

Commercial Poultry Farming



Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
Sanothimi, Bhaktapur

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**Technical and Vocational Stream
Learning Resource Materials**

**Commercial Poultry Farming
(Grade 11)**

**Secondary Level
Animal Science**



**Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
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Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline and self-reliance, creativity and thoughtfulness. It is essential to develop in them the linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills. It is also necessary to bring in them the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values so as to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This Learning Resource Material for Animal Science has been developed in line with the Secondary Level Animal Science Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops and seminars, interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Dr. Lekhnath Poudel, Prof. Dr. D.K. Singh, Dr. Shambhu Sah, Dr. Yam Bahadur Gurung, Dr. Shishir Bhandari, Dr. Asmita Subedi, Ganesh Gautam, Dr. Shusila Shrestha, Dr. Kiran Pokhrel and Bhumika Poudel is highly acknowledged. The book is written by Dr. Hari Prasad Panta and the subject matter of the book was edited by Badrinath Timsina and Khilanath Dhamala. CDC extends sincere thanks to all those who have contributed in developing this book.

This book is a supplementary learning resource material for students and teachers. In addition they have to make use of other relevant materials to ensure all the learning outcomes set in the curriculum. The teachers, students and all other stakeholders are expected to make constructive comments and suggestions to make it a more useful learning resource material

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Unit - 1

Introduction

1. Historical background of poultry farming

Poultry farming was started in Nepal centuries before but the development of poultry farming was not satisfactory. It is said that chicken was provided to army and battalions. Generally Brahmin people of Nepal did not use to take chicken along with pork. It was regarded as taboo in community. So poultry was only limited to Limbus and Rais people in the past. The historical background of poultry farming in Nepal was developing as follows:

Date (BS)	Event
2010	Conventional management of native breed.
2014	Import different species like Black Minorca, white leghorn and Rhode island red.
2017	Established central Hatchery at Parwanipur Bara, Helping by USA providing 1700 new Hampshirechicks.
2018	Late King Mahindra inaugurated Central Hatchery
2019	Ratnafeed, Kantipur poultry farm and Joshi poultry farm imported hybrid chicks and distributed to farmer.
2024	Production of Ranikhet and Fowl pox vaccine at Central Biological Production Laboratory Tripureswor
2028	Established Hatuda cattle feed plant to produce poultry feed.
2030	Brooder farm running at Khumaltar
2027 - 2037	Established Hatcheries at Pokhara, Tarahara and Nepaljung
2040	Started Local poultry development programme
2045	Vaccination against Gambaro and biosecurity strategy along with poultry stakeholder
2047	Established Avinash group
2048	Imported Giriraja from India by NARC for research and development

2050	Pancharatna started commercial broiler production.
2052	First Chitwan Poultry Expo
2055	Animal Health and livestock service Act 2055 and Slaughterhouse and Meat Inspection Act 2055 established.
2057	Established Livestock and poultry promotion directorate.
2058	Imported Japanese quail and Turkey from India
2060	Control the disaster of Litchii Heart Diseases
2061	Established central swine and poultry promotion programme
2062	First pellet feed mill (Probiotec Industries) established.
2065	Exporting egg and chicken to Bhutan
2066	First time outbreak of birdflu (H5N1) in Jhapa district.

Source: Department of Livestock Service, Hariharbhawan

2. Pioneer commercial poultry raisers in Nepal

Ratna feed, Kantipur poultry farm and Joshi poultry farm imported hybrid chicks and distributed to farmer. **Avinash Hatchery** was the pioneer in the production of broiler and layer. Nowadays poultry production is a growing industry which accounts for about 3.5% of total GDP. Nepal lies at 112th position for chicken meat production of world, which is at the 92nd for egg production in world.

3. Poultry statistics

There is no doubt to say that, Nepal is an agricultural country. About 33.7% of people in Nepal depend upon agriculture for their livelihoods. Livestock production is an important agricultural subsector in Nepal, accounting for about of 8% agricultural GDP, and about 4% of total national GDP. Numerous people are involved in production, slaughtering, processing and trading of livestock and livestock products. History of commercial poultry production in Nepal is not very old but, in non-commercial scale its history is very old. Poultry farming have emerged as a major income generating enterprise in agriculture sector over the last three and a half decades. Today, poultry production has become one of the most rapidly growing enterprises within the reach of the poor, women, marginal farmers and entrepreneurs,

considering the trends of population growth, urbanization, road access, transportation linkages, increasing awareness on nutrition and growing demands for consumer products, increasing international level restaurants, it will be safe to assume that poultry sector will constantly grow in a foreseeable future. In addition, since poultry farming are within the reach of all classes of society, including women, marginal farmers and schedule caste and tribes, it could become one of the government's strategic activities for poverty reduction and for reaching the most disadvantaged socio-economic groups. In Nepal, the national poultry flock includes chickens, ducks, pigeons and other birds that are kept in different production system.

Ranking

- Chicken meat production ranking in the world: 112th
- Egg production ranking in the world: 92nd
- Laying hen 12,388,889(2016/017)
- Chicken meat 57268mt(2016/017)
- Egg production 1352296000 (2016/017)
- GDP contribution by agriculture: 33.7 percent
- GDP contribution by poultry: 3.5 percent
- Investment: NRs 22billion industry
- Export: No history of export, recently started exporting broilers/eggs to Bhutan
Import: 1 091 7309 (985 503 broiler and 107 894 layer parent stock in 2011/2012), ample evidence of informal trade of local, broiler live chickens, eggs and dressed chickens from India in cross-border districts.
- Growth rate: 17-18 percent
- Number of farms: More than 1 000 broiler farms and 500 layer farms
- Grand Parent stock: established by Cobb-Nepal with start of production from September 2013 Supporting industries: 98 hatcheries, 111 feed industries
- Employees: 70 000 direct and many more indirectly
- Production: 1 170 573 broilers and 118 208 layers chickens per week
- Feed production: 646 845 tones in 2010/2011
- Demand of poultry meat/day: 150 000 kg/day

Source: FAO. 2014. Poultry Sector Nepal. FAO Animal Production and Health Livestock, Country Reviews No. 8. Rome

1.4 Importance, scope, problems and contribution to NGDP and AGDP

Importance of Poultry in Nepal:

- Unproductive, low land area produce high product.
- Fast gain (within 40 days)
- Chief source of Human food and nutrition(Protein)
- Any age group and community easily accepts.
- Livelihood and generate self-employment.
- Poverty elevation
- Easy source of income
- Utilization of waste food to convert valuable meat and egg.
- Decrease malnutrition
- Contribution to National economy (NGDP and AGDP)

Scope and constrain:

So far as the scope of poultry in Nepal is concerned, poultry farming has a great and good scope in present context. People are being engaged in poultry farming because of more profit. Some of the reasons for the increment in its scope are summarized under the points given below:

- Increase in the number of hatchery farms and consumers of the poultry product.
- People are being educated thus consumers of poultry products have been increased.
- Products can be obtained within short period of time in case of the meat production.
- Poultry farming provides the employment opportunity all-round the year.
- Poultry meat, egg as well as litters can be used.
- Decrease malnutrition

Talking about the constraints of the poultry farming in Nepal:

- Unavailability of the required materials like vaccines, medicines in time.
- Some disease which appears suddenly like bird flu has become a great threat to Nepalese poultry farming.
- No proper and adequate support from the government side.

Conclusion:

From the above data regarding the present poultry condition in Nepal we can draw some conclusions which are summarized under the following:

- Terai has maximum percentage share in poultry population and the mountain has the least.
- Central development region has the maximum share in poultry population whereas far-western development region has the least.
- Hills have maximum contribution in egg production and the mountain has the least.
- In belt wise meat production share terai has maximum contribution and the mountain has the least.
- In region wise meat production, central development region has the most and the farwestern development region has the least contribution.
- In egg production hill contributes the most and the mountain the least.
- Production and farming of duck is very less as compared to the chicken so duck production can be improved where there is possibility.

Above concluding points reveals that, for the betterment of poultry farming people of mountain should be taken into focus during policy making. They should be encouraged to be involved in this sector. Reasons why the mountain is back in poultry production should be explored and the solution measures should be implemented. Similarly, far western development region is also backward in poultry production than other regions. It may be due to the lack of transportation facilities, unavailability of the required materials in time and lack of the market. Thus, in FW development region those problems should be solved in order to uplift the poultry status. In case of egg production, hill comes the first so layers can be promoted in the hilly regions if poultry meat production cannot be better than the egg production.

Furthermore, it can be concluded that present status of the poultry farming in Nepal is very good. If some constraints in this occupation are solved then poultry can also be a good option for addressing food security problem also. People should also be more motivated towards this occupation. Support from government side should be increased. A major threat in this occupation; some diseases if are prevented then poultry could be one of the major part of Nepalese economy.

Unit-2

Care and Management

2.1 Broiler and Layers

Care and Management of Layers

Care and management of laying birds generally from 20 weeks up to 72 weeks is known as care and management. Maximum hen housed egg production with fair egg size, feed efficiency and minimum mortality are the basic goals of layer farming. Following points must be taken into consideration during layer management.

1. Segregation and transfer of pullet

Ready to lay pullets should be shifted from grower to layer sheds around 16 to 18 weeks to allow one to two weeks adaption period before laying starts. Underdeveloped pullets should be segregated while transferring them to layer sheds and be housed in separate compartments or cages to allow them extra nutrition to achieve normal standard of growth, these segregated pullets are fed 25 extra proteins along the additional minerals and vitamins including liver tonic to gain normal growth within three to four weeks. The pullets which are crippled, emaciated, injured and infected are discarded at the time of transfer.

2. Lighting

From 21 weeks onwards ,the layers should be provided with artificial light starting with total 14 hours duration and gradually(o.5 hr/ wk) be increased to reach to 16 hours and kept constant up to 42 weeks of age. At the age of 43 weeks, it is again gradually increased to 17 hours. The total artificial light may be divided equally in the morning and evening. The appropriate lighting schedule stimulates egg production by 4-6%.

3. Floor, Feed and water space

Floor space of 1800-2200 cm² per bird on deep litter and 337-375 cm² per bird in cages is recommended for layers. About 12-15 cm linear feeder space and 2.5 cm water space per bird is adequate.

4. Temperature

The comfortable temperature for optimum laying ranges from 18.3⁰c to 21.5⁰c(65-70⁰f). Egg production starts declining when temperature rises more than 27⁰c. The effect of cold weather becomes more prominent when temperature drops below 12.8⁰c.

5. Feeding and watering

Layers generally should be provided with around 110-120 gm of feeds daily. Ample amounts of fresh clean water should be provided. As a thumb rule, birds drink 2.5 to 3 times of water of feed consumed depending on season and size of birds.

6. Vaccination

Vaccination should be done as per schedule. In laying condition, generally in our case depending upon the farm and location, vaccination of IB+ND is repeated in every 2-3 months.

7. Culling

Low egg producing and diseased birds should be culled from the flock.

8. Nests

In deep litter system, nests should be provided for laying. 1.5 m long and 0.6 m deep nests divided into three portions equally (0.5 m) is enough for 50-60 birds.

9. Deworming

Birds should be dewormed in every 2-3 months.

1. Reducing stress factors such as vaccination, medication especially antibiotic in disease outbreaks, improper and restricted feeding, extreme weather changes, starvation, high production and shifting from one to another house induce stress in chickens. This results in drop in egg production, poor growth and increased susceptibility to diseases. Administration of electrolytes, vitamins, minerals, controlling, effect of weather changes helps to reduce or combat stress on birds.

Care and management of Broiler

The desired weight at earlier age with efficient feed conversion ratio (FCR) with minimum mortality is prime objectives of broiler rearing. The management on respect of brooding, feeding, watering, litter management, lighting and diseases remains the same as that of layer chicks with litter variation for floor space, feeding, vaccination

and other managerial practices.

1. Floor space

A floor space of 450 cm² upto 4 weeks and 750-850 cm² from 5-7 weeks are sufficient to achieve maximum performance. Inadequate space will lead to slower growth rate, increased respiratory ailments and sometimes cannibalism also. Therefore floor space allotment plays an important role in growing efficient broilers.

