim milk moves to the periphery and fat portion moves to the centre. Separated products are collected through separate outlets. The cream separator delivers, under normal conditions, a definite ratio of skim milk and cream, which is usually 90 : 10 (or 85 : 15) by volume.

(b) Ghee

Ghee may be defined as clarified butter fat prepared mainly from cow or buffalo milk. According to the PFA (1976), ghee is the pure clarified fat derived solely from milk or from desi (cooking) butter or from cream to which no coloring matter is added.

Chemical composition of ghee

Characteristics	Requirements	
	Cow	Buffalo
Milk fat	99 to 99.5 per cent	
Moisture	Not more than 0.5 per cent	

Ghee can be prepared by various methods like,

- Country/Desi method
- Creamery butter method

Desi Method

Fresh or accumulated desi butter (makkhan) is taken in a suitable open mud-pot or metallic vessel, and heated with stirring on a low fire to drive out the moisture. When practically all the moisture has been removed, a stage judged by experience, further heating is stopped and the vessel removed from the fire. On cooling, when the residue has settled down, the clear fat is decanted into suitable containers.

The ghee will have a desirable flavour, golden yellow colour and granular body.

Creamery butter method

Unsalted creamery butter is heated in a ghee boiler consisting of a steel jacketed pan with a stirrer, with steam supply and control valves. The butter mass, is cut into small pieces and heated on low heat and carefully stirred. Later after complete melting, the steam pressure is raised to bring the liquid mass to boil at a temperature of 90 °C. The contents are constantly agitated throughout the process of conversion of butter into ghee, to prevent scorching. The scum, gathering on the top is periodically removed, until there is profuse effervescence, followed by crackling sound, initially. When all the moisture has been driven out, the temperature of the liquid shoots up suddenly and end point is indicated by the appearance of effervescence for the second time together with browning of the curd particles. At this stage, characteristic ghee flavor appears and the temperature now will be around 110-120 °C. Heating is then stopped, and after cooling and sedimentation, the ghee is filtered through a muslin cloth.

4. Fermented products

a) Dahi/Curd

In India, curd is also called Dahi. As FSS Regulations (2011), dahi is a product obtained from pasteurized or boiled milk by souring using previously cultured milk or by using selective lactic or other harmless bacterial cultures. Dahi may contain added cane sugar. Dahi shall have the same minimum percentage of milk fat and milk solids not-fat as the milk from which it is prepared. Where dahi is sold without any indication of class of milk, the standards prescribed for dahi prepared from buffalo milk shall apply.

Pasteurize milk at 85 °C for 10 min and cool the milk immediately (20-25 °C) by keeping the container in running water, by simultaneous agitation. Add 0.5

% of starter culture at this temperature and mix thoroughly. Permit the cultured milk to remain undisturbed for 16 -18 hours at 22-25 °C, or to reach the acidity of 0.8-0.98. If stored at 5-10 °C, dahi usually keeps well for a period of one week.

- (b) **Cheese:** Cheese has been defined as a product made from the curd obtained from milk by coagulating the casein with the help of rennet or similar enzymes in the presence of lactic acid produced by added microorganisms, from which part of the moisture has been removed by cutting and /or pressing which has been shaped in a mould, and then ripened by holding it at some time at suitable temperature and humidity.

Steps in manufacture of Cheddar Cheese

1. Receiving of milk
2. Preheating (35 to 40°C)
3. Filtration/clarification.
4. Standardization of casein/fat ratio
5. Pasteurization
6. Ripening (cheese starter culture-*Streptococcus lactis*/*Streptococcus cremoris*)
7. Renneting – addition of rennet enzyme
8. Coagulation
9. Cutting of coagulum: (cutting into cubes).
10. Cooking: (heating of curd cubes)
11. Drainage of whey - removal of whey from the curd.
12. Cheddaring: (combined operations of packing, turning, piling and repiling the curd cubes).
13. Milling: (cutting the blocks of cheddared curd into small pieces with the help of a cheese mill).
14. Salting: addition of salt
15. Hooping: (curd placed in hoops or moulds).
16. Pressing: (kept pressed overnight, a second pressing for another night)
17. Drying: (keeping in a drying room at 12 to 16 °C for a few days.)
18. Paraffining: (dipping the cheese for a few seconds in melted paraffin bath)
19. Curing or Maturing: (storage of cheese for at least 2 to 3 months at low temperature, 0-16°C).

5. Frozen products

Ice cream: Ice cream may be defined as a frozen dairy product made by suitable blending and processing of cream and other dairy products together with sugar and flavor, with or without stabilizers or colour, and with the incorporation of air during the freezing process. According to the PFA rules (1976) ice cream is the frozen product obtained from the cow or buffalo milk or a combination thereof or from cream, with or without the addition of cane sugar, eggs, fruits, nuts, chocolate, edible flavors and permitted colours. It may contain permitted stabilizers and emulsifiers not exceeding 0.5 per cent by weight. The mixture must be suitably heated before freezing. The product should contain not less than 10 % milk fat, 3.5 % protein, and 36 % total solids.

Preparation

- a) **Selection of ingredients:** A clean fresh creamy flavour of the ice cream can be secured only by the use of products, which have been carefully selected and handled. The selection of ingredients depends on,
 - Availability of milk products
 - Perishability of the products
 - Convenience in handling
 - Effect on flavor, body and texture of ice cream
 - Cost and
 - Equipment available.
- b) **Figuring the mix:** Knowledge of calculation of ice cream mix is helpful in properly balancing the mix, in establishing and maintaining a uniform quality and in producing ice cream that conforms to legal standards.
- c) **Making the mix:** The ingredients are taken in appropriate quantities to make an ice cream mix to which sugar is added @ 15 % to make up the Total Solids to not less than 36 % and stabilizer (gelatin or sodium alginate) is added not exceeding 0.5 % by weight.
- d) **Pasteurization of mix:** Ice cream mix is pasteurized to a temperature of 68-74 °C for 25-30 minutes and cooled to 50 °C or lower.
- e) **Homogenization of mix** It produces more uniform ice cream with a smoother texture. Improves whipping ability and shortens ageing period.
- f) **Cooling and ageing of mix:** Cooling the mix immediately after homogenization to 0-5 °C is essential, after which it should be held in ageing tanks until used. Ageing refers to holding the mix at a low temperature for a definite time before freezing. The ageing temperature should not exceed 5 °C. The ageing time

under commercial conditions may range from 3 to 4 hours. Ageing improves (1) the body and texture (2) the whipping capacity (3) increases overrun, and (4) Increases melting resistance, of the icecream. Overrun is defined as the volume of ice cream obtained in excess of the volume of the mix. It is usually expressed as a percentage.

- g) **Freezing the mix:** Freezing is one of the most important operations in the making of ice cream for upon it depends the quality, palatability and yield of the finished product. Before freezing, permitted food colours and flavors are added and mixed thoroughly. Freezing is carried out in an icecream freezer (batch or continuous freezer).
- h) **Hardening of ice cream:** The containers with ice cream is then placed in cold room or deep freezer, at a temperature of about -20°C or lower for few hours.

6. By-products from Milk

Whey: By-product generated during manufacture of products like cheese, paneer and chhana. It is the base material for manufacture of not only nutritional products like Whey Protein Concentrate, Lactose etc., but also the base for manufacture of whey drinks and dietetic beverages. **Whey drink:** It contains valuable and nutritious whey proteins. Various kinds of Whey drinks are available in the market. Whey is sweetened with sugar, pasteurized and cooled to room temperature followed by addition of a pleasing flavour and colour.

Butter Milk - Produced when butter is made by churning cream or whole milk curd. Desi buttermilk is an important domestic beverage even in olden days. Sambharam is prepared using buttermilk.

Skim milk - Skim milk is produced by separation of cream from milk in dairy processing. Skim milk is rich in SNF content and is used for standardization of milk, preparation of skim milk powder and coffee whitener.

Practical activities

Preparation of traditional milk products

1) Preparation of curd

Materials and Apparatus required:

- a) Stainless steel vessel, glass / stainless steel jar, water bath, incubator, refrigerator, etc.
- b) Good quality milk, starter culture which includes *Streptococcus diacetyl lactis*, *Streptococcus cremoris*, with an aroma producing bacteria mainly *Leuconostoc citrovorum*.

Procedure: Pasteurize milk at 85°C for 10 min and cool the milk immediately (20-25°C) by keeping the container in running water, by simultaneous agitation. Add 0.5% of starter culture at this temperature and mix thoroughly. Distribute this cultured milk into a small sterile steel or glass container taking aseptic precautions, and fix a sterile cap. Permit the cultured milk to remain undisturbed for 16-18 hours at 22-25°C, or to reach the acidity of 0.8-0.98

2) Preparation of paneer

Principle

Paneer is primarily acid coagulated milk solids. As per FSS Regulations (2011), Chhana or Paneer means the product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70 per cent moisture and the milk fat content shall not be less than 50 per cent of the dry matter. Paneer or chhana when sold as low fat paneer or chhana, it shall conform to the following requirements:

Moisture - Not more than 70 %

Milk fat - Not more than 15 % of dry matter:

Materials required:

Milk, citric acid, muslin cloth, dairy thermometer, stainless steel vessel, wooden rectangular hoop with top and bottom open, stainless steel knife

Procedure

1. Take fresh milk in a stainless steel vessel.
2. Heat the milk to 82 °C for 5 minutes.
3. Promptly cool it to 70 °C.
4. Add coagulant slowly in a thin stream with slow and continuous stirring till clear whey separates out. One per cent citric acid solution (@ 200 ml/ litre) at a temperature of 75 – 80 °C or one lemon juice dissolved in 200ml water can be used as coagulant for 1 litre of milk.
5. Allow 5 minutes for the whey to become clear.
6. Drain the whey through a muslin cloth. Do not allow to go down the temperature of the whey below 65 °C during straining.
7. Collect coagulum and fill in hoop lined with strong and clean muslin cloth.
8. Apply pressure of about 2- 3 kg/sq. cm on the top of the hoop for 15 to 20 minutes.
9. Remove pressed paneer from hoop.

10. Soak the block of paneer in chilled water for 2-3 hours.
11. Cut the paneer into pieces.

Assessment activities

1. Prepare a chart showing types of milk commercially available in the local market and their BIS standards.

TE questions

1. The percentage of water content in cow milk is (1 score)
(a. 55 b. 77 c. 87 d. 99)
2. Name the preservation method used for milk in dairy plants before packing for sale. Discuss about the method (4 score)
3. Dahi is a fermented milk product.
 - a. Name another fermented milk product (1 score)
 - b. Prepare a flow chart showing the stages of preparation of that product (3 score)
4. Match the following. (2 score)

A

Cow milk
Ghee
Toned milk
Standardized milk

B

3 % fat
4.5 % fat
3.5 % fat
99.8 % fat

5. Prepare a radio talk on pasteurization of milk (4 score)
6. Arrange the following products into various categories of milk products (paneer, gulab jamun, chhana, khoa, ice cream, cheese, ras gola (4 score)
7. _____ is the sugar present in milk (1 score)
8. The percentage of dry matter content in normal cow milk is
a. 50 b. 25 c. 12.5 d. 7
9. In a dairy plant you have seen that milk is heated to 63 °C for 30 minutes for preservation
 - a. Identify the preservation method adopted here (1 score)
 - b. Write about two other preservation methods for milk (3 score)
10. Fill the blanks after understanding the relation of first pair (2 score)
 - a. Cow milk - 3.5 %
 - b. Buffalo milk -
 - c. Toned milk -
11. Choose the acid coagulated product from the given group and write about the method of preparation (4 score)
(khoa, peda, paneer, ice cream)



Peda



Khoa



Cream



Cheese



Paneer



Butter



Chhana



Rasgola



Gulab jamun

UNIT 2. WHOLESOME MILK PRODUCTION

Overview

Milk is rich in nutrients and thus becomes susceptible to spoilage by microorganisms. Wholesome milk production involves avoiding all such sources of bacterial contamination of milk. To increase the profitability and reduce perishability, chemicals and other substitutes are added to milk which are called adulterants. The important adulterants are also dealt in this chapter.

Learning outcomes

The learner;

- ❖ Practices hygienic methods for clean milk production in cattle
- ❖ Identifies common adulterants present in milk

Concepts

Clean milk production

Wholesome milk production denotes the production of milk with minimum amount of bacteria and keeping it in safe conditions till the milk is processed. Proper hygienic measures and storage should be followed for clean milk production. Milk is a good medium for the growth of bacteria, so care should be taken to reduce the bacterial load in the milk to minimum level. The bacteria enter into the milk through various sources - from udder, milker, environment, utensils, improper storage etc.

Wash and wipe the udder properly before milking. Clip the hairs around the udder and flank region. Inside the udder there is always some number of bacteria, so discard first few strips of milk to reduce the bacteria level in milk. Sub clinical mastitis can be detected by California Mastitis Test (CMT). The hands of the milker should be cleaned properly before milking and he should be healthy with clean habits for proper hygiene.

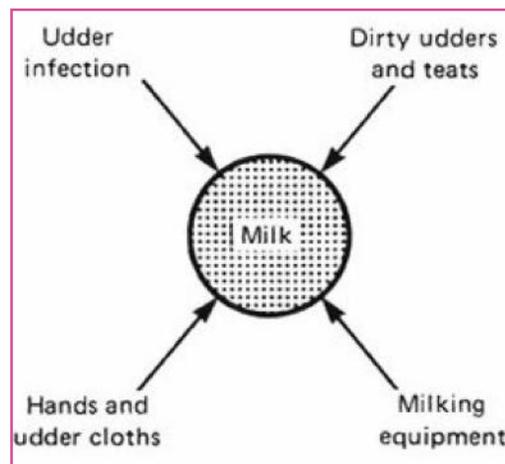


Fig. 91. Sources of contamination of milk

Avoid dusty environment at milking time and falling of dung, urine etc into the milk. Milk pails with small top and hoods can be used to reduce these problems. Also control flies and other insects to avoid contamination of milk. The milk can be strained to remove large particles.

The milk vessels/utensils are main sources of contamination. Usually aluminium vessels are used. It should be thoroughly cleaned with detergents and sanitizers in clean water. Sanitization can be done with hypochlorites. The milk should be cooled to 5 °C to improve the keeping quality after collection.

Source of contamination of milk and control measures

Sources of contamination	Control measures
Exterior of udder	Wash and wipe udder with antiseptic lotion Clip the hair around udder and flank
Interior of udder	Check for mastitis using strip cup or California mastitis test (CMT) Discard fore-milk
Air and dust in cattle shed	Avoid dusty environment at milking time Use small top /dome shaped milk pail Keep milk covered
Flies and other insects	Eliminate breeding places Control flies and insects with mild insecticidal sprays, repellents
Milker	Practice clean habits - cut the finger nails closely, washing of hands with antiseptics, health awareness and free of disease Dry milking (dry udder as well as hands after washing using clean towel/paper towel).
Utensils	Clean, sanitize and dry before use.

Adulteration of milk

The common adulterants present in the milk are starch, sugar and water. The addition of water can be detected by measuring specific gravity of milk using lactometer. Addition of starch can be identified by adding iodine solution and sugar can be detected using Seliwanoff's reagent in to the milk. The fat percentage of milk can be estimated by Gerber's method.

Wholesome milk production



Clean shed



Washing the hands before milking



Correct milking method



Cleaning utensils



Cleaning udder using antiseptics



Sieving of milk

Fig. 92. Wholesome milk production

Practical activities**1. Determination of specific gravity of milk by lactometer****Aim**

To determine the specific gravity of milk using lactometer

Materials required

1. Milk Lactometer (Zeal)
2. Dairy thermometer (10-100 °C)
3. Lactometer Jar
4. Tray
5. Beaker/bottle
6. Milk Sample

Principle

Lactometers are used for rapid determination of specific gravity. This method is based on the law of floatation which states that when a solid is immersed in a liquid it is subjected to an upward thrust equal to the weight of the liquid displaced by it and acting vertically upward. There are two types of lactometers. The normal specific gravity of milk is 1.028-1.035.

1. Quevenne's lactometer which is calibrated at 60 °C
2. Zeal lactometer calibrated at 29 °C

Procedure

1. Well mixed milk sample is filled in a lactometer jar avoiding air bubbles.
2. Insert the lactometer in the lactometer jar.
3. Note the corresponding upper mark of curved meniscus. This is the observed lactometer reading.
4. Note the temperature of the milk sample simultaneously using the thermometer.
5. Obtain the corrected lactometer reading by applying approximate correction factor using the measured temperature of milk. Correction factor of 0.3 is added or subtracted for every 1 degree centigrade above or below 29 °C. The reading thus obtained is corrected lactometer reading (CLR).
6. Specific gravity can be calculated based on the formula,

$$\text{Specific gravity} = 1 + \frac{\text{CLR}}{1000}$$

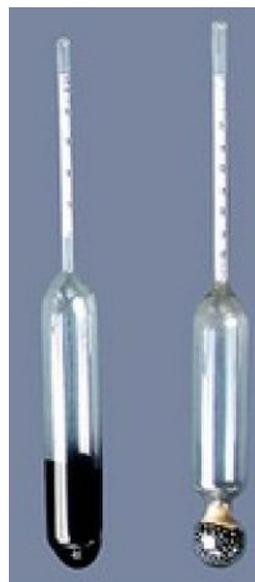


Fig. 93. Lactometer

Activity

Find out the specific gravity of given samples of milk and comment on the result.