2. Feeding

Broilers are fed special feeds to cope up their faster growth. They are offered broiler starter mash from day old to 4 weeks of age and broiler finisher mash from 5 weeks onwards till disposal. These are high energy and high proteinous rations when compared to layer and breeder diets.

3. Vaccination

Only few vaccinations are recommended in the schedule serves the purpose. However, the vaccination schedules can vary from area to area depending on the disease prevalence.

4. Debeaking and deworming

Usually these activities are not required due to the short span of life.

5. Separate sex and rearing

Broilers are straight run chicks, they are not sexed at day old age. However, visual sexing is possible at four weeks of age by earlier appearance of combs in case of males, some of farmers adopt separate sex rearing from 4-5 weeks onwards to take added advantage of faster growth in males for earlier disposal by 5-6 days to enhance profitability.

2.2 Care and management of grower and pullets

The care and management essentially remains the same as that of chicks except that they neither require artificial heat nor artificial light in the night, grower need 8-10 hour light in a day, as the age advances, floor, feeder and water spaces are increased to 900-1900 cm², 7-10 cm (Linear) and 1.5 to 2.5 cm (Linear) respectively. Water intake depends on temperature, humidity, feed constitutes, air circulation, activity and age. The intake of water is higher when temperature exceeds 28⁰c.

Periodic deworming (once in 2.5 -3 months) usually one week prior to R₂B vaccinations is helpful to keep away birds parasitic infestation. Preferably deworming should be carried out either early in the morning or late in the evening to avoid the stress on birds. Pullet are reared on natural day length and never provided artificial light. If this is not observed, early maturity of pullet can lead to production of number of small eggs and increased incidence of prolapsed and egg bounds. In case of heavy coccidiosis outbreaks, the complete liter may be replaced with fresh one to have effective control of infection. Debeaking is done during growth at the age of 14-16 weeks. The vaccination as per schedule is also completed with proper care. The representative birds (5-105) should be weight weekly to access the growth performance.

2.3 Care and Management of Chicks

In care of layer birds, chick from day old age to 8 weeks are usually reared in brooding houses and transferred to grower houses until it starts to lay egg, whereas in case of broilers even after four weeks of brooding, they are reared in the some house by increasing space and other requirements and removing brooders.

1. Ventilation;

The brooder house must be properly ventilated at the same time it should be devoid from drafts .The draft can adversely affect growth and livability of chicks. The excessive dust in the poultry house can cause irritation of respiratory tract of chicks and can increase diseases incidence. Similarly, high moisture level also can lead more ammonia fumes causing again irritation of eyes and respiratory distress.

2. Sanitation;

The brooder house must be carefully cleaned and disinfected well in advance before housing new batch of chicks in it. The required practice is the house should be given rest of 3 weeks in layer operation and 2 weeks on broiler operation after cleaning and disinfectant of the house. The appliances and equipments like feeders, waterers, brooders which can be removed, be taken out and removed, be taken out and cleaned, disinfected and allowed sun drying of them. The manure should be removed and floor may be scraped to remove all diets. The inside and outside of the house also be sheets must be removed. Insecticides like sumithion and cythion and flame

gun blowing of sheets and wire netting help in controlling insects, mites and ticks. Litter is used for every new batch. The disinfectant foot bath is necessarily provided at the entrance of the house.

3. Litters;

The bedding materials like rice husk, saw dust or ground nut can be used as litter materials as they can absorb moisture. The litter materials should be spread on floor with depth of about 10 cm. Daily stirring of litter should be practiced to avoid caking, to keep it dry and loose to reduce ammoniac odor.

4. Space under brooder;

Around 50-60 cm² space under brooder per chick is recommended. This means a hover of 1 m diameter can house 270 chicks. In case of small pens, length and width of pens should also be considered to accommodate number of chicks under brooder. Inadequate space leads to piling, increase disease incidence, stunted growth, starvation and subsequently more parentage of culls.

6. Chicks guard;

Chicks guard is a barrier to avoid *straying always of chicks from source of heat in younger age placed at a distance around brooder in a circular manner.....*. The brooder guard also protects baby chicks from drafts. Usually it is placed at a distance of 85-90 cm from edge of brooder initially and can be increased to 130 cm as the age advances. Usually it is used up to 7-8 days initially. The height is usually 40-50 cm.

7. Temperature;

Maintenance of appropriate temperature during brooding is necessary. The temperature is measured at level of 6 cm above floor and 6-8 cm inside the edge of warm zone of brooder. The temperature in the week should be around 33⁰c (95⁰F) which is to be reduced lower by 8-12⁰c than brooder temperature. The height of the brooder should be at least 10-12 cm above the chick. A pleasant movement with uniform scattering of chicks under brooder is correct guide for accuracy of temperature.

8. Floor space;

Appropriate floor spaces as per size and age of the chicks is an important factor

governing performance of chick. Less floor space than recommended, adversely affect overall performance of chicks. Inadequate floor space leads to slower and uneven growth, more number of culls, increased mortality, poor feed efficiency, and sometimes pecking and cannibalism. Floor space of about 450 cm² to start with is adequate which can be increased by allotted 450 cm² initially, which may be increased to 850 cm² after 4 weeks.

9. Feeder and water space;

The requirement of feeding space varies from 2-7 cm (linear) per chick from 0-8 weeks. Similarly, water space required is from 0.5-1.5 cm (linear) per chick. For efficient growth of chicks, frequent feedings (4-5 times in a day) with availability of fresh water all the times are beneficial.

10. Light;

Chick are provided continuous light ,i.e. sunlight during the day time and using electric bulbs during night. It helps in faster development of feathers, increased feed intake and is essential for vision.

11. Other activities;

Other activities like vaccination may be carried out according to the recommendation of the veterinarian and De-beaking may be carried out on 1st day or 6-9th day or 3-4th weeks to prevent cannibalism and feed wastage.

Unit-3

Other Managerial Tips

3.1 Cleaning and disinfection of sheds

Proper cleaning followed by disinfection of poultry shed and its surrounding and poultry equipments are must to prevent the chances of introduction of disease producing organisms in the farm. Cleanliness is very important aspect to maintain the sanitation and hygiene of the poultry farm.

- Poultry house is to be cleaned daily to remove dirt and dust.
- Feeders and waterers are to be cleaned daily before giving feeds and water.
- After proper cleaning of poultry house and poultry equipment's, disinfectants is to be applied followed by rest and fumigation.
- Some of the commonly available disinfectants are phenyl, lime, formalin, bleaching powder, potassium permanganate, caustic soda. After disinfection (as per manufactures direction) rest is to be given for at least 2-3 weeks to break up the life cycle of disease producing organisms in the poultry house.
- The last step is formaldehyde fumigation to kill the remaining organisms for routine disinfection purpose. 20 g KMnO_4 and 40 ml of formalin (40%) are required for 100 cubic feet area.

Common disinfectants-

1. Phenyl; for washing of floors, washing and dipping of stores as 5% solution
2. Lime; for disinfection of litter, floor and poultry carcass at the rate of 4-7 kg per 100 square feet.
3. formalin- used for fumigation of brooder and hatchery along with potassium-permagnate.
4. Coppersulphate- generally used to destroy fungi
5. Bleaching powder- 20% solution of bleaching powder for disinfecting floor and poultry equipments
6. Caustic soda; 2% of solution for cleaning waterers, feeders, metallic fittings, brooders, floors etc.

3.2 Chicks transport from hatchery to farm

The transport of day old chicks from hatchery to farm has a critical role to play in subsequent performance. If the chicks are not protected from unpredictable changes to their climate, varying road constructions and other delays, performance is directly impaired. Hence, transportation of day old chicks from hatchery to farm sites has to be done in proper way to reduce or eliminate mortality during transits.

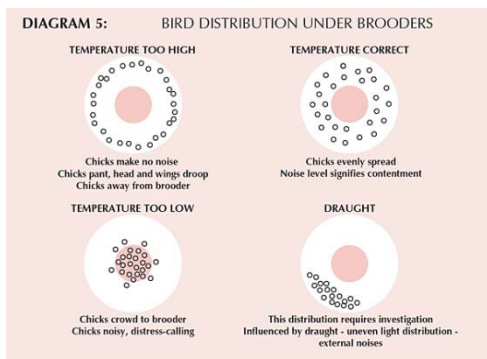
Transportation of chicks is usually done by packing the chicks in perforated cartoons. The cartoon must be perforated to prevent chicks from suffocation. The day old chicks are usually transported by means of vehicle with closer supervision. Generally transportation is done early in the morning or evening when the weather is not too hot. If proper transportation is done, we will be able to reduce excessive stress and mortality of chicks.

3.3 Brooding of Chicks

Care and management of chicks is known as brooding of chicks. In case of broilers, till four weeks of age and in case of layers till six to eight weeks of age are called chicks. Brooding plays a major role in growing efficient layers and broiler finishers as it is development period for body of birds. This is a very sensitive period because chicks do not have ability to regulate body temperature for the first five days and thermoregulatory system is not fully developed until two weeks of age. Extra effort during the brooding phase will be rewarded in final flock performance.

Brooding of chicks has following components:

Temperature-



Chicks require appropriate temperature. Variation towards higher or lower leads to

more mortality or slower growth. Temperature is usually measured at level of 6cm above floor and 6-8cm inside the edge of warm zone of brooder.

Age (week)	Brooder temperature (°F)	House temperature(°F)
1	95	81
2	90	76
3	85	71
4	80	66
5	75	61
6	70	56
7	70	56
8	70	56

Too high or too low temperature results in slow feathering; retarded growth; piling; pecking and mortality. Behavior and distribution of chicks under and around the brooder is the best guide for judging correctness of temperature instead of thermometer. Device for providing artificial heat is called brooder. Electric hover or canopy is used commonly. Height of brooder depends on need of brooding temperature but at least 10-14cm clear space above chicks. Bulbs of different intensity like 200, 100 or 60 watts can be used to reduce or increase temperature. Infra-red lamps of 250 watts can also be used with an added advantage of germicidal effects of organisms.

Chick guard

Chick guards are placed as a barrier to avoid straying away of birds from heat source. Guard area should be gradually expanded and removed after 7-8 days. Cardboard or metal sheet of 45cm height are placed in a circular manner at a distance of 85-90cm from the edge of brooder and can be increased to 130cm as age advances.

Floor space

System	Age (weeks)	Floor space/bird (sq. ft.)
Deep litter system	0-4	0.5
	4-8	1.0

	8-12	1.5
	12-16	2.0
	16-20	2.5
	>20	3.0
Cage system	0-6	33 sq. inch
	6-18	45 sq. inch
	>18	72 sq. inch

Feeding and watering space

Age (week)	Feeding space/ chick (cm) - Linear type	Watering space/ chick (cm) - Linear type
0-2	2.5	0.25
3-6	4.0	1.0
7-12	7.5	1.0
>13	10.0	1.5

For efficient growth of chicks frequent feeding (4-5 times) in a day with ad-libitum fresh water is required.

Litter or bedding

Rice husk, saw dust, groundnut hulls, straw etc. are used as comfortable bedding material for rearing poultry. Spread the litter/ bedding material with depth 4-5cm and increase to 8-10cm as age advances. Daily stirring should be done to avoid caking and to keep dry and loose to reduce ammoniacal odor. On an average, litter should contain around 18-24% of moisture.

Ventilation

Brooder should be well ventilated for excellent growth performance and health of birds. High moisture level also can lead more ammonia fumes causing irritation of eyes and respiratory distress. Level of ammonia should be below 25ppm and carbon-dioxide should be below 0.5% and oxygen availability should be 21%. Excessive dust

causes irritation of respiratory tract and increase disease incidence.

Light

Generally chicks are provided with continuous light; sunlight in day time while in night, with using electric bulbs or tubes up to 8 weeks of age. Light helps in faster development of feathers, increased feed intake and is essential for vision

Vaccination and de-beaking

Appropriate schedule of vaccination adopted for proper health care of chicks. Schedule varies according to disease prevalence. De-beaking can be done either on first day or on 6-9th day or 3-4th week to prevent cannibalism and feed wastage.