Sample No.	Lactometer reading	Temperature (°C)	CLR	Specific gravity	Comments on quality of milk

2. Detection of adulteration of milk**Aim**

To detect common adulterants of milk

Introduction

Milk is a costly commodity and almost a complete food. Some milk vendors/retailers adulterate milk and milk products with various materials to make profit. The common forms of adulteration are

1. Addition of water
2. Addition of separated milk
3. Removal of fat
4. Addition of water and some solid soluble substances like starch, sugar etc

Materials required

1. Lactometer
2. 1% iodine solution
3. Seliwanoff's reagent

Procedure**1. Addition of water to milk****Principle**

If water is added to milk there is reduction in lactometer reading and thereby reduction in specific gravity. If water is added greater than 10 % level it can be determined by SNF content of milk.

$$\text{Percentage of added water} = \frac{S - S_1}{S} \times 100$$

Where S = SNF content of normal milk

S₁ = SNF content of observed sample.

$$\text{SNF \%} = \frac{\text{CLR}}{4} + 0.2 F + 0.14$$

Where CLR is corrected lactometer reading

F is fat percentage of the milk

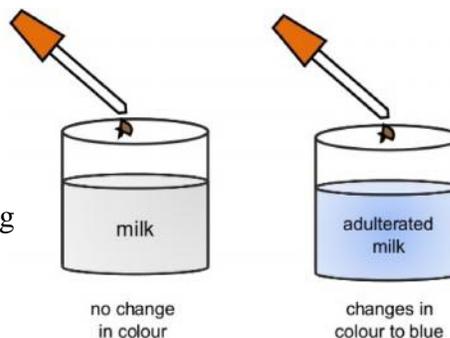


Fig. 94. Adulteration detection - starch

2. Addition of starch to milk

Principle

Iodine solution gives intense blue color with starch due to formation of an unstable starch iodine complex compound.

Procedure

Take about 3ml of well mixed sample of milk in the test tube. Boil the milk over a flame. Cool to room temperature and add one drop of 1% iodine solution. Observe for any colour development. Formation of blue violet colour indicates presence of starch. This colour disappears on cooling.

3. Addition of cane sugar

Principle

When sucrose is present in an acidic medium it gets split to give glucose and fructose, and resorcinol when added gets reduced by the reducing sugars to give red colour.

Procedure

Take 5ml of well mixed sample of milk in a test tube. Add 1 ml of Conc. HCl and mix. Add pinch of resorcinol powder and mix thoroughly. Place the test tube in boiling water for 5 minutes and observe for development of colour. The development of red ring indicates presence of cane sugar as adulterant.



Fig. 95. Adulteration detection - sugar

Changes effected in milk by various forms of adulterants

Sl. No	Types of adulteration	Specific gravity	Fat%	SNF%
1	Addition of water	Falls	Falls	Falls
2	Addition of skim milk	Rises	Falls	Rises
3	Removal of fat	Rises	Falls	Rises
4	Addition of water and some solid soluble substances like starch, sugar etc	Normal*	Falls	Normal*

*it can be made normal

Assessment Activity

1. Detect the adulterant present in the given sample of milk using iodine and resorcinol solutions.

TE questions

1. Prepare a leaflet on “Clean milk production” for circulating among dairy farmers in your locality. (4 score)
2. During milk analysis, when iodine solution is added to milk sample a blue colour is developed. Express your inference on this test (2 score)
3. Name a compound that can be used both as detergent and sanitizer in a dairy plant. (1 score)
4. After collection milk should be cooled to — °C to improve keeping quality (1 score)
 - a. 0
 - b. 2
 - c. 5
 - d. 10
5. Discuss about the environmental factors affecting clean milk production (3 score)
6. Unhygienic milking is a major threat to clean milk production. Substantiate the statement (3 score)
7. Name a reagent used for the detection of sugar adulteration in milk (1 score)

UNIT 3

PROCESSING OF MEAT AND ABATTOIR MANAGEMENT

Overview

Meat processing industry is burgeoning fast in India with many players entering the field. A general idea about the slaughter techniques of various species of animals, slaughter house requirements and activities in an abattoir are presented in this unit.

Learning outcomes

The learner;

- Selects the suitable stunning method for different species.
- Describes the terms associated with meat technology
- Prepares the flow chart of slaughter operations in cattle, pig and chicken
- Explains the importance of ante and post mortem examinations in animals
- Prepares the layout of an abattoir
- Describes the importance of rendering of slaughter house waste
- Defines the importance of HACCP

Concepts

Terminology

Abattoir is the place where animals are slaughtered for human consumption.

Lairage is a place in slaughter house where animals are rested before slaughter.

Humane slaughter: In humane slaughter, an animal must be either killed instantly or rendered insensible to pain until death supervenes. When killing animals for food, they must be stunned prior to bleeding so that they immediately become unconscious.

Carcass: Means the dead body or any part thereof including the viscera of any animal which has been slaughtered.

Meat: Means the flesh and other edible parts of a carcass.

Veal: Meat of calves of less than 3 months of age reared on milk or milk replacer.

Kara beef: Meat of buffalo

Chevon: Meat of goat

Mutton: Meat of mature sheep

Pork: Meat of pig

Stunning

Stunning is the operation for making an animal unconscious.

Stunning pen/stunning box

Stunning pen should be of durable construction, uncomplicated in design and noiseless in operation. Improperly stunned animals may regain their consciousness. For the safety purpose from such regained animals, bars are provided. The floor of stunning box should be properly drained and should be made of non-slip material.

Different methods of stunning

1. Physical method
2. Mechanical method
3. Chemical method
4. Electrical method

1. Physical method

In this method a pole axe or a hammer is used. A blow on the fore head fractures the frontal bone and results in cerebral concussion. The point of aim of blow is the intersection of lines drawn from the base of each horn to the inner corner of the eye of the opposite side. In this point the brain is under the thinnest portion of the skull.

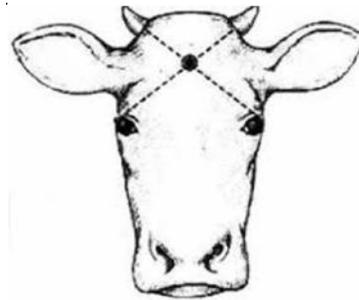


Fig. 96. Site of stunning

2. Mechanical/percussive stunning

In this method a device hits animal's head with or without penetration. Devices used in this method are (a) captive bolt pistol (b) free bullet pistol.

a. Captive bolt pistol: captive bolts pistols work by means of blank cartridge or by pneumatic form. Two types of captive bolt pistols are there *i). Penetrative type* - it produce immediate insensibility. *ii). Non penetrative/ mushroom type* – used when brains are used for edible purpose.

In adult cattle the correct point of stunning is the middle of the forehead where the 2 lines taken from the medial canthus of each eye to the base of the opposite horn cross. The gun is placed right angle to fore head. For



Fig. 97. Captive bolt pistol

pigs the pistol is placed about 2.5 cm above the level of the eyes and fired upwards into the cranial cavity.

b. Free bullet pistol: used to stun horse and sometimes cattle.

3. Chemical method

In chemical method of stunning carbon dioxide gas is used for pre-slaughter anaesthesia of pigs. Gas blocks the nerve endings and reduces speed of nerve impulses. 65-70 % concentration CO₂ air is the most suitable for pre-slaughter anaesthesia. The period of exposure should be 45 seconds and bleeding should be performed immediately before the pig leaves the stunning chamber.

Advantages of CO₂ method of stunning

1. Carcass is more relaxed, so dehairing and dressing will be easy.
2. Less noise and reduced labour requirement.
3. Pork obtained is free from harmful residues.
4. Less haemorrhage in muscles
5. More loss of blood from body while bleeding and lower pH.

4. Electrical method

In this method a low voltage alternating current pass through the brain of animal. Usually used for stunning of pigs, cattle and birds. The instrument used is similar to a pair of tongs. Electrodes are fastened to the jaws.

Advantages of electrical stunning

1. Deep level of unconsciousness
2. The strength and duration of current may be adjusted to the suit the kind of animal.

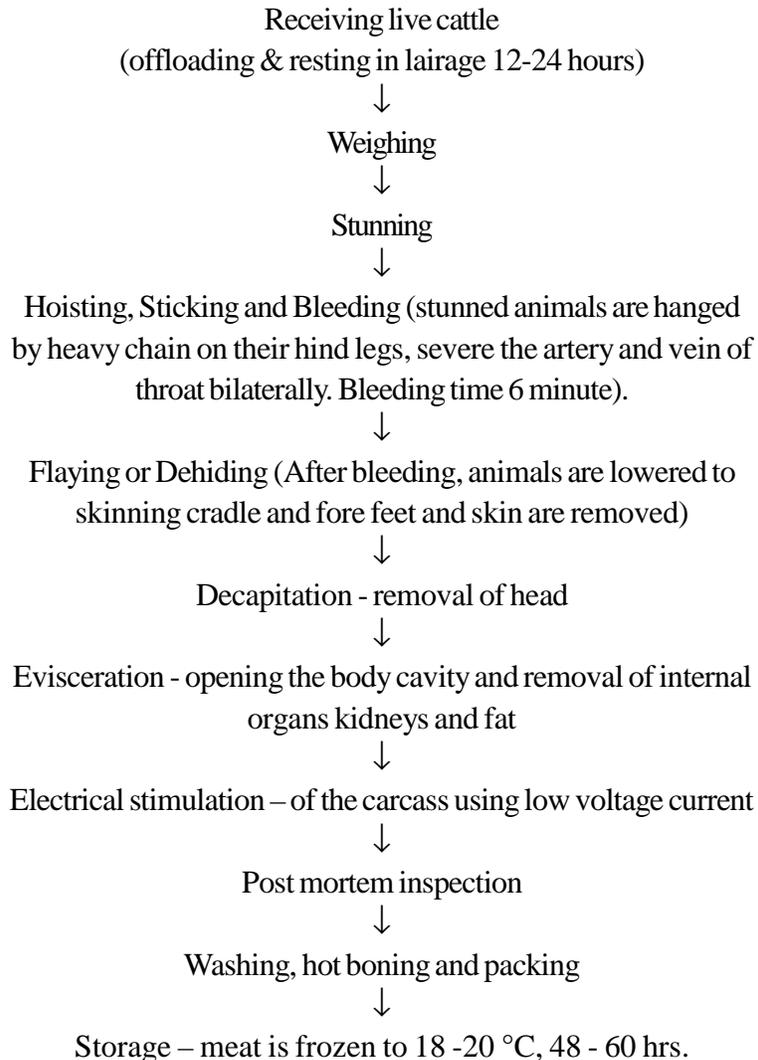
The important disadvantage of electrical stunning is the haemorrhage in muscles. This can be reduced by prior resting and immediate bleeding.



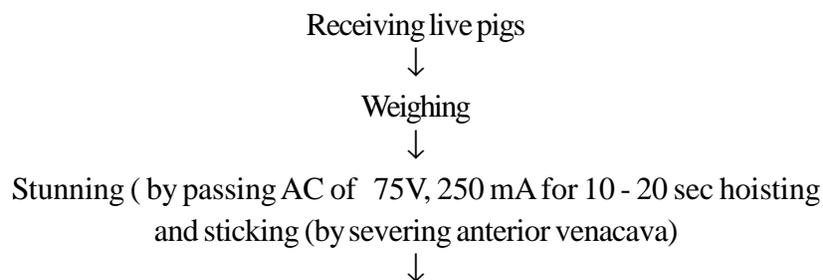
Fig. 98. Water bath for electric stunning

The steps in the slaughter process of different animals are shown below.

Cattle and Buffalo – Steps in slaughter



Pigs - Steps in slaughter



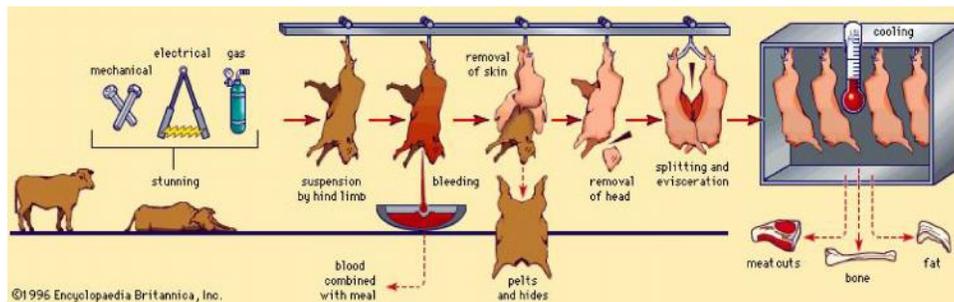
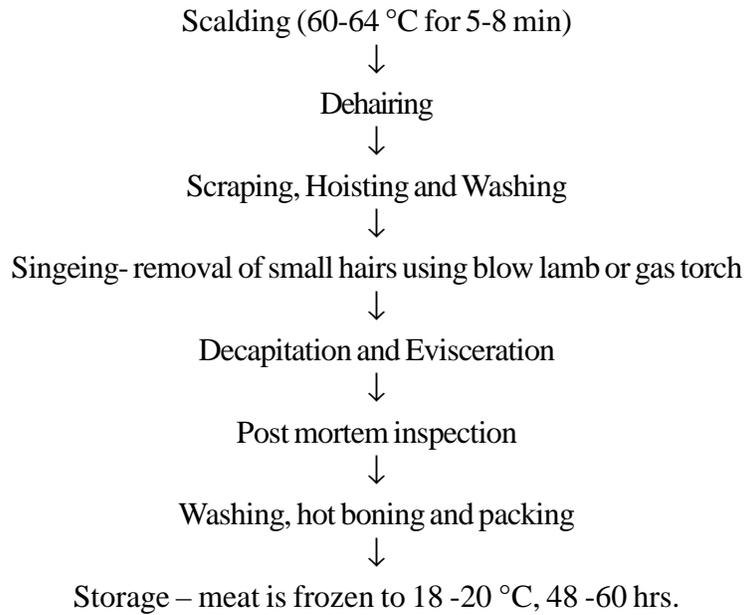
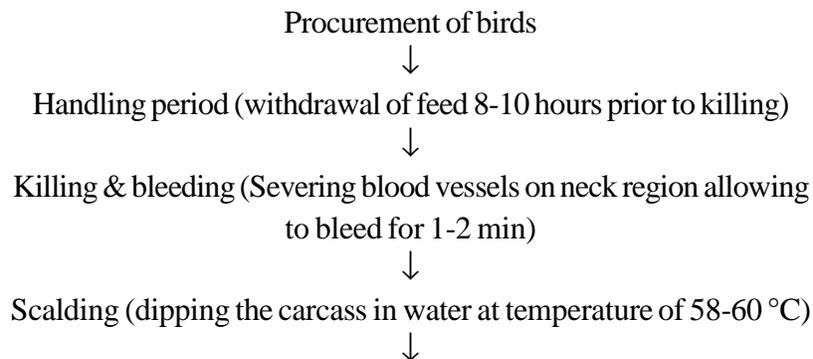
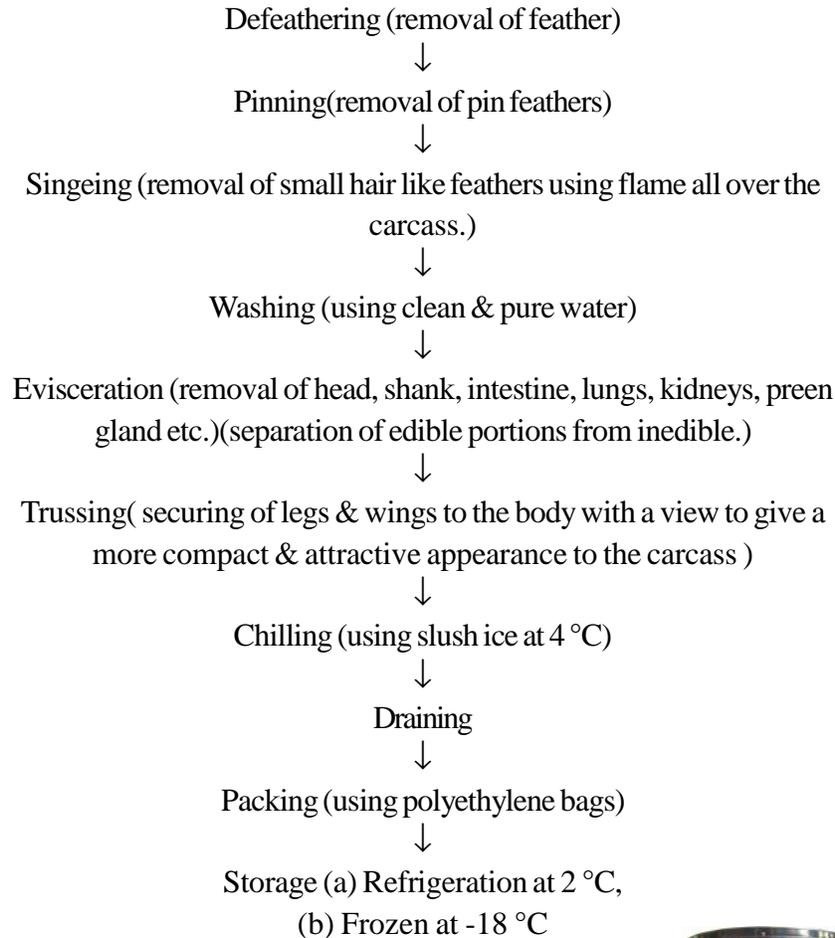


Fig. 99. Slaughter of cattle - steps

Broiler processing - Steps in slaughter





Meat inspection

Primary aim of meat inspection is to provide wholesome meat for human consumption.