Provision of bio-security

Proper biosecurity should be maintained for the poultry farming. Chicks should not be reared with adult birds. The footbath with disinfectant should be managed before the entrance of the farm. Unnecessary persons should not be allowed to enter the poultry house.

Preparation before pre-arrival of chicks-

- Clean and disinfect the floor or cages and all equipments.
- Arrange all the equipments like brooders, drinkers and feeders properly at right place and at right height and ensure they are working properly.
- Keep papers above the litter or beddings
- Start heating before 24 hrs of arrival of chicks
- Adjust the temperature to 95°F (35°C) at the edges of brooder and house temperature at around 81°F (27°C)
- Fill the drinkers several hours before arrival of chicks so that water is warmed at approx 25°C at chicken arrival.

Care during the post arrival of chicks-

- Weight 5% of the boxes to determine day old body weight
- Remove carefully the chicks from the boxes and place into the brooders
- Allow chicks to drink for 1-2 hrs before providing feed (by dipping the beak in drinker). This will reduce dehydration and chocking
- Ensure minimal human activity in the brooder house so that chicks become

familiar with new environment and become trained with equipment.

- Monitor the distribution of the chicks properly and closely during the first few days.

3.4 Transfer from brooder to grower to layers-

It is essential to move the pullets to the lay house well in advance of the first eggs being laid to ensure no eggs are laid in the grow facilities and, if a cage-free system is used, to ensure that the females are well trained to use the nest . The flock can be moved into the laying facility at 16 to 17 weeks of age or after administration of the last live vaccinations.

Unit-4

Housing

For modern commercial, efficient and highly profitable poultry production, scientific and suitable housing is essential for raising poultry. Housing is a capital investment in poultry farming; hence economy must be kept in mind while providing housing.

Purpose of Housing

1. Protect birds from direct sun rays and rain.
2. Protect birds from inclement weather like excessive heat or cold.
3. Minimize effect of dampness, especially in rainy season.
4. Safety from their predators like dogs, cats, foxes, wild animals etc.
5. Apply scientific management practices easily for improving productive performance.
6. Provide suitable atmosphere for expression of full genetic potential.

Essentials of good poultry house location

There should be good drainage facility. Sandy loam type of soil is desirable. The elevation should be higher than surroundings.

- The house should be such that the floor is well exposed to sunlight
- Protection from wind
- Market should be near.
- Availability of cheap labor
- Availability of water and electricity
- Good transportation facilities
- Surrounding should be safe, clean and peaceful
- Other infrastructures like bank, school, post office etc. should be near

Layout plans for poultry house construction

The following points must be taken into consideration while making the layout plans for the poultry house.

1. **Orientation of house:**

The orientation should be such that the morning sunlight should enter the poultry house.

- East west direction
- Width wall facing West and East.
- Length wise sides to North and South.

2. Foundation of house:

The foundation of house should be raised to about 0.6-0.9m height to avoid dampness and to keep out surface water during rainy season.

3. Floor:

The floor should be moisture proof, plain, free from cracks and services and easy to clean.

4. Walls and partition:

Partition should be of 1m height of bricks and cements lengthwise. And above that wire-netting is better to maintain effective cross ventilation. Full wall was made in breath wise.

5. Ventilation:

In case of brooder house in cage system, small ventilation of about 0.4m width and 0.6m length are installed in every 3m section of side walls on both sides of house. The center height of house is about 10ft and side height of 6ft is optimum.

6. Doors:

Preferably placed to side walls facing North or South, 1m wide and 2m height is desirable. Small disinfectant ditch at the entrances as a footbath should be managed.

7. Width of poultry house:

6.20-9.0m to have effective cross ventilation, If greater than 9m, birds in centre of houses are severely deprived of adequate ventilation.

8. Length of poultry house:

As per need

Housing system of poultry:

Brooding, Housing system of poultry can be categorized into the following types:

1. Free range system:

This is the oldest method and now has been replaced by intensive system due to relatively more advantages. A range should provide shelter, greens, feed, water, shade and safety. Foraging is the major source of feeding for birds. The average stocking density of adult birds in this system is 250 birds per hectare. Scientific management practices cannot be followed in this system. Hence this system is not suitable for commercial purpose.

2. Semi-Intensive system:

In this system, birds are confined to house in night time but they are also given access to runs. Generally, outside run of 16-24 sq.m per hen is provided. In this system also there is only slight control over birds and scientific management practices cannot be applied.

3. Intensive system:

Birds are totally confined to houses. For the commercial production of birds, intensive system is used.

Advantages of Intensive system:

- Minimum land is sufficient.
- Scientific management can be employed.
- Production performance is better.
- Saving of labors.

Types of intensive system of housing:

Deep litter system:

The bedding materials like rice husk, saw dust, ground-nut hulls or sugarcane bagasses called litter are used to rear birds on floor.

Advantages of deep litter system:

- Safety to birds.
- Birds receive nutrients like Riboflavin, Cynocobalamin and ‘Animal Protein Factor’ from the litter.
- Litter is a bad conductor of heat, so provides warmth in cold weather.

- Excellent manure is produced.
- Germs like Salmonella are killed by heat produced by fermentative action.
- Control of humidity in the house.

Disadvantages of deep litter system:

- If not cared properly, remains moist and full of foul smell.
- Damp litter produces ammonia which can be problematic.
- If not cared properly, problem of coccidiosis may be seen.
- Requirement of balance feed at all times.

Litter management:

The success of deep litter system mostly depends on skillful management of litter during entire period of rearing. Caking of litter should be avoided. For this regular stirring of litter should be done. The waterer should be checked for leaking of water. The wet litter should be removed and may be replaced with fresh ones. The ammonia level produced by litter should not exceed 25ppm. Proper ventilation should be maintained to keep litter dry. To control dampness in litter mix 1kg lime or 0.5kg superphosphate per 15 sq. ft floor area.

Cage system:

It is the more intensive type of poultry production and involves rearing of poultry on raised wire netting floor in smaller compartments called cages. This system has been proved very efficient for laying operations. Feeders and waters are attached to cages from outside. The droppings are either collected in trays underneath cages or on belts for it or on the floor or deep pit under cages, depending on types of cages.

Advantages of cage system:

- Less space per bird is required. Generally one third spaces as compared to deep litter.
- Better flock supervision.
- Pecking and cannibalism minimized.
- Saving of labor.
- Better disease prevention and control of infection.
- The major litter borne problem like coccidiosis are eliminated.

- Less mortality rate.
- Less expensive on medication.
- The cost of litter and litter management problems are totally eliminated.
- Definite feed saving up to 10gm/bird/day.
- Breakage of egg is reduced.

Disadvantages of cage system:

- Initial investment is higher.
- Sometimes problems of “Cage Fatigue” may be observed in overweight birds.

Types of cages:

1. Stair-step (reverse) type cage:

It is also known as California type. The compartments are arranged step-wise in two or three tiers on stands in two or three rows. Droppings may fall on ground or in deep pit under cages. The droppings may be removed once in 6 months or after 12 months.



Source: www.rulework.co.uk

2. Battery cages:

It is also known as Vertical cages. The compartments of cages are arranged one above the other on stands with a tray or shift belts under the compartments for collection of droppings. Droppings are preferably removed everyday or at least on alternate day in this system.



Source: www.hdnus.com

3. Flat deck cages:

This is a single tier cage system popularly used for rearing chicks up to 8 wks, for easy handling of them in modern methods of poultry production and management. Each cage is usually 1m square block fitted on stand. Lengthwise each cage is divided into two compartments and each compartment consists of 20 chicks. Up to 4 weeks of age, waterer are provided from width wise and then from both the sides (length and breadth). Feeders to cages are attached to both sides of length wise. Dropping can be easily removed along with the shifting of chicks to grower houses at 8 weeks of age.



Source: www.bravebird.org

Floor space requirement in different system:

System	Age	Floor Space/ birds
Deep litter	0-4 weeks	0.5 sq.ft
	4-8 weeks	1.0 sq.ft
	8-12 weeks	1.5 sq.ft
	12-16 weeks	2.0sq.ft
	16-20 weeks	2.5 sq.ft
	More than 20 weeks	3.0 sq.ft
Cage system	0-6 weeks	33 sq. inch
	6-18 weeks	45 sq. inch
	Above 18 weeks	72 sq. inch

Equipments for commercial poultry farming

1. Water equipment

Pan and jar type-



This type of waterer is circular in nature, having two compartments i.e. jar for filling water and pan for delivering water.

Water basin made of plastic / wood/GI with grill-



Basins of different diameters are available (10", 12", 14" and 16" diameter).

A separate grill is available to prevent the entry of birds inside the water.

Bell type automatic waterer-



These are made of high-impact plastic in a bell shape usually suspended from separate pipeline for the purpose. This type of waterers has control over the water flow and maintains the required water level always. There will be a continuous flow of water so as to ensure water available for the birds throughout the day. Height at which the water is available can be easily adjusted by simple clamp mechanism and rate of flow water is adjustable by a valve (spring-mounted). Plastic drinkers will be brightly colored (red,blue) and hence are expected to attract layers, especially chicks to water.

No. of bell-drinkers= $1.3 * (\text{circumference} \div \text{Drinker space})$

Nipple drinker-



It can be used both in deep-litter and in cage system. When used in deep-litter system, it is attached with cup under the nipple to prevent wetting of litter material. These drinkers look like a nipple and water drops comes out when they are pressed. They can be used for all types and classes of birds, but most commonly used in laying cages. One nipple drinkers in each cage housing 3 layers is sufficient.

Manual drinker-

In case of chicks during first week of brooding, manual drinkers are popularly used. They also referred as “fountain drinkers” because water comes out of the holes like that in case of a fountain. The main advantage of manual drinkers is the ease of giving vitamins and other probiotics/medicines/vaccines through water. Manual drinkers with stand made of high-impact plastic in bright colors (red or blue) are available, arrangement of drinkers at an equal distance of 0.6m between any two feeders and feeder and a drinker.



2. Feeding Equipment

Feeders are equipment used in feeding poultry birds. The food is deposited in the feeder and the birds feed from it. The amount of feeders provided for a poultry farm should be according to amount of birds available. It is important that you always keep the feeders clean to ensure the health safety of the birds.

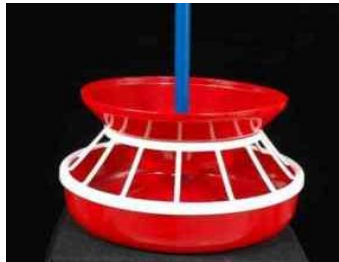
Linear feeder

Different sizes of linear feeder with guards are available. Provision is also made to adjust the height of the feeder. Linear feeders are usually made of Galvanized Iron. However it can as well be made out of any locally available material like wood, bamboo, etc. Provisions for stability and adjustment in height at which the feeder stands have to be made in its design. Birds can stand on either side of the linear feeder. Total feeder space available = 2* length. No of linear feeders = $(2 * \text{Length of the feeder}) \div \text{Feeder space with all measurements in cm.}$



Circular feeder

These are semi-automatic feeders and can hold 5 to 7 kg feed in its cone at a time. The feed is slowly delivered to the bottom by gravity. It can also be attached with feed grills to prevent wastage.



These are made of high plastic and usually suspended from roof/ roof-truss or from separate pipeline for the purpose. These are also called as ‘hanging feeders’. These feeders are available in different capacity and when completely full, the feed will suffice 4 to 7 days, depending upon the age and number feeding on them. The height at which the feed is available can be easily adjusted by simple clamp mechanism. Plastic feeders will be brightly colored (red or blue, generally) and hence are expected to attract layers, especially chicks to feed. No. of hanging feeders = 1.3^* (Circumference ÷ Feeder space) with all measurements in cm. 30% more birds can be accommodated in a hanging feeder when compared to that in linear feeder.