It has 2 major components.

1. Ante mortem inspection
2. Post mortem inspection

Ante mortem examination or pre slaughter examination

Ante mortem inspection/examination (AMI) is the first line of defence in the wholesome meat production. Professional examination by a qualified veterinarian before slaughter is the ante mortem examination. Animals intended for slaughter are



Fig. 100. Defeathering machine

inspected in rest and in motion when they are not excited. Animals showing signs of ill health are isolated for detailed examination.

Purpose

- Some diseases are recognised only in AMI
- It will be useful in making a sound post mortem judgement
- Removal of diseased animals by AMI prevent contamination of the abattoir and persons
- Helps in animal disease control programmes

Post mortem inspection (PMI)

Post mortem inspection is the professional examination of the carcass and offals (inedible portions) with the help of laboratory tests, if necessary. This helps to detect and eliminate abnormalities including contamination, thus ensuring that only meat fit for consumption is passed as food. PMI determines character and extent of conditions. In routine PMI, Veterinarian examines the head, viscera, carcass and lymph nodes for any sign of abnormality.

Requirements for a slaughter house

1. Adequate lairage.
2. Room for emptying and cleaning stomach and intestine.
3. Rooms for dressing guts and tripe.
4. Separate room for preparing and cleaning offal, including a separate place for storing head.
5. Separate room for the storage of fat, hide, horn and hooves.
6. Accommodation for sick or suspect animals and place for slaughter of such animals and storage of detained meat.
7. Large chilling rooms.
8. Veterinary room equipped with microbiological and parasitic examination of carcasses.
9. Changing room.
10. Facilities for veterinary inspection
11. Separation of clean and contaminated parts of building.
12. In rooms where work of meat is undertaken water proof floor, rat



Fig. 101. Over head rail system

proof building and suitable drainage system. Smooth wall with light colours, washable coating upto a height of 3 m with curved angles and corners are desirable.

13. Adequate ventilation and steam extraction facility.
14. Adequate lighting in different areas.
15. Adequate supply of water with pressure.
16. Adequate hot water.
17. Waste water disposal system.
18. Work room with adequate equipment for cleaning and disinfecting hand and tools.
19. Equipment for dressing carcass metal cradle, spreaders etc.
20. OHT (Over Head Transmission) system of rail for further handling of meat.
21. Protection against pest.
22. Provision for cleaning and disinfection of vehicles.

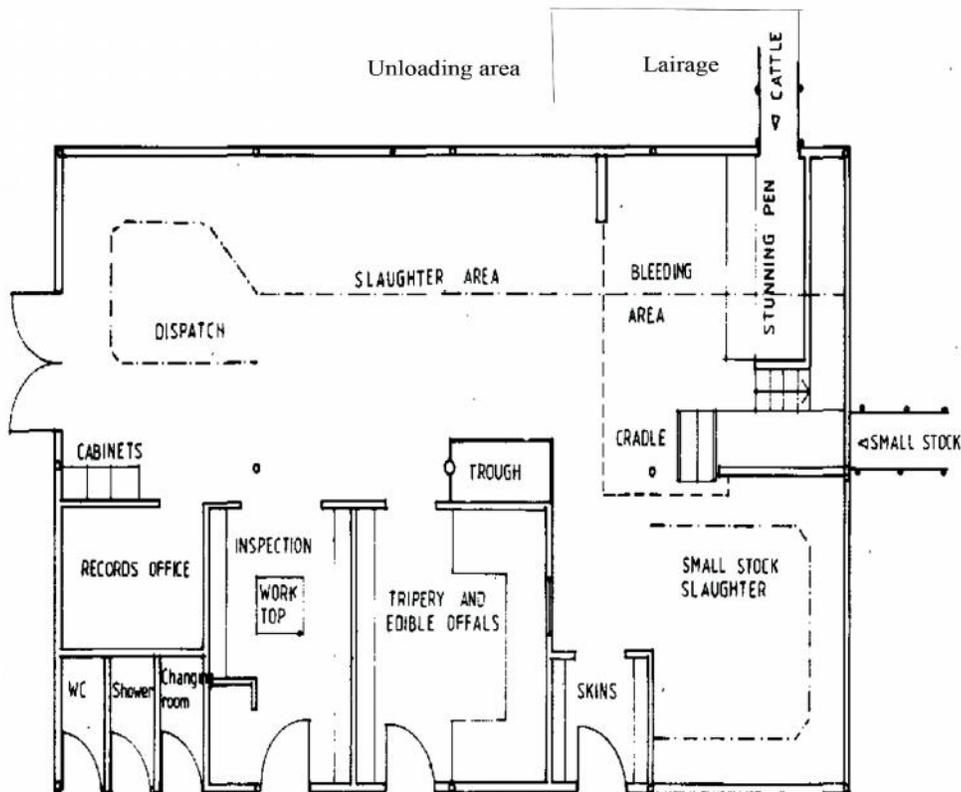


Fig. 102. Layout of an abattoir

Important space requirements

Total Area

Small abattoir - (upto 30000 units/ year) - 1-2 acre

Medium - (50000 units/ year) - 2-4 acre

Large - (over 1,00,000) - 4-6 acre

The off loading platform of lairage should be about 0.9 m or 1.2 m. Space requirement in lairage for animals are Cattle: 2.3-2.8 m²; large pigs: 0.7 m², calves, sheep, goat, small pigs: 0.6 m². Bleeding area for cattle: bleeding trough – 1.5 m; overhead bleeding rail – 4.9 m; dressing rail – 3.4 m. Doors should be wide enough to allow passage. A door width of 4.5 ft is usually adequate.

Lighting

Light required in different areas of slaughter house

540 lux (50 foot candles) at inspection area

220 lux (20 foot candles) at work room

110 lux (10 foot candles) at other area

Rendering of slaughter house waste

Rendering is a process that converts animal waste into stable, value-added materials. It is a heating process for meat industries' waste products through which fats are separated from water and protein residues for the production of edible fat and dried protein residues. Commonly it includes the production of a range of products of meat meal, meat-cum-bone meal, bone meal and fat from animal tissues. There are basically two different rendering processes: (1) High temperature rendering: through cooking or steam application (2) Low temperature rendering (around 80°C).

HACCP (Hazard analysis critical control points)

HACCP - Hazard analysis critical control points – is a system that identifies, evaluates and controls hazards which are significant for food safety.

Hazard analysis - the process of collecting and evaluating information on hazards

Hazard - agents causing adverse health effect

Critical control point- point at which the hazard can be controlled to an acceptable level

Practicals

1. Layout of the slaughter house

Aim - prepare the layout of an abattoir

Principle: A modern abattoir has following components shown in figure for wholesome meat production.