Shell grit box

It is used to provide shell grit to the layer birds as a supplemental source of calcium.



Automatic feeder



In case of automatic feeder the feed is supplied to the entire length of the poultry house by specially designed feed troughs with auger type or chain type devices to move the feed from the feed bins to the other end. These are operated with electricity and the height of the feeder can be adjusted depending upon the age of the birds.

Heaters or Brooders

It is essential that the temperature of the poultry farm be regulated especially during cold weather. The heater or brooder is equipment used in regulating and increasing the temperature of the poultry farm. These helps to keep the birds warm when the weather is cold.

Charcoal stove / kerosene stove



These are used in places where electricity is not available or costly and where power failure is quite common. These stoves are covered with plates or pans to sustain the

heat in the brooding area.

Gas brooder



Natural gas, LPG or methane is connected to heating element which is hanged 3 to 5 feet above the chick to provide heat. It is attached with canopy type reflectors to reflect the heat towards the chicks.

Infra-red bulbs



It is a self reflecting bulb and hence no need of reflector over the bulbs. 150 and 250 watt bulbs are available to provide sufficient heat to 150 and 250 chicks, respectively.

Reflectors/ Hovers



These reflectors are called Hovers. These are reflectors of heat and light. These hovers are flat provided with heating element, heating mechanism and pilot lamp and in some cases thermometer are also there in order to record the temperature. Generally they are

mounted with stands on all four corners, instead of hanging from the roof.

Incubator

This is an instrument used in hatching eggs. Egg hatchery with an incubator can be described as a means of hatching of eggs in an unnatural way. These means can be employed when there are many eggs to be hatched.

Chick box

The chick box is equipment where the poultry birds are kept for egg laying. It has a roll away egg tray attached to it so that when eggs are layed, they roll away and the birds will not trample on the eggs. This particular equipment help in preventing egg damage.

Fly Tray

Fly trap is an equipments used in controlling the number of flies around a poultry farm. It helps to poultry farmer reduce the number of flies in the poultry.

Poultry Plucker Rubber Finger

This is equipment applied to chicken dressing machine. These rubber fingers are fixed to the bottom and side plate of the of the dressing machine in order to produce many dressed chicken in a short period.

Egg Tray

This is equipment used in setting the eggs. Just like the name, it is a tray-like equipment where the eggs are placed for sampling.

Poultry Incubator Controller

Poultry incubator controller is equipment used for controlling the incubator and timer counter. It displays the temperature and humidity condition of the incubator.

Ventilation Fan

The ventilation fan is equipment used for ensuring maximum ventilation in the poultry farm. It is also an equipment used in reducing the temperature of the poultry farm during a hot weather.

Laying Nest

Laying nest is equipment that help the birds for laying of eggs. One of the advantages

of this equipment is that it increases the egg productivity of the poultry birds.

Egg Scale

This is equipment used in weighing the weight of the eggs. It helps the poultry farmer know the eggs that are fertile enough for hatchery because it is assumed that an underweight egg does not have what it take to form a chick.

Egg Washer

Egg washer is equipment that makes use of a powder called the egg washing powder. Water is added into the egg washer and then the egg washing powder is added also. It is used for washing the eggs before delivery.

Water Pots and Drinkers

Neat water is required for growth and digestion in poultry birds just like in humans. Therefore, the drinkers are equipments used for supplying water to the birds. You must ensure that the drinkers are washed regularly to avoid disease.

Cages and Coops

This poultry equipment is used for keeping poultry birds. Coops and cages are poultry equipments suitable for small scale poultry farming.

Dressing Machine

This is equipment used for feathering birds after slaughter. The use of a dressing machine makes chicken dressing easier, clean and hygienic.

Lastly, the use of protective clothing for humans is very necessary. Special protective clothing like hair caps, disposable sleeves, boots and coverall are required to avoid transfer or contamination from the birds to man or from man to the birds. Also, it is important to ensure that visitor disinfect their hands before touching the birds.

Unit-5

Characteristics of Commercial Broiler and Layer Breeds Introduced in Nepal

Poultry Breeds

There are hundreds of highly productive poultry breeds available around the world. Some of them are very famous for egg production, some are popular for meat production and some breeds are famous and popular for both meat and egg production. Poultry breeds are of three types, on the basis of their productivity. We have described the name and characteristics of some productive poultry breeds below.

Egg Productive Poultry Breed (Layers)

The chickens raised for egg production are known as layer chickens. Almost all types of commercial layer poultry breeds start laying eggs within their five to six month of age. They continuously lay about 275 to 300 eggs per year. Some strain lay about 330 eggs per year. Some highly egg productive breeds are leghorn, minorca, ancona, fayoumi, isa brown, babcock, star cross, lohmann etc.



- Comparatively weights less than other poultry breeds.
- Gain sexual maturity earlier.
- Less egg incubating trend.

- Start laying eggs within their five to six month of age.
- Converting efficiency of food to egg is very high.
- Contain less fat in their body.
- Egg producing power is very high.
- Lay big sized eggs.

Meat Productive Poultry breed (Broiler)

This type of poultry breeds are used for only meat production purpose. Their meat become very soft and tasty. They weights about 2 to 2.5 kg within their 7 to 8 weeks of age, consuming about 4 kg food. They become suitable for marketing within 8 weeks. The worlds most popular broiler poultry breeds are starbro, plymouth rock, cornish, sussex, brahma, hy-line, rose broiler, asil, cochin etc.



- Comparatively weights much than other poultry breeds.
- Don't incubate their eggs.
- Food to meat converting efficiency is very high.
- Grow very fast.
- Contain much fat in their body.
- Egg producing power is very low.
- They become very big sized.

Egg and Meat Productive poultry breed

Popular poultry breeds for both meat and egg production are new hampshire, australorp, rhode island red, plymouth etc. Characteristics of this types of poultry breeds are described below.



- This types of poultry breeds are of medium sized.
- Weight high.
- They may have trend for hatching eggs.
- Lay less eggs than egg productive breeds.
- They contain proper ratio of fat in their body.
- Grow very well.
- Gain maturity very fast.

Unit-6

Vaccination and De-worming

Common vaccines, available sources and schedule to be given

Vaccine:

It is a protective and preventive biological product which contains processed organisms of same disease, capable of producing disease in mild form producing antibodies to set up immunity against disease.

Purpose of vaccination:

- Protect birds from deadly diseases which have got no effective treatment.
- Prevent epidemics of highly fatal diseases in poultry birds, which are difficult to diagnose also.
- Minimize risk by producing immunity in time to prevent outbreaks
- Prevent heavy losses in the form of high morbidity, mortality and lowered productive performance by building up resistance in birds.

Types of vaccines

Vaccines are grouped into various types depending on status of organism in it and efficacy mostly depends on this which are described as:

1. Live vaccine:

It contains live organisms capable of producing immunity in a better form. It is available in freeze dried powder form and stored in refrigerator at 2-4°C. They should be handled and disposed the empty vial properly otherwise it may lead to outbreaks merely by contact.

2. Attenuated vaccine:

This vaccine also contains live organisms but weakened by attenuation. It produce milder form of disease when administered via. proper route but cannot produce outbreaks merely by contact. These vaccines should also be stored at 2-4°C temperature in refrigerator.

3. Killed vaccine (inactivated vaccine)

It contains killed organism and do not infect birds merely by contact. It produces quick immunity via proper route of administration. It can be stored at room temperature and usually oil based. It enhances immunity in birds which are previously exposed to live vaccines or along with live vaccines. In this type of vaccines, inactivated bacterins are also available against bacterial diseases.

Route of vaccines/ method of administration

Route of vaccine mainly depends on age (stage of birds) and type of vaccines. Following are the mainly used routes:

Intraocular (I/O)

In this route, vaccination is mainly done by putting drops in the eyes. The care has to be taken to absorb drop through open eye. The drop should not fall down with closed eye.

Inranasal (I/N)

Vaccine drops are administered through nostrils and mouth is shut to absorb them in nostril. In this method birds should not be supplied water for two hours to avoid dilution of vaccine by dipping beaks in water.

Subcutaneous (S/C)

Vaccine is deposited under the skin by injection with insertion of needle below skin to form a small bump or swelling. Usually wing web or area behind head at upper part of neck are the sites preferred for this purpose due to thinness and flexible nature of skin at these places.

Intramuscular (I/M)

Vaccine is deposited in between muscle fibers by injection with penetration of needle in muscular layer. Usually muscles of leg at thigh region or chest are preferred sites of this inoculation.

Intradermal (I/D)

Vaccine with sticky thick diluents (glycerin) is applied to dermis layer by piercing skin through and through so that vaccine is absorbed by dermal layer. Usually fowl pox vaccine is carried out by this route.

Cloacal

Vaccine is rubbed to upper part of cloaca with a small glass rod.

Drinking water

Now a day this route is popularly used to vaccinate birds on large scale by avoiding handling stress. The temperature of water should be brought down to temperature of vaccine by using ice and stabilizer like milk or skimmed milk powder is used during administration of vaccine. For 10 liters of water 1 kg of ice and 60g of skimmed milk powder is used. Another precaution is that birds should be made thirsty for 2-3 hours before vaccination, so that they drink vaccine water immediately within 15-20 minutes after pouring it in waterers. Usually double dosage is used for vaccination by taking into account *kilution* factor. (not clear)

Aerosol route

Vaccine is sprayed in air in the form of fine mist, which is absorbed by birds through nostrils. The route is used for mass vaccination for large scale poultry farming to avoid handling stress on birds.

Care of vaccine

- Live and attenuated vaccines should be shipped in ice as quickly as possible to avoid spoilage during transit. The diluents can be transported without ice.
- Killed vaccines can be transported without ice
- Vaccine must be kept in ice till it is administered to birds.
- Vaccine should be stored at 2-4°C temperature in refrigerator.
- Manufacturer's instructions must be observed scrupulously for storage, preparation and use of vaccines.

Precautions and care during vaccination

- The diluent must be freezed for overnight for vaccination
- Do not stretch vaccine; administer correct dosage, count wastage also to achieve desired immunization.
- Vaccinate only healthy and stress free birds to avoid increase in mortality or lowering down of productive performance
- Vaccination, preferably should be carried out during cooler hours of day

- Vaccinate all birds in a flock at a time to avoid cross infection
- Reconstituted vaccine must be used within 2-3 hours, otherwise it loses its potency.
- The balance reconstituted vaccine and empty vials after use of vaccine should be boiled and then disposed off to avoid contamination.
- All equipments used for vaccination should be sterile.
- Don't add sanitizers to water on the day of vaccination, while vaccinating through drinking water to avoid neutralization of organisms in vaccine.
- Do not use expired vaccines.
- As far as possible carry out only one vaccination at a time. Try to keep an interval of at least 1-2 weeks in between two vaccinations
- Administer vitamins and electrolytes one day before, on the day after vaccination to combat vaccination stress in birds.

Vaccination Schedule in broilers-

S.N.	Days	Vaccine	Strain	Dose	Route
1	1	Marek's disease	HVT 126	0.1 ml	S/C
2	5-7	Ranikhet disease	F1 or R2B	1 drop	I/O or I/N
3	10	Leetchy	-	0.25ml	S/C or I/M
4	12-13	Gumbaro (IBD)	Intermediate plus	1 drop	I/O or I/N
5	18-19	Gumbaro (IBD)	Intermediate	1 drop	I/O or I/N
6	25-27	Ranikhet	Lasota	1 drop	D/W, SMP

Vaccination schedule in layers-

S.N.	Days	Vaccine	Strain	Dose	Route
1	1	Marek's disease	HVT 126	0.1 ml	S/C
2	5-7	Ranikhet disease	F1 or R2B	1 drop	I/O or I/N
3	10	Leetchy	-	0.25ml	S/C or I/M
4	12-13	Gumbaro (IBD)	Intermediate plus	1 drop	I/O or I/N
5	18-19	Gumbaro (IBD)	Intermediate	1 drop	I/O or I/N

6	25-27	Ranikhet	Lasota	1 drop	D/W SMP
7	30	IBD	Intermediate		D/W SMP
8	42	Fowl pox			Wing web
9	7 wks	ND	Lasota		D/W SMP
10	9-10wks	ND	R2B	0.5ml	I\M
11	13wks	Fowl pox			Wing web
12	14wks	IB	IBH120		D/W SMP
13	16wks	IB + ND		0.5ml	I\M
14	25- 26wks	IB + ND			D/W SMP

Note: This schedule can be changed according to the place and disease prevalence

Common dewormers and ecto-parasite control

Ectoparasites:

1. Mites

Ornithonyssus spp remain on chickens permanently. *Dermanyssus* mites parasitize chickens nocturnally. Heavy mite infestation is characterized by anemia and the appearance of black mite exoskeleton casts and excreta and dermatitis in the vicinity of the vent.

2. Argasid Ticks

Soft-shelled ticks (*Argas* spp) occur in tropical areas and may affect cage- housed laying flocks or birds maintained on litter. Argasid ticks are nocturnal feeders and favor the soft unfeathered skin beneath the wings. Parasitized birds show multiple hematomas associated with feeding sites. Ticks transmit spirochetosis.

3. Scaly Leg Mites

Chronic infestation of the legs of free-roaming chickens with *Knemidocoptes mutans* results in proliferation of scales overlying the shanks and feet. The gross appearance of the lesion is pathognomonic. The diagnosis may be confirmed by microscopic examination of detritus from scales.

4. Lice

Lice are frequently encountered in subsistence flocks. Lice are responsible for irritation and damage to feathers. Mature adults are evident on examination. Egg clusters (“nits”) are observed as spherical white structures adherent to the shafts of feathers.

Treatment

Ectoparasites may be treated with a carbamate insecticide such as Sevin®, applied as a 5% powder to birds at two week intervals. Cages and housing can be treated with 2 - 7% carbamate suspension administered by spray. Only approved insecticides should be applied to poultry or used in the vicinity of housing to avoid contamination of the food chain. Insecticides should be used in accordance with manufacturers’ label instructions.

Worms:

1. Roundworms

Roundworms (nematodes) are common in poultry, waterfowl, and wild birds. Species of roundworms that affect poultry include species of large roundworms (*Ascaris* sp., also known as ascarids), species of small roundworms (*Capillaria* sp., also known as capillary worms or threadworms), and cecal worms (*Heterakis gallinarum*). Roundworms can cause significant damage to the organ(s) they infest. Most roundworms affect the digestive tract; others affect the trachea (windpipe) or eyes.



Large roundworms are the most damaging of the worms common to backyard flocks. A severe infestation can cause a reduction in nutrient absorption, intestinal blockage, and death. Easily seen with the naked eye, large roundworms are about the thickness of a pencil lead and grow to 4-1/2 inches long. Occasionally, they migrate up a hen’s

reproductive tract and become included in a developing egg. The life cycle of a roundworm is direct; that is, worm eggs are passed in the droppings of infected birds and then directly to birds that consume contaminated feed, water, or feces. Also, worm eggs may be picked up by snails, slugs, earthworms, grasshoppers, beetles, cockroaches, earwigs, and other insects. Known as intermediate hosts, these insects carry the eggs and when eaten by a bird pass the eggs to the bird. Identifying and minimizing the number of intermediate hosts that poultry have contact with helps prevent the birds from being infected with worms. Because approved wormer medication in poultry is limited, you should check the US Food and Drug Administration (FDA) Approved Animal Drug Products list (known as the Green Book) for currently approved medication. Medication containing the active ingredient piperazine is available for use against large roundworms in poultry but is not effective against other internal parasites of poultry. As with all medications, read the label concerning dose to administer and withdrawal period before consumption of eggs or harvesting for meat.



Fig. Gape worm of poultry

Several species of small roundworms can affect different parts of birds and cause a variety of symptoms. Species that infect the crop and esophagus cause thickening and inflammation of the mucus membranes located there. Turkeys and game birds are most commonly affected by such species, and producers can suffer severe losses due to these parasites.

Other species of small roundworms are found in the lower intestinal tract and cause inflammation, hemorrhage, and erosion of the intestinal lining. Heavy infestations result in reduced growth, reduced egg production, and reduced fertility. Severe infestations can lead to death. If present in large numbers, these worms can be seen

during necropsy (examination after death). Small roundworm eggs are very small and difficult to see in bird droppings without a microscope. Medications that contain levamisole are effective in treating small roundworms.

Cecal worms are commonly found in chickens. As the name implies, they grow in the ceca (two blind pouches at the junction of the small and large intestines). Although cecal worms typically do not affect chickens, the worms can carry *Histomonas meleagridis*, a species of protozoan parasite that causes histomoniasis (blackhead) in turkeys. Turkeys can contract histomoniasis by eating chicken manure containing infected cecal worm eggs or earthworms that have ingested infected cecal worm eggs. So, although chickens generally are immune to problems caused by cecal worms, controlling the worms is still important for turkey health. Levamisole is effective in controlling cecal worms. A veterinarian's prescription is required for use of the drug in poultry.

2. Tapeworms

Several species of tapeworms (cestodes) affect poultry. They range in size from very small (not visible to the naked eye) to more than 12 inches long. Tapeworms are made up of multiple flat sections. The sections are shed in groups of two or three daily. Each section of tapeworm contains hundreds of eggs, and each tapeworm is capable of shedding millions of eggs in its lifetime. Each species of tapeworm attaches to a different section of the digestive tract. A tapeworm attaches itself by using four pairs of suckers located on its head. Most tapeworms are host specific, with chicken tapeworms affecting only chickens, and so on. Tapeworms require an intermediate host to complete their life cycle. These intermediate hosts include ants, beetles, houseflies, slugs, snails, earthworms, and termites. For birds kept in cages, the most likely host is the housefly. For those raised on litter, intermediate hosts include termites and beetles. For free-range birds, snails and earthworms can serve as intermediate hosts.

There are no approved medications for use against tapeworms, so controlling the intermediate hosts of tapeworms is vital in preventing initial infections and reducing the risk of reinfection. If you get a laboratory diagnosis of tapeworm infection, always ask which tapeworm species is causing the infection and which intermediate host is

involved in the parasite's life cycle. Because the intermediate hosts for tapeworms vary greatly, it is important to identify the tapeworm species to target prevention efforts toward the correct intermediate host.



3. Protozoa:

Protozoa are single-celled organisms found in most habitats, and they include some parasitic pathogens of humans and domestic animals. Protozoan parasites that are important to backyard poultry growers are coccidia (species of the *Eimeria* genus), cryptosporidia (*Cryptosporidium baileyi*), and histomonads (*H. meleagridis*).

By far, the most common protozoan parasites of chickens and turkeys are coccidia. Nine species of coccidia affect chickens, and seven affect turkeys. Coccidia are species-specific, meaning that coccidia that affect chickens, for example, do not affect turkeys or other livestock. Coccidia live and reproduce in the digestive tract, where they cause tissue damage. This damage reduces nutrient and fluid absorption and causes diarrhea and blood loss. Coccidiosis (infection with or disease caused by coccidia) can increase a bird's susceptibility to other important poultry diseases, such as necrotic enteritis. Coccidia are in nearly all poultry. Chicks develop immunity to coccidiosis over time, with most severe cases occurring when chicks are three to six weeks old. Signs of coccidiosis include bloody diarrhea, watery diarrhea, abnormal feces, weight loss, lethargy, ruffled feathers, and other signs of poor health. Most store-bought feeds contain medication that controls but does not eliminate coccidia. Eating such feed allows young birds to develop resistance to the coccidia prevalent in their environment. However, if the birds are exposed to a different species of coccidia, they will not have immunity, and disease symptoms may result. A common medication for controlling coccidiosis in birds not fed medicated feed is amprolium. As mentioned above, following the instructions for administration is important for proper drug delivery and bird recovery. Vaccines are currently

available that give newly hatched birds a small amount of exposure to coccidia, allowing them to develop immunity without developing the disease. With proper vaccination and management, routine anti-coccidial medications are not necessary.

Cryptosporidiosis is infection with or disease caused by cryptosporidia. Cryptosporidia are not specific to chickens and can infect other birds and even mammals. Cryptosporidia frequently spread from flock to flock on the feet of animals and people and can be carried by wild birds. Intestinal cryptosporidiosis is common, and symptoms are usually mild. Frequently, the only symptom is pale skin in yellow-skinned breeds. Cryptosporidiosis also can be contracted by inhalation, resulting in a respiratory infection that is more severe than the intestinal form. There is no treatment for this form of cryptosporidiosis. Provide supportive therapy and guarding against secondary infection are the only courses of action. Once recovered, birds are immune to future infection.

Treatment

Flubendazole (Flubenvet) is the only licensed treatment for worms in poultry and game birds – available as a Flubenvet 1% Medicated Premixture in a 60g pack to treat 20 chickens for backyard users, or Flubenvet 2.5% Medicated Premixture (as a 2.4kg bag or 240g tub) for larger flocks, or the 5% Premix can be incorporated in foodstuff by a registered feed manufacturer.

Unit-7

Most Common Disease of Poultry

Bacterial diseases of poultry

1. Avian Salmonellosis

Two main important diseases

- Pullorum disease.
- Fowl typhoid.

Pullorum disease:

Synonyms

- White diarrhoea
- Bacillary White Diarrhoea
- BWD

Definition

Pullorum disease is an infectious, egg-transmitted disease of poultry, especially chick and turkey poults, often characterized by white diarrhoea and high mortality in young birds and by asymptomatic adult carriers.

Etiology

Salmonella pullorum

Distribution and Incidence

Acute systemic infectious disease of chicks

Chronic form in adults

May remain as carrier

World wide

Birds of 3 weeks are mostly affected

Host

Chicken, Duck, Goose, Parrot, Cockatoos, Sparrows, Finches, Canaries, Ostrich, Emu, Kiwi, Crane, Rail, Pheasants, Moynah, Peacocks.

Transmission

- Vertically through egg
- Horizontal
- Contaminated utensils, feed water
- Dead embryos and chicks
- Rodents, flies
- Visitors

Clinical signs

- Excessive number of dead-in-shell chicks
- Death shortly after hatching
- Acutely affected birds
- Depressed
- Anorexic
- Respiratory distress
- White viscous dropping (diarrhoea) adhere to feathers around vent (Bacillary White Diarrhoea)
- Dehydration
- Finally death
- Occasional blindness
- Occasional brown colored droppings

Sub-acute form

- Lameness
- Swollen hock joint
- Poor growth rate

Chronic form

- Inappetance, depression
- Ruffled feathers
- Greenish brown diarrhoea
- Drooping of wings and head
- Death, if any severe dehydration

Diagnosis

History, Clinical signs, Gross lesions

Isolation and identification of organisms

Gram negative, Aerobic, Non spore forming rods

Serology

TAT (Tube Agglutination Test)

RST (Rapid Serum Test)

Stained Ag whole blood test

Treatment

1. Sulphonamides: 0.5% in feed for 5 days.
2. Trimethoprim-Sulfadiazine preparations 1-2 gm / L of DW b.i.d. for 5-7 days
3. Trimethoprim-Sulfamethoxazole preparations 1 gm / 4 L of DW for 5 – 7 days
4. Furazolidone preparations 250 – 500 gm / ton of feed

Antibiotics

1. Chloramphenicol 0.5% in feed for 10 days
2. Chlortetracycline 200 mg / kg in ratio for 10 days
3. CS test

Fowl Typhoid

Definition

Fowl typhoid is an infectious disease, primarily of chickens and turkeys, with many of the clinical and epizootiologic features and lesions that occur with pullorum disease.

Etiology

Salmonella gallinerum.

Distribution and Incidence

World wide

Birds > 3 months – most affected.

Host: Same as PD.