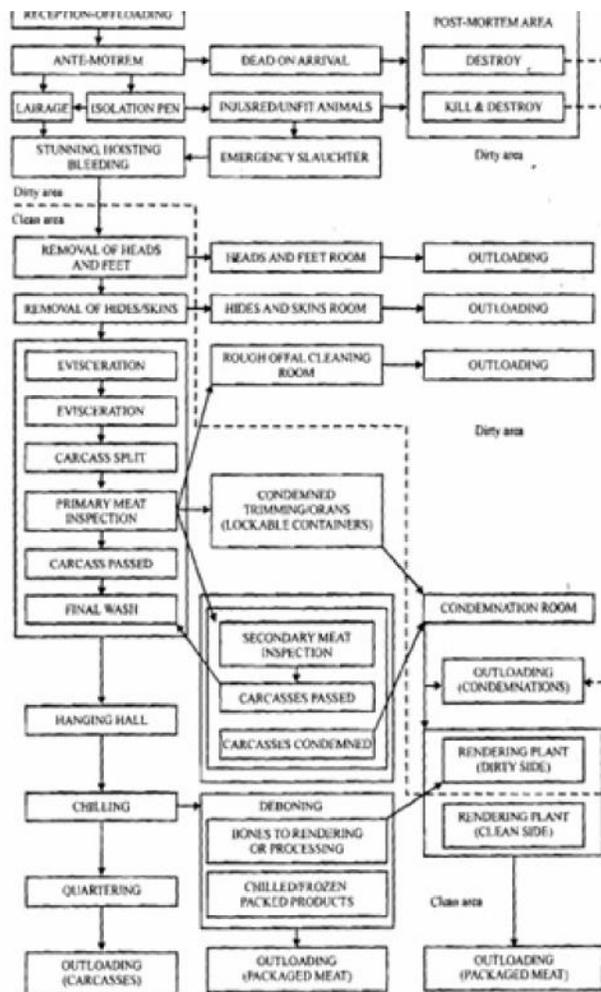


Fig. 103. Structure of an abattoir

Assessment activities

1. Prepare a chart showing various steps in the slaughtering procedure of cattle

TE Questions

1. Meat of goat is called (1 score)
(a. Chevon b. Mutton c. Chevalin d. Pork)
2. Prepare a flow chart on broiler processing (4 score)
3. Discuss about the common method used in meat plants for the disposal of condemned carcasses and slaughter wastes. (3 score)

4. Your father brought a broiler chicken to home during the Christmas time. You happened to see the crude processing techniques of your mother and how will you make her aware of the scientific and hygienic processing of broiler
(6 score)
5. Name the resting place for animals before slaughtering in an abattoir (1 score)
6. Fill the blanks after understanding the relation of first pair (2 score)
 - a. Pig - pork
 - b. Goat -
 - c. Sheep -
7. Before slaughtering the animals are made unconscious
 - a. Name the process (1 score)
 - b. Write about any one method used for making cattle before slaughtering
(3 score)
8. Define the term 'flaying' in buffalo slaughter (2 score)
9. State true or false. If false correct the sentence (1 score)

The scalding temperature for pig slaughtering is 54°C
10. Animals should be examined by a Veterinarian before slaughtering
 - a. Name the examination (1 score)
 - b. Write its advantages (2 score)
11. Name the system used to identify and evaluate hazards in a meat plant
(1 score)

UNIT 4

EGG AND MEAT PRODUCTS

Overview

Animal proteins are the best proteins available to human beings which supply certain amino acids absent in plants. Just like milk, egg and meat are perishable and thus necessitate prompt and scientific processing and preservation. The nutritive benefits of egg/meat, various preservation techniques and common products are presented here.

Learning outcomes

The learner;

- Describes the chemical composition and nutritional values of egg and meat
- Chooses the suitable preservation method of egg according to purpose
- Chooses the suitable preservation method of meat according to purpose
- Lists out various commercial egg products
- Prepares different egg products
- Prepares different meat products

Concepts

Nutritive value of chicken egg

Water - 66 %
Protein - 12 %
Fat - 10 %
Carbohydrate - 1 %
Ash - 11 %

Egg is a rich source of high quality animal protein. It is an important source of unsaturated fatty acids, minerals especially iron and phosphorus, and almost all the vitamins thus forming well-balanced source of nutrients. Vitamin C is absent in eggs. It has low calorific value. Easy digestibility make it a valuable food for diseased persons as well as children. It is possible to enrich table eggs with minerals (iron and iodine), antioxidants (selenium, vitamin E), omega-3 fatty acids and vitamins, such eggs with added nutrients are called enriched eggs. One egg yolk has a cholesterol content of 200-300 mg.

Nutritive value of meat

Water - 75 %
Protein – 20.65 %

Lipid - 2.5 %

Carbohydrate - 1.2 %

Minerals and vitamins - 0.65 %

Meat is a good source of essential amino acids, major fatty acids, potassium, iron and phosphorus. The protein is almost comparable to whole egg. Meat is a minor source of calcium but high in phosphorus. Iron in meat is absorbed by the gut more efficiently than from plant foods. Meat is an important source of B vitamin and traces of Vitamins A and C, but liver and other organs contain all these vitamins comparatively more. Pork is the richest source of thiamin and beef of folic acid. Poultry meat has high nutritive value, easily digestible and has high protein content (20 %). Chicken meat has lesser fat and cholesterol content (60-90 mg per 100 g) than red meats like beef and nutritively closer to milk and egg proteins. Chicken meat has fewer carbohydrates.

Preservation of egg

Chilling - for short period preservation, eggs can be stored at 10-15 °C and 70-80 % relative humidity

Freezing - eggs can be stored for long period (6 month) at -10 °C and 80-90 % RH

Pickling - Eggs can be preserved as vinegar and oil based pickles

House hold methods

- a. Water glass method - The eggs are immersed in 10% sodium silicate solution for 12 hours. A thin layer of silica gets precipitated over the surface of egg shell providing protection.
- b. Lime sealing - 1 kg of quick lime is mixed with 5 litre of water. The supernatant solution is taken and eggs are immersed for 16-18 hours. A thin layer of carbonate is formed around the egg shell which seals the pore. The eggs can be stored for one month at room temperature.

Preservation of meat

Chilling - storage at 0-4 °C for short period

Freezing - storage at -18 to - 40 °C for long period (12 months)

Canning - meat is preserved in brine solution or curry in cans

Thermal processing - The canned products are heated to 115 °C for commercial sterility and it can be stored without refrigeration.

Curing - means salting the meat along with glutamate, ascorbic acid, acetic acid and phosphates- dry and wet curing are there. Cured meat can be stored for 2 weeks at ambient and refrigeration temperature.

Smoking - gives characteristic flavor and colour to the cured meat and preserve the meat by combined action of heat and smoke components like phenol. It can be stored for one month at ambient and refrigeration temperatures.

Irradiation - canned and packaged foods are irradiated by gamma rays for sterilization.

Egg products

Commercial egg products: Commercial egg products are not popular in India but very common in foreign countries. Some of the products are listed here - pasteurized shell eggs, liquid egg white liquid yolk, egg powders (yolk, albumen, whole egg), sugared yolk, whole egg in citric acid. Egg powder – dehydrated eggs prepared by spray drying. Advantages are less weight, reduced storage space and cheaper compared to whole egg.

Other products - puffs, samosa, omelette, egg pickle etc.

Meat products

Sausages

Sausage may be defined as a food consisting of a mixture of minced meat and cereal for binding, spiced and stuffed into casings. Casings serve as a container for the sausage material during the cooking and smoking procedures. Casings can be 1) Natural (made mostly from the sub mucosal layer of sheep intestines) 2) Artificial (made of cellulose) and 3) Reconstituted collagen.

Sausages are economical since these are generally prepared from cheaper and underutilized cuts of meat and by-products of meat industry. Eg: cheek, jowl, head meat, pork fat etc. Meat by-products such as heart, kidney, tongue etc are used in many sausages.

Preparation of Sausage - Steps in processing

1. Mincing

It is advisable to cut the meat in small pieces, prior to mincing it. Fat is also minced in this. Meat grinders are used for mincing.

2. Mixing

The meat obtained by grinding is tumbled in a mixer to give a uniform distribution of fat and lean particles.

3. Chopping

The meat is first added followed by the salts, phosphate, spice mix, condiments and finally binder or filler and chopped together to produce a fine ground emulsion. Chopping is initiated at temperatures below 3°C.

4. Stuffing

Sausage dough or batter is transferred to stuffers for extruding into casings.

5. Linking and tying

After the emulsion is stuffed into casings, the encased mass is tied with thread or fastened with metal clips. In linking sausage, the casings are pressed together at appropriate intervals and twisted around once.

6. Smoking and cooking

The sausages are placed on smoke trees or trolleys and are transferred to the smoke house. During cooking the temperature rises to 68 to 72°C and humidity 35-45%.

7. Chilling

After smoking and cooking, the product is chilled by refrigeration or by dipping or spraying with brine solution to an internal temperature of 1.5 to 4.5°C.

8. Peeling and packaging

After chilling, the cellulose casings are removed. This is known as peeling. Peeling can be done by hand/machines. Peeled sausages can be packed for sale to the consumers.