Transmission

- Vertical
- Horizontal
- Recovered bird as carriers for long periods
- Feces- at least one month
- Clinical signs

Acute form

- Infected eggs → Hatched → Die shortly after hatch
- Before death → Appear depressed and weak with white chalky material adhere to vent
- Mortality → 93%
- If birds don't die within 2-3 days: Progressive loss of condition and anaemia → Shrunken and pale comb and wattles
- Watery to mucoid yellowish diarrhoea
- Decreased egg production in case of layers

Sub-acute form

- Increased dead-in-shell embryos
- Small, weak, moribund / dead chicks on hatching trays

Chronic form

Dyspnea

Depression

Ruffled feathers

Closed eyes → Blindness

Diagnosis and treatment and control

Same as PD

Chronic respiratory disease (Mycoplasma gallisepticum)

This is a chronic slow spreading contagious disease in birds characterized by obstinate hacking cough, sneezing and tracheal rales. Large numbers of birds in a flock used to suffer causing heavy economic loss especially in broilers.

Etiology: Mycoplasma gallisepticum

Clinical findings

- Tracheal rales
- Sneezing
- Respiratory distress
- Open beak breathing
- coughing and nasal discharge
- Young chicks show signs of conjunctivitis with lacrimation
- 40% reduction in egg production
- Hatchability may be affected.
- Sign of ataxia and lameness accompanied with enlargement of hock joint may appear in some birds.

Diagnosis

- History of slow spread of the disease.
- Clinical signs manifested as reduced food intake, hacking type of cough, reduced egg production.
- Serological test: rapid serum agglutination test, whole blood agglutination test
- ELISA (enzyme linked immunosorbent serologic assay test)
- PM lesion

Treatments

1. Tylosin tartrate@1 gm/ lit of water for 24-72 hrs.
2. Timulin@ 0.025% in water for 3 consecutive/Regular days
3. Lincomycin powder@1 gm/litre of drinking water

Viral Diseases of Poultry

Avian Influenza

Avian influenza is an infectious disease caused by 'A' type influenza virus of the family Orthomyxoviridae.

Occurrence

Most species of birds, Zoonotic importance

A few outbreaks in chickens

Most outbreaks in duck and turkeys

All age group of birds, if previously unexposed, are presumed susceptible.

Etiology

- Influenza virus in the group of orthomyxovirus
- There are several serotypes

Transmission

- Airborne virus particles from the respiratory tract, droppings and people-carrying virus on their clothing and equipment are the main routes of transmission

Clinical signs

- Symptoms are diverse according to species, age, sex, virus strain, mixed infections, and environmental factors
- Loss of activity
- Loss of appetite for food and water
- Egg production drops
- Weakness
- Coughing, sneezing, rales
- Lacrymation
- Ruffling of feathers
- Edema and cyanosis in the head, comb, and wattle
- Nervous symptoms and diarrhoea



Gross lesions

- Air sac hypertrophy
- Catarrhal or fibrinous peritonitis or enteritis
- In layers, exudate may be observed in the oviduct.

Diagnosis

- As influenza of fowl has varied symptoms, it cannot be diagnosed by clinical signs, except in the epidemic period.
- Isolation and identification of the virus gives definitive diagnosis.
- Serological tests
 - ◆ Agar gel precipitation test (AGPT).
 - ◆ HI test and ELISA are performed to determine the subtypes.

Avian influenza should be differentiated from ND, fowl pox.

Prevention/treatment/measures

- There is no treatment for fowl influenza.
- Although H5 and H7 virus inactivated vaccines are used for prevention in U.S.A. and Australia, it is not practicable in our country.
- It is important to prevent contact with wild birds, turkeys and ducks.
- Apply all-in, all-out systems.
- Disinfection and hygienic control of humans, foodstuff, vehicles, and other equipment should be effectively managed.

Infectious Bursal Disease

IBD is an acute, contagious viral disease of young chickens characterized by diarrhoea, vent picking, trembling, incoordination, inflammation followed by atrophy of the bursa of Fabricius and by a variable degree of immune-suppression.

- Synonyms

Etiology

- Family: Birnaviridae.
- Genus: Birnavirus.
- 2 serotypes-
 - ◆ Serotype 1: Pathogenic.
 - ◆ Serotype 2: Non- pathogenic.

Host

- Chickens
- 3 to 6 weeks old

- Ducks, geese, swan
- Pheasant, grouse
- Peacocks

Transmission

- Excreted through faeces
- Vectors / Reservoirs
 - ◆ Meal worms
 - ◆ Litter mites
 - ◆ Wild birds
 - ◆ Vermin
 - ◆ Rats
 - ◆ Visitors

Route

- Oral

Clinical signs

- Depends on
 - ◆ Age
 - ◆ Breed
 - ◆ Maternal antibody level

Morbidity

- High- up to 100%

Mortality

- Usually 20-30%
- Occasionally 50%
- In case of vvIBDV- 90-100%

Acute form

- Depression
- White watery diarrhoea
- Soiled vents

- Anorexia
- Ruffled feathers
- A reluctance to move
- Closed eyes
- Finally death

Mild form

- Little / no signs
- Suboptimal growth

Gross lesions (BF)

From 2-3 days

- Develop transudate
- White color to cream color
- Mucosal surface – Hemorrhagic
- Purulent exudates
- Necrotic foci
 - ◆ On 3rd day- Increase in size and weight
 - ◆ On 4th day – Double in size and begins to reduce. Transudate starts to disappear
 - ◆ On 5th day – Returns to its normal size and then atrophied
 - ◆ After 5th day – grey in color
 - ◆ On 8th day – One third to its normal size

Gross lesions

Hemorrhages

- Thigh muscle
- Pectoral muscle
- Proventriculus
 - ◆ Splenomegali
 - ◆ **Liver** – Necrotic foci, infarcts
 - ◆ **Intestine** – Increased mucus
 - ◆ **Kidney** – Hemorrhagic, urates deposition

Diagnosis

- Clinical signs
- Gross lesions
- Isolation and identification of IBDV
- Serology
 - ◆ ELISA

Treatment and control

- No practical therapeutic measures
- Management procedures
 - ◆ All in all out system
 - ◆ Sanitation program to reduce the level of IBDV
- Vaccination of parent breeders and / or young chicks
 - ◆ Live and killed vaccines
- Maternal antibody will normally protect chicks for 1 to 3 weeks but booster vaccination in breeder flocks in which the passive immunity may be extended to 4 to 5 weeks

Newcastle Disease

Synonyms

- Ranikhet Disease
- Paramyxovirus 1 infection
- Avian pneumoencephalitis

Definition

- It is an infectious several virus disease of birds, caused by Paramyxovirus 1 (PMV-1) and characterized by characteristic respiratory, alimentary and nervous signs.

Occurrence

- Usually in chickens or (less often) in turkeys.
- Most poultry and cage birds are susceptible.
- All age groups are susceptible.
- All poultry raising countries.

- Zoonotic importance.

Etiology

- Newcastle disease is caused by a paramyxovirus.
- The many known strains vary greatly in pathogenicity. They often are classified or referred to as
 - ◆ Lentogenic- these are mildly pathogenic (eg. B-1, F, LaSota).
 - ◆ Mesogenic- these are moderately pathogenic.
 - ◆ Velogenic- these are markedly pathogenic.

Transmission

- Through infected droppings and respiratory discharge between birds
- Spread between farms is by
 - ◆ Infected equipment
 - ◆ Trucks
 - ◆ Personnel
 - ◆ Wild birds or air
- The incubation period is variable but usually about 3 to 6 days

Clinical signs

- The severity of the ND depend on the
 - ◆ Infecting virus (amount and pathotypes)
 - ◆ The host species and its age and immune status
 - ◆ Coinfection with other organisms
 - ◆ Environmental conditions (stress)
 - ◆ Route of exposure and dose
- Infection with the highly virulent viruses
 - ◆ It may produce peracute infections of fully susceptible chickens where the first indication of disease is sudden death
 - ◆ Typically, disease signs such as
- Depression
- Prostration
- Diarrhoea

- Odema of the head and
- Nervous signs may occur with mortality reaching 100%

Infection with moderately virulent virus

- Severe respiratory disease, followed by nervous signs.
- Laboured breathing with sneezing and gurgling, accompanied by the nervous signs like paralysis or twisted necks (torticollis) are the main signs.
- The appearance of shell-less or soft-shelled eggs, followed by complete cessation of egg laying may be an early signs in adult fowl.

Infection with low virulence virus

- These viruses cause no disease, or mild respiratory distress for a short time in chickens and turkeys.

Internal lesions

- Inflamed tracheas.
- Pneumonia and/or froth in the airsacs are the main lesions.
- Haemorrhagic lesions are observed in the proventriculus and the intestines.

Diagnosis

- Although the history of outbreak, clinical signs and pathological changes are suggestive for ND but none of the clinical signs or lesions of ND may be regarded as pathognomonic.
- Diagnosis is made by virus isolation from tracheal or cloacal swabs together with blood testing to demonstrate high antibody levels.
- Infectious bronchitis or infectious laryngotracheitis can give similar clinical signs, but lesions, blood tests and virus isolation tests are decisive.

Treatment

- There is no satisfactory treatment due to viral etiology.
- Some poultry raisers use PPM 0.01% in drinking water.
- Some farmers use sulphadiazin or sulphamethazine 0.5% in feed to check secondary infections.

Prevention and control

- Chickens and turkeys can be immunized against Newcastle by proper vaccination.

- Live and/or inactivated (killed) adjuvant vaccines is the only reliable control method.
- Furthermore, in order to prevent virus spread to other flocks, general hygiene and prevention of invasion of infected wild birds are required.

Marek's Disease

Synonyms

- MD
- Neurolymphomatosis

Definition

- Marek's disease is a herpes virus induced neoplastic disease of chickens characterized by infiltration of various nerve trunks and/or organs with pleomorphic lymphoid cells.

Occurrence

- Important only in chickens.
- However, turkeys, quail and other species have limited susceptibility.
- Most commonly in young, sexually immature chickens 2 to 7 months old.
- It can occur at virtually any age beyond 3 weeks.
- Worldwide distribution.

Etiology

- Herpes virus.

Transmission

- The MD virus is present in desquamated feather follicle epithelial cells and in oral, nasal and tracheal secretions of infected birds.
- Main transmission is by infected premises, where day-old chicks will become infected by oral and respiratory routes.
- Dander from feather follicles of MD-infected chickens can remain infectious for more than one year.
- Young chicks are particularly susceptible to horizontal transmission.
- Susceptibility decreases rapidly after the first few days of age.

Clinical signs

- Classical MD (typical)

- The signs depend on the peripheral nerves affected and involvement of the brachial and sciatic nerves is common, leading to progressive spastic paralysis of the wings and legs, respectively.
- Leg nerve involvement causes a bird to lie on its side with one leg stretched forward and the other backward.
- When the cervical nerves are involved, there may be torticollis and if the vagus and intercostal nerves are affected, respiratory signs may develop.
- Classical type MD occurs mainly among chickens of 3-5 months old.
- Mortality rate is less than 10%.

Acute MD

- Many birds die suddenly without preceding symptoms.
- Some appears depressed before death and some show paralytic signs.
- Mortality reaches 10-30% and occasionally 50%.
- Mostly seen in 2-4 months of age, but is sometimes also seen in chicks less than one-month old.
- In case of broiler it is called visceral type MD.

Skin type MD

- Tumors form mainly in the feather follicles.

Eye type MD

- Contraction of pupils.
- Deformation and decoloration of the iris

Gross lesions

- Tumors formation is observed in the liver, which occasionally can be enlarged even ten times or more.
- Diffuse nodular lesions with a white appearance are observed.
- The spleen is markedly swollen and uniformly white or develops a lot of tumors.
- In the bursa of Fabricius, tumor lesions white in color uniformly form.
- As to skin lesions, various sizes of tumors are formed in the skin.
- Other organs and tissues like proventriculus, ovary, kidney, heart and muscle tumors also form.
- There are swelling, edema and disappearance of the normal striation of

peripheral nerve fibres, and the peripheral nerve in a serious case enlarges more than ten times.

- In MD of broilers, however, invisible nerve lesions do occur.

Diagnosis

- A tentative diagnosis can be made on history, clinical signs and pathological changes.
- A definitive diagnosis can be made on isolation and identification of the causative virus.

Treatment and control

- There is no effective treatment.
- Prevention and control of MD is based on
 - Management and hygiene.
 - Rearing of genetically resistant stock.
 - Vaccination.

Infectious Bronchitis

Synonyms

- IB

Definition

- Infectious bronchitis is an acute, highly contagious, virus-caused disease of chickens characterized by respiratory signs (gaspings, sneezing, coughing, and nasal discharge), severe renal disease associated with nephrotropic strains, and a marked decrease in egg production.

Occurrence

- Only chickens are susceptible to IB virus.
- All ages are susceptible, assuming they have not had prior exposure to the virus.
- The disease is more severe in baby chicks.
- Worldwide in distribution.

Etiology

- The disease is caused by the several different serotypes of IB virus (Coronavirus).

Transmission

- The nasal discharge and faeces are the main sources of organism and transmission by aerosol (droplet) and contact to the susceptible birds.
- The virus can also be transmitted via the air between chicken houses and even from farm to farm.

Clinical signs

- In young chicks, it causes a cheesy exudate in the bifurcation of the bronchi, thereby causing asphyxia, preceded by severe respiratory distress (“pump handle breathing”) like
 - Gaspings
 - Coughing
 - Tracheal rales and
 - Nasal discharge.
- In older birds IB does not cause mortality.
- Respiratory signs include
 - Wet rales
 - Gurgling and
 - Wheezing.
- Egg production will decrease dramatically.
- Deformed eggs with wrinkled shells will often be laid, and shell irregularities with bumps of calcium deposit.

Internal lesions

- Mucus and redness in tracheas in older chickens.
- Froth in airsacs in older chickens.
- In young chicks a yellow cheesy plug at the tracheal bifurcation is indicative of IB infection.

Diagnosis

- There are three main factors to be considered in order to arrive at a diagnosis.
 - Isolation of the virus in the laboratory.
 - A rising antibody titre when the serum is tested against a known strain of IB virus.

Treatment

- There is no treatment for IB but it is helpful to increase the temperature of the room as well as the brooder in young flocks.
- Secondary bacterial infections may be prevented by or treated with broad-spectrum antibiotics

Prevention and control

- Recovered chickens are immune for at least a year and local immunity in the respiratory tract is important.

Prevention by vaccination is the best method to control infectious bronchitis

Fowl Pox

Synonyms

- Avian pox
- Pox
- Avian diphtheria

Definition

- Fowl pox is a slow spreading viral disease of chickens, turkeys and other birds characterized by cutaneous lesions on unfeathered skin of the head, neck, legs and feet and / or by diphtheric lesions in the upper digestive and respiratory tract.

Etiology

- Family: Poxviridae
- Pox virus
- Distribution
- Chickens
- More than 200 species of wild birds
- Parrot, cockatoos, myna, canary
- Crane, rail, emu, ostrich, raptors
- Canary pox (Kikuths's disease)

Transmission

- Mechanical
 - Injured / lacerated skin
- Insects

- Mechanical vectors
- Humans
 - Hands
 - Cloths
- Routes
 - Aerosol

Clinical signs

- Cutaneous form
 - Nodules
 - Comb
 - Wattles
 - Eyelids
 - Non feathered parts

Diphtheric form

- Cankers / Diphtheric yellowish lesions
 - Mucous membrane of mouth
 - Esophagus
 - Trachea
- Tracheal involvement
 - Mild respiratory signs (coryza like)
- Blindness
 - Cutaneous eye lesions
- Starvation
 - Most losses
- Mortality
 - 50%

Gross lesions

- Cutaneous form
 - Local epithelial hyperplasi
 - Nodules as white-yellow foci

- Papules by 5th day
- Vesicular stage with formation of extensive thick lesions which may coalesce become scars

Diphtheric form

- Slightly elevated, white opaque nodules develop on the MM
- Nodules coalesce becoming a yellow, cheesy necrotic, pseudo-diphtheric / diphtheric membranes

Diagnosis

- Clinical signs
- Gross lesions
- Sample collection
- Isolation and identification of virus

Treatment and control

Topical application-

- Antiseptics
- Tinctures
- Fat solvents

Antibiotic therapy (CS test)

- To prevent secondary bacterial infections

Antifungal therapy

- Nystatin orally

Vitamin A

- Small birds- water and food
- 10,000-25,000 iu/im- Psittacine bird weighing 300-500 gm
 - Proper husbandry should be practiced to alleviate environmental stress
 - Immunization
- Fowl pox vaccine

Fungal diseases of poultry

Mycotoxicosis

Mycotoxicosis is a disease caused by a toxic fungal metabolite. Mycotoxicoses may affect both man and animals. Poultry mycotoxicoses are usually caused by fungi that

colonize and invade grains and feeds, but other environmental aspects may be involved.

Occurrence

- Grains and forages (feed stuffs).
- Fungi produce metabolites that are toxic to birds.
- Although specific mycotoxins from more frequently in certain geographic locations, interstate and international shipment of grains may result in widespread distribution of a mycotoxin problem.

Transmission

Ingestion or cutaneous exposure

Ergotism

Etiology

- The ergot alkaloids
- *Claviceps* spp. that colonize wheat, rye, and triticale are the most common causes of ergotism
- Clinical signs
- Retarded growth
- Low egg production
- Nervous incoordination

Gross lesions

- Abnormal feather development
- Necrosis
 - Beak
 - Comb
 - Toes
- Enteritis.

Trichothecene mycotoxicosis

Synonyms

- Fusariotoxicosis

Etiology

- Fungus *Fusarium sp. producetrichothecene* (not clear)
- More than 40 trichothecenemycotoxins are known to exist
- Only two of the most toxic found naturally are
 - T-2 toxin and
 - Diacetoxyscirpenol

Clinical signs

- Reduced growth
- Severe depression
- Bloody diarrhoea

Gross lesions

- Necrosis of the oral mucosa
- Reddening of the mucosa of the gastrointestinal tract
- Mottling of the liver
- Distention of the gall bladder
- Atrophy of the spleen
- Visceral hemorrhages

Aflatoxicosis

Etiology

- Aflatoxin
 - Group B1, B2, G1, G2
 - Aflatoxin produced by *Aspergillusflavus*

Clinical signs

- Reduced growth
- Reduced pigmentation of carcass
- Reduced egg production
- Reduced immune function
- Increased nutrient requirements for protien, trace elements (Selenium), and vitamins

Gross lesions

- Jaundice

- Generalized edema and hemorrhages
- Tan or yellow discoloration of the liver
- Swelling of the kidneys

N.B. Aflatoxin B1 is a potent, naturally occurring carcinogen and thus has special public health considerations.

Ochratoxicosis

Etiology

- Ochratoxin A, B and C
- Produced by *Penicilliumviridicatum* and *Aspergillusochraceus*
- Ochratoxin A is the most toxic and is the greatest threat to poultry production

Clinical signs

- Reduction in feed intake
- Increased mortality
- Reduced growth
- Reduced immune function
- Reduced egg production

Gross lesions

- Visceral gout
- Lesions in the liver and kidney

Treatment

- Remove the toxic feed and replace it with unadulterated feed
- Treat concurrent diseases (parasitic, bacterial) identified in the diagnostic evaluation
- Substandard management practices should be immediately corrected
- Vitamins, trace minerals (selenium) and protein requirements are increased by some mycotoxins and can be compensated by feed formulation and water-based treatment

Prevention and control

- Detection and control of mycotoxin contamination
- Proper storage of feed ingredients

- Good processing, shipping and handling procedures of feed
- Storage of ground feeds more than 14 days should be avoided
- Store feeds under cool, dry conditions
- Feeds and grains can now be screened for several mycotoxins (aflatoxin, T-2 toxin, ochratoxin, zearalenone) using monoclonal antibody detection kits
- Detection of toxin by other techniques
- Mycotoxins can form in decayed, crusted, built-up feed in feeders, feed mills and storage bins and these should be controlled
- Antifungal agents should be added to feeds
- Toxin binder may be added to the feed

Aspergillosis

Synonyms

- Brooder Pneumonia
- Mycotic Pneumonia
- Pneumomycosis

Definition

- Aspergillosis is a mycotic disease, usually of the respiratory system (including the air sacs) of turkeys, chickens, many other kinds of poultry, wild birds and cage birds.

Occurrence

- Aspergillosis occurs frequently in turkeys, chickens, captive game birds and zoological birds
- Occasionally in cage birds
- Penguins raptors, migratory waterfowl and psittacines frequently have aspergillosis
- All species of birds probably are susceptible
- Poults and chicks less than 3 weeks of age are affected more frequently than adults
- Market age tom turkeys and turkey breeders are also commonly affected.

Etiology

- Fungus *Aspergillus fumigatus*

Transmission

- Transmission is by inhalation of fungus spores from contaminated litter (e.g. wood shavings) or contaminated feed
- Hatcheries may also contribute to infection of chicks

Clinical signs and lesions

- Infected birds are depressed and thirsty
- Gasping and rapid breathing (“pump handle breathing”) can be observed
- Mortality is variable, from 5 to 50%
- Gross lesions involve the lungs and air sacs primarily
- Yellow-whitish pinpoint lesions can be found
- Sometimes all body cavities are filled with small yellow-green granular fungus growth

Diagnosis

- The signs and gross lesions of aspergillosis are very suggestive of the diagnosis
- Confirmation by microscopic demonstration of fungus in fresh preparations made from the lesions
- Culture on blood or sabouraud’s dextrose agar
- Should be differentiated from other respiratory diseases of birds

Treatment

- Treatment is apparently not cost-effective for poultry
- However, different drugs have been tried against avian aspergillosis with variable results
- Amphotericin B @ 1.0 mg/kg body weight i/v injections
- Copper sulphate 1:2000 (0.2%, 1 gm copper sulphate into 2000 cc water) solution as drinking water for two weeks
- Potassium iodide 30-65 mg/ 500 ml drinking water may be used @ 2.5 ml / 100 g body weight of birds

Parasitic diseases of poultry

Coccidiosis

Coccidia are almost universally present in poultry-raising operations, but clinical disease occurs only after ingestion of relatively large numbers of sporulated oocysts by

susceptible birds. Both clinically infected and recovered birds shed oocysts in their droppings, which contaminate feed, dust, water, litter, and soil. Oocysts may be transmitted by mechanical carriers (eg, equipment, clothing, insects, farm workers, and other animals). Fresh oocysts are not infective until they sporulate; under optimal conditions (70°–90°F [21°–32°C] with adequate moisture and oxygen), this requires 1–2 days.

Etiology-

Coccidia are host-specific, and there is no cross-immunity between species of coccidia. The prepatent period is 4–7 days. Sporulated oocysts may survive for long periods, depending on environmental factors. Oocysts are resistant to some disinfectants commonly used around livestock but are killed by freezing or high environmental temperatures.

There are seven different *Eimeria* species that infect chickens;

1. *Eimeria acervulina*
2. *Eimeria maxima*
3. *Eimeria tenella*
4. *Eimeria necatrix*
5. *Eimeria mitis*
6. *Eimeria brunetti*
7. *Eimeria praecox*

Clinical Signs-

- Signs of coccidiosis range from decreased growth rate to a high percentage of visibly sick birds, Severe diarrhea,
- High mortality
- Feed and water consumption are depressed
- Weight loss
- Decreased egg production
- Increased mortality may accompany outbreaks.
- Mild infections of intestinal species, which would otherwise be classed as

subclinical, may cause depigmentation and potentially lead to secondary infection, particularly Clostridium spp infection.

- Survivors of severe infections recover in 10–14 days but may never recover lost performance.

Control-

Poultry that are maintained at all times on wire floors to separate birds from droppings have fewer infections; clinical coccidiosis is seen only rarely under such circumstances.

Other methods of control are vaccination or prevention with anticoccidial drugs.