Practical activities

1. Preparation of egg and meat products

1) Egg pickle

Aim: To prepare vinegar based quail egg pickle

Materials required

Stain less steel vessels, glass jar with air tight lid, stainless steel sieve, stove etc.

Quail eggs - 150 numbers

Synthetic white vinegar – 500 ml

Water – 500 ml

Table salt – 80 g

Spice mixture – 20 g -



Fig. 104. Egg pickle

Peeled and sliced ginger – 20 g

Peeled and sliced garlic – 20 g

(Composition of spice mixture: Red chili - 20 %, Cumin - 20 %, Anise -10 %, Cardamom - 10 %, Caraway - 10 %, Cinnamon -10 %, Turmeric -10 %, Black pepper -7.5 % and Cloves - 2.5 %)

Procedure

Hard boil the eggs by placing them in boiling water for 15 to 20 minutes in a vessel. Keep the boiled eggs submerged in cold water for approximately 5 minutes. Peel off the egg shells and wash with pure water. Place the peeled eggs in a clean glass jar. To prepare the pickle solution, boil the measured amount of water, vinegar and salt together in a pan. Add spice mixture and condiments. Boil it, reduce the flame and allow the mixture to simmer for 10 minutes. Remove the pickle solution from heat. Strain it through a mesh sieve. Pour the solution into the glass jar, over the eggs. Screw on the lid tightly. Place the container in the refrigerator for 3 days before serving. This can be stored for 4 months at room temperature and 12 months at refrigeration.

2) Cutlet

Aim: To prepare chicken cutlet

Materials required

Pressure cooker, cooking pan, mixer, stainless steel vessels, knives etc

Ingredients:

Boneless chicken – 1/2 kg

Potato: 3 numbers

Finely chopped Onion: 1 big sized

Ginger (Chopped): 1 tablespoon

Green chili (Chopped): 2-3 numbers

Turmeric powder: 1 teaspoon

Red chili powder: 1 teaspoon

Pepper powder: 1 teaspoon

Garam Masala: 1 teaspoon

Bread crumbs: 1 cup

Beaten Eggs: 2

Salt: as needed

Oil: for frying



Fig. 105. Meat cutlet

Procedure

1. Cook the potatoes in a pressure cooker, peel and mash it. Keep it aside.
2. Cut the chicken in to small pieces and apply the red chili powder and turmeric powder on the pieces and keep aside for 10-15 minutes.
3. Cook the chicken pieces in a pressure cooker with a little water and salt.
4. Mean while in a pan pour some oil and heat it. Add the chopped onions, ginger, green chillies and sauté till it turns translucent and soft.
5. Mince the chicken in a mixer and add it to the pan along with the pepper powder and garam masala. Sauté it for 10- 15 minutes.
6. Turn off the flame and allow the mixture to cool for 10 minutes.
7. Once it is cooled add the mashed potatoes and mix well using hands. (The mixture should hold shape when rolled into balls).
8. Roll out small portions of the mixture into lime sized ball and flatten it between the palms to give it shape.
9. Dip each cutlet in beaten egg and roll them in breadcrumbs, making sure that all sides are nicely coated.
10. In another pan heat the oil and fry the cutlets in medium flame till they are golden brown.

Assessment activities

1. Collect commonly available egg and meat products from local markets and conduct an exhibition

TE questions

1. How can you preserve shell eggs using sodium silicate and calcium oxide?
(3 score)
2. Discuss about the common methods used for the preservation of meat
(4 score)
3. In a seminar organized by health department, the dietitian opined that constant use of high cholesterol meat like beef can lead to heart problems. Your friend who eats beef was panicked. Suggest a safer meat quoting its advantages.
(3 score)
4. An ovoid “cell” laid by female species of birds is one of the best nutritionally balanced diet available to humans. Substantiate the statement. (4 score)
5. You are directed to store the chicken eggs for six months in a hatchery. Describe the preservation method followed in this situation
(2 score)

6. Prepare a flow chart showing the preparation of meat sausage (3 score)
7. Name a dehydrated egg product (1 score)
8. The percentage of water is more in (1 score)
 - a. egg b. meat c. milk d. egg powder
9. discuss about smoking method of preservation of meat (2 score)



Fig. 106. Meat and egg products

UNIT 5 ZOO NOTIC DISEASES

Overview

Zoonotic diseases are those diseases transmitted from animals to man and vice versa. An awareness of such diseases can prove helpful for those persons who handle animals and work in animal related fields.

Learning outcomes

- Describes and differentiate various zoonotic diseases
- Identifies different zoonotic diseases in animals
- Identifies different food borne diseases originating from livestock products

Concepts

Definition of zoonoses and classification

Zoonoses

Those diseases naturally transmitted between animals and man

Anthropozoonosis - diseases transmitted from animal to man, Eg. - brucellosis

Zooanthroposis - diseases transmitted from man to animal, Eg. - human TB

Amphixenosis - diseases transmitted between man and animal, Eg. - staphylococcosis

Common zoonotic diseases

Anthrax

Caused by *Bacillus anthracis*

Mode of transmission- contact, ingestion, inhalation

Prevention and control- disinfection, proper disposal of carcass, immunization, post mortem and slaughter should not be conducted in infected animals.

Tuberculosis

Caused by *Mycobacterium bovis*.

Mode of transmission - ingestion, inhalation.

Prevention and control - avoid contact, immunization, health education, treatment.



Fig. 107. Anthrax

Rabies

Caused by Lyssa virus

Mode of transmission - bite of animal, lick and scratches on abraded skin

Prevention and control - avoid stray dogs and cats, immunization, health education, control rabies in wild animals

Brucellosis

Caused by *Brucella abortus*

Mode of transmission - contact, ingestion, sexual contact

Prevention and control - disinfection, proper disposal of placenta, immunization, pasteurization of milk, health education

Leptospirosis

Caused by *Leptospira icterohaemorrhagiae*

Mode of transmission - contact, ingestion, inhalation

Prevention and control - disinfection, proper disposal of garbage, immunization, control of rodents, protective clothing.

Avian influenza

Caused by Influenza (orthomyxo) virus.

Mode of transmission - contact, ingestion, inhalation.

Prevention and control - disinfection, proper disposal of garbage, immunization, protective clothings.

Important Food borne diseases originating from livestock products

Colibacillosis - caused by *E. coli*. The common sources of *E. coli* in livestock products are contaminated water with faecal matter and unhygienic practices of handling. Main symptom is massive watery diarrhoea.

Cholera - caused by *Vibrio cholerae*. Products are affected with contaminated water. The main symptom is watery stool and abdominal pain.

Botulism - caused by clostridium botulinum. It is an anaerobic organism found in soil mainly affect canned products. It produces a potent neurotoxin which is fatal to human.

Taeniasis - caused by *Taenia saginata* and *T. solium*. Ingestion of viable form of larvae (cysticercus) in meat of cattle and pork (measly pork) cause infection in human.

Control of food borne diseases

1. Sanitary disposal of human excreta
2. Maintenance of strict hygienic practices during production, processing, storage and handling of livestock products
3. Control of flies
4. Proper cooking and heat treatment of products
5. Proper awareness to society

Practicals

Prevalence of zoonotic diseases in the locality

Aim - Identify the common zoonotic diseases prevail/present in your locality

Principle: Zoonotic diseases are diseases transmitted between man and animals. Proper identification and control of these diseases are important for guarding public health.

Activity: Visit the nearby veterinary hospital and inspect the outpatient register for information about the prevalence of common zoonotic diseases in your locality. Prepare a table showing the details about the zoonotic diseases.

Place:

Sl. No	Date	Zoonotic disease	Species of animal affected	Number of animals affected

Assessment Activities

1. Prepare slides of common zoonotic diseases for power point presentation

TE Questions

1. Discuss about any two zoonotic disease prevail in your locality (3 score)
2. Name a food borne disease caused by bacteria clostridia (1 Score)
3. Name one examples each for anthroozoonosis and zooanthroponosis (2 score)
4. Discuss about the zoonotic disease caused by lyssa virus (3 score)
5. Which of the following is not a food borne zoonotic disease (1 score)
 - a. cholera
 - b. taeniasis
 - c. botulism
 - d. black quarter
6. Discuss about a zoonotic disease caused by bacillus bacteria (2 score)

UNIT 6

ANIMAL WELFARE AND FOOD SAFETY GUIDELINES

Overview

Human beings are the dominant species on this planet now. With this prevailing anthropocentric view point, animals are considered inferior and several cruelties are done on small and large animals like in the form of poaching, illegal transportation and slaughtering, unethical animal experimentation, hunting etc. To prevent such incidences several guidelines are there, out of which some are presented here. Animal products like milk, meat and egg form the staple diet of human beings. Various hazards could occur during the processing of these foods and an understanding of guidelines for food processing is aimed in this chapter.

Learning outcomes

The learner;

- Identifies various cruelties to animals
- Describes specifications for transportation of animals
- Describes important food standard and safety practices.

Concepts

Prevention of cruelty to animals act (PCA) -1960

It is an act to prevent the infliction of unnecessary pain or suffering on animals and to prevent cruelty to animals.

It refers to general cruelty to animals like beats, over rides, tortures, keeping confinement without necessary opportunity for movement, mutilation or killing of animals, unreasonable administration of injurious substances, carrying on vehicles in such a manner that it causes unnecessary pain, keeping chain for unreasonable time or habitual chaining, owner fails to provide sufficient water, feed and shelter, willfully permitting the animal to die in streets without treatment

Exhibition and performing training of animals should be registered legally for that purpose. Exemption should be given to military purpose, education and scientific purpose by eligible institutions

Persons or institutions carrying on experiments should be registered legally. Experiments should be performed with due care and humanity, if possible under

anaesthesia. Experiments on animals should be conducted only in unavoidable situations, otherwise make use of alternatives like books, multimedia, simulation etc. Animals used for experiments should be properly looked before and after experiment. Keep proper records of all activities.

Transportation of animals

Transport of animal rules - 1978 was published as a sub section of PCA act.

Animals transported shall be healthy and in good condition and such animal shall be examined by a veterinarian for freedom from infectious disease and their fitness to undertake the journey. An animal that is new born, diseased, blind, emaciated, having given birth preceding 72 hours or likely to give birth during transport shall not be transported. Pregnant and very young animals shall not be mixed with other animals during transport. Troublesome animals shall be tranquilized before transport.

The maximum distance allowed for cattle in a day while transport on foot is 30 km and travelling time is 8 hours per day mainly in cooler hours.

During transport by road 6 large animals or 12 smaller calves can be loaded in a lorry. The space required for each cattle is 2 m². In rail transport an ordinary goods wagon shall carry not more than 10 adult cattle or 15 calves.

The space required for each poultry cage during transport of chicken is 2 ft × 2 ft × 2 ft.

Food safety and standard act (FSS act) - 2006

It is an act to consolidate the laws relating to food and to establish the food safety and standards authority of India for laying down science based standards for articles of food and regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption and for matters connected there with or incidents there to.

The level of following substances or contents in the food should be in accordance with the provision of FSS act and regulations

- Food additives
- Contaminants, naturally occurring toxic substances, heavy metals etc
- Pesticides, veterinary drug residues, antibiotic residues and microbiological counts
- Genetically modified foods, organic foods, functional foods, proprietary foods etc

Functional food - processed specially to satisfy particular dietary requirements due to physical or physiological conditions or diseases.

Proprietary food - food for which standards are not specified, but are not unsafe

The act also deals with packaging and labeling of foods and restriction of advertisement and prohibition of unfair trade practices.

Practicals

1. BIS standards of common livestock products

Aim - assess the standards of various livestock products by verifying the BIS standards

Principle: Purchase common milk products from market and compare its contents with BIS standards and assess its quality.

Activity- prepare a table showing the BIS standards of cow milk, toned milk, double toned milk, icecream and paneer and compare it with the purchased products from market to assess the quality.

Sl. No	Item	Fat percentage	SNF %	Others

Assessment activities

1. Prepare a chart showing the common cruelties to animals in your locality

TE questions

1. List out the common cruelties to animals (2 score)
2. Which are the regulations we should follow for the transportation of animals by road (2 score)
3. The space requirement for cattle during transportation by road is (1 score)
 - a. 2 m²
 - b. 1 m²
 - c. 3 m²
 - d. 4 m²
4. Describe the measures followed for experimental animals as per PCA act (2 score)
5. The maximum distance allowed for cattle in a day while transport on foot (1 score)
 - a. 10 km
 - b. 20 km
 - c. 30 km
 - d. 40 km

Extended activities

Veterinary Hospital visits, field visits to milk/meat product marketing units, meat plant/slaughter house visit, expert classes, exhibitions of products, dairy co-operative society visit, dairy plant, camps associated with animal husbandry department, OJT, dairy farm visit.

List of Practicals

1. Preparation of traditional milk products
2. Determination of specific gravity of milk by lactometer
3. Detection of adulteration of milk
4. Layout of the slaughter house
5. Preparation of egg and meat products
6. Prevalence of zoonotic diseases in the locality
7. BIS standards of common livestock products

LIST OF REFERENCES

1. 19th Livestock Census. (2012). All India Report, Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi: p. 120.
2. Ballard, B and Rockett, J. (2009). Restraint and handling for veterinary technicians and assistants. Delmar Cengage Learning Inc., Cifton Park, USA: p. 172.
3. Banerjee, G.C. (1992). A Textbook of Animal Husbandry. 7th Edn. Oxford and IBH publishing Co. Pvt. Ltd., India.
4. Basic Animal Husbandry & Fisheries Statistics. (2014). Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi: p. 156.
5. Bundy, C.E and Diggins, R.V. 1999. Livestock and poultry production. 3rd ed. Blackwell publishing, UK: p. 298.
6. Food safety and standards act. (2006). Ministry of law and justice, Government of India, No. 34. New Delhi. India: p. 69.
7. Ghosh, N and Samanta, R. (2008). Manual on Avian Production and Management, 1st Edn. International Book Distributing Co., Uttar Pradesh, India: p. 156.

8. Indian Standard, Poultry Feeds - Specification (5th Revision) IS 1374 (2007), Livestock Feeds and Equipment Systems Sectional Committee, FAD 5, Bureau of Indian Standards, New Delhi. Pp. 1-30.
9. Kumar, D. S. (2015). Aruma Pakshikal Alamkaarathinum Aadaayathinum. 7th Edn. Manorama Books., Kottayam, India: p.208
10. Leeson, S. and Summers, J. D. (2001). Nutrition of the chicken. 4th edition. International book distributing Co., Lucknow: p. 591.
11. North, M.O and Bell, D.D. (1990). Commercial chicken production manual. – 4th Edn. Chapman and Hall, New York: p. 913.
12. Package of Practices. (2001). Kerala Veterinary and Animal Sciences University. Thrissur, Kerala, India: p. 266
13. Pattison, M., McMullin, P., Bradbury, J.M and Alexander, D. (2008). Poultry Diseases. 6th Edn. Elsevier Health Sciences. New York: p. 611.
14. Prevention of Cruelty to Animals Act. (1960) as amended by Central Act 26 of 1982, Government of India, New Delhi: p.23.
15. Rimler, R. B., and Glisson, J. R. (1997). Fowl Cholera. In B.W. Calnek, H. J. Barnes, C. W. Beard, L. R. McDougald, & Y. M. Saif. (Eds.), *Diseases of Poultry* (pp. 143-159). (10thed). Ames, Iowa: Iowa State University Press.
16. Sharp, P. E. and LaRegina, M. C. (1998). The Laboratory Rat. 1st Edn., CRC Press, Philadelphia: p. 204.
17. Singh, R.A. Poultry production. (1990). 3rd Edn. Kalyani Publishers, Ludhiana, India: p. 361.
18. Smith, F. W. K. (2012). Veterinary Medical Guide to Dog and Cat Breeds. Teton New Media. New York: p 705
19. Suckow, M. A and Douglas, F.A. (1997). The Laboratory Rabbit. 1st Edn., CRC Press, New York: p. 166.
20. Suckow, M. A, Danneman, P and Brayton, C. (2001). The laboratory mouse. 1st Edn., CRC Press, New York: p. 167.
21. Sukumar De. (1980). Outlines of Dairy Technology. 1st Edn. Oxford University Press, New Delhi, India: p. 539.

Web references

- http://www.dogbreedslist.info/Tags-S/list_47_2.html#.Vva7jjGnGyA (accessed on March 27, 2016)
- <http://dogtime.com/dog-breeds> (accessed on March 27, 2016)
- <https://en.wikipedia.org/> (accessed on March 27, 2016)
- <http://www.merckvetmanual.com/mvm/> (accessed on April 08, 2016)
- <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=76191> (accessed on March 01, 2016)

NB: *We do not own the copyright of the figures/photographs presented in this manuscript and the figures are open source to the best of our knowledge. As it is not practical to show the source of all images, we are not listing them in this manuscript, though we thankfully acknowledge the help of those photographs in improving the quality of the manuscript.*