Treatment-

Sulfonamides are widely used: sulfadimethoxine, sulfaquinoxaline, sulfamethazine,

The supplementation of vitamins A and K promotes the recovery. 10g/10 lit for 3 days
Plain water for next 2 days 10g/ 20 lit water for next 3 days supercox

CODRINAL- 4 gm of codrinal is to be added to 1 litre of drinking water and administered to the ailing (ill) birds for 2-4 days. Each gm contains : Sodium salt of (P) - toluenesulphonyl 0.55 gm betamethoxyethylurethane Tetracycline hydrochloride 0.05 gm Crystalline lactose 0.375 gm Dried sodium bisulphite 0.025 gm-30 gm in 25 litres of water for 5-7 days.

Alternative medicines-

Oregano, green tea and cinnamon all help fight coccidiosis

Metabolic diseases of poultry

Gout in poultry

Introduction Visceral gout is the deposition of white urates, which are normally excreted as a whitecap on well formed faeces, in various tissues. In gout, the kidney function is slowed down to a point where uric acid accumulates in blood and body-fluids. Further, it leads accumulation of white uric acid or urate-crystals occurs in soft tissues of various organs in body.

Other names

Nephrosis, Baby Chick

Nephropathy

Types of Gout

- **VISCERAL GOUT:** A condition in which white uric acid or urate crystals deposits are seen in soft tissues of various organs in body.
- **ARTICULAR GOUT:** Conditions in which urate crystals deposit are seen in joints.

Factors/Causes of VG

The main causes of gout are many as kidney damage occurs due to multi etiological factors. These causes can be broadly categorized as:

- (1) Infectious causes
 - (2) Nutritional and metabolic causes
 - (3) Other causes (Managemental)
- Could be a viral like IB/ANV /C astroVetc (possibility for Horizontal/vertical transmission)
 - Could be a bacterial like E coli strains.
 - Could be a Management **ieat (not clear)** various operations to handle the chicks from hatchery to farm house and due to nutrition (Feeds). So due to these causes make it a complex disease.

All poultry species are susceptible.

Treatment-

- Individual cases of gout may be ignored.

In acute cases of gout mortality following prescription would be beneficial. Provide plenty of water and adequate drinkers.

- Avoid a diet higher in protein than the recommended level as per the age and breed. Provide low protein diet for 3-5 days based on need depending on severity of gout.
- Review IB vaccination programme. In the areas where IB is endemic it is advisable to vaccinate with nephrotropic strain at around 4 days. Day one beak dip vaccination has proved to be beneficial in broilers.
- Use of urine acidifiers:
- Any one of the following urine acidifiers may be given in water or feed.

- Using of methaniminein drinking water for 1 weeks if the problem is severe. (0.5-1gm/ lit.)
- Vinegar: 1-2 ml per litre water up to 24 hours.
- Potassium chloride: 1gram per litre water up to 24 hours.
- Ammonium chloride: Two and half kg/ton feed for 7 days.

Ammonium sulphate: Two and half kg/ton feed for 7 days. Ensure adequate levels of A, D3, K and B complex vitamins. Excessive use of sodium bicarbonate i.e. more than 2kg/ton should be avoided. Use of electrolytes through water may assist in controlling mortality.

- Provide broken maize at least for 3 days and jiggery 5g/litre for 3-5 days in case of mortality.
- Provide 0.6% methioninehydroxyl analogue free acid with 3% calcium in the diet.

Unit-8

Bio-Security and Sanitation in and around Farm Premises

Bio-security

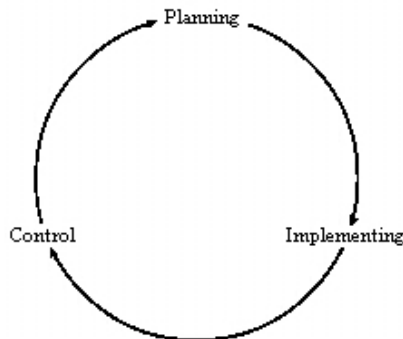
Bio-security is a tool to help minimize the effect of infection and decrease the impact of disease. It is the way to reduce risk of introducing and spreading disease. It is a managerial tool that should be implemented and practiced at all levels of poultry farm. Bio-security is the cheapest, most effective means of disease control available. No disease prevention program will work without it.

Evaluating the bio-security of ongoing operations is important in developing effective programs to prevent the introduction of disease into a complex or to limit subsequent dissemination among farms.

A successful bio-security program presumes an understanding of the principles of epidemiology and economics and requires teamwork to maximize benefits. Biosecurity programs require a structured approach involving the following sequence:

- Planning.
- Locating resources.
- Implementing.
- Control.

FIGURE 1.1 CYCLE OF MANAGEMENT



The following items should be considered in evaluating a comprehensive a bio-

security program for a breeder or grow out complex;

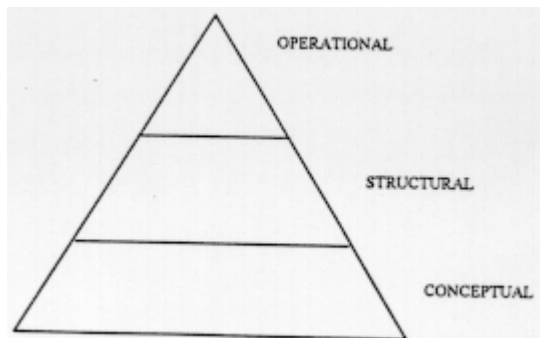


Fig. Hierarchy of Biosecurity

1. Conceptual Bio-security

- Location of the complex in relation to concentrations of poultry of the same or different species.
- Distance among breeder and grow out farms and facilities such as hatcheries, feed mills, and processing plants or packing units.
- Location of major and minor roads and the movement of commercial and backyard poultry in relation to company facilities.
- Proximity to large lakes or waterways or migratory flyways.

For commercial egg production consider the implications of multi-age on-line units or single-age, company owned or contractor operated facilities.

2. Structural Bio-security

- Fenced farm area with notices to prevent trespass.
- Fencing of house area, with secured gates.
- Water supply free of pathogenic bacteria, and chlorinated to a level of 2 ppm.
- Farm service module comprising an office, storage, and change room-shower facilities.
- Concrete apron with a suitable water and power supply to permit decontamination vehicles entering the farm.
- All weather roads within secured perimeter to facilitate cleaning and to prevent dissemination of disease agents by vehicles and footwear.
- Appropriate location of bulk bins or secure, vermin-free storage areas for bagged

feed.

- Installations for disposal of dead birds.
- Secure housing with appropriate bird and rodent proofing.
- Concrete floors for breeding stock at the grandparent levels. In many countries with endemic pullorum disease, concrete floors are required in all breeder houses.
- Correct positioning of extractor fans to prevent airborne transmission of pathogens to flocks in adjacent houses.
- Impervious apron adjacent to the door of each house and installation of drains.
- Feed, litter and equipment should be stored in a module separated from the live-bird area of the house to prevent contamination of flocks by delivery and maintenance workers.

3. Operational Bio-security

- Operational manuals should be developed for routine procedures carried out in feed mills, hatcheries, breeding and grow out facilities. Manuals should incorporate contingency plans in the event of a deviation from normal production parameters or outbreaks of disease in company farms or in units located in close proximity to the operation. Manuals should be developed for appropriate levels of management including company veterinarians and health maintenance professionals, service personnel, contractors, and employees.
- Standardized procedures should address specific aspects of operation including:
- Decontamination and disinfection of units following depletion of flocks.
- Storage, reconstitution and administration of vaccines by various routes.
- Specific procedures on entering and leaving farms should be designated for managers, supervisors, authorized visitors, work crews and permanent and part-time employees.
- Strict controls are required to prevent contact with exotic avian species, and backyard poultry.

Decontamination of Housing and Equipment

Definitions

Decontamination is the process of physically removing biological and inorganic material from the surfaces of a building or equipment. Disinfection is the destruction of pathogenic organisms

Decontamination

Thorough decontamination is necessary to achieve effective disinfection. Cleaning programs require planning followed by implementation and control to ensure satisfactory preparation of surfaces for subsequent application of disinfectants.

Disinfectants

A number of compounds are available commercially, each with characteristics for specific applications.

- Cresols, derived from petroleum distillation are cheap and effective biocides when applied to buildings and soil. These compounds should not be used in the presence of live poultry, eggs, or processed meat as tainting of products will occur.
- Organic phenols are suitable for use in hatcheries to decontaminate equipment.
- Quaternary ammonium compounds are highly recommended to decontaminate housing, equipment, and in hatcheries.
- Chlorine compounds are widely used in processing plants and to purify water on farms.
- Formalin is a corrosive and potentially carcinogenic compound suitable to fumigate eggs in purpose-designed cabinets. Formalin requires special precautions to avoid exposure and injury to applicators.

In selecting a disinfectant, it is necessary to take into account the chemical characteristics, toxicity, and the cost of application.

Public Health Consideration

The use of disinfectants and pesticides is controlled in most countries by legislation which restricts the use of products to specified and approved applications in accordance with manufacturers' label directions.

Recommendations concerning disinfection and pest control should always conform to statutory regulations and should be designed to limit possible contamination of the

environment, flocks, and products. In the absence of national or local rules, the US Department of Agriculture and the US Food and Drug Administration guidelines are recommended.

Disinfection of Poultry Houses

Complete depopulation of houses and decontamination of units and surroundings at the end of each broiler, rearing, breeder or layer cycle will contribute to enhanced liveability and performance in subsequent flocks. The following procedures should be followed:

- The surface of the litter and the lower side walls should be sprayed with a 2% carbamate insecticide.
- Litter should be graded to the center of the house for removal either manually or with a front-end loader. Litter should be either bagged or transported in bulk from the house to a central site for composting or disposal. Equipment should be disassembled and removed from the house for cleaning and disinfection.
- Electrical units, motors, and switch gears should be cleaned using a high-pressure air spray and then sealed to protect installations from water damage.
- The floor of the house should be swept to remove residual litter.
- The house should be decontaminated by spraying a non-ionic detergent at a concentration recommended by the supplier. Detergent should be applied to the exterior in the sequence of roof, exterior walls, drains, and service areas. The interior sequence should follow the ceiling, internal walls, and then the floor.
- The interior structure and equipment should be rinsed with water and remaining detergent solution should be allowed to drain.
- The interior of the house should then be sprayed with a quaternary ammonium or phenolic disinfectant solution at a concentration recommended by the manufacturer. A cresolic disinfectant can be applied to earth floors.
- A 2% carbamate insecticide solution should be sprayed on the ceiling, walls, and floor to control litter beetles. (*Alphitobius*spp)
- Equipment should be reassembled and routine preventative maintenance completed. A clean, dry substrate (wood shavings, ground nut hulls, rice hulls, sawdust) should be spread to a depth of 3 - 10 cm, over the floor area.

- Breeder houses should be sealed and fumigated with formalin generated from heated paraformaldehyde or from a mixture of formaldehyde and potassium permanganate. A fog generator can also be used to distribute formalin in aerosol form through the house. It is emphasized that formalin is a toxic compound and is potentially carcinogenic. Appropriate protective clothing and respirators should be used and workers should be trained to use the compound in accordance with accepted procedures to protect health.
- Water lines and drinkers should be drained and cleaned. A quaternary ammonium compound (1 - 2,000 dilution) or chlorine solution (1 liter of 6% sodium hypochloride per 50 liters of water) should be used to flush water lines.
- Rodent control measures should be implemented including sealing of burrows and baiting.

Control of rodents

Rats and mice are significant pests in poultry facilities. They cause damage to building structures, including foundations, water lines, electrical cables, switch gear, and insulation. Rodents are major vectors and reservoirs of poultry and zoonotic pathogens, including *Pasteurellamultocida*, *Salmonella typhimurium* and *S. enteritidis*. The mouse population in a poultry house can remain infected for at least 10 months after cleaning and disinfection. Mice amplify environmental contamination and will infect poultry and products. Rodents serve as mechanical transmitters of infectious agents such as influenza and infectious bursal disease viruses.

Rodents are nocturnal and are active after lights have been turned off. Rats and mice are seldom seen during the day unless infestation is very heavy. Colonization can be detected through the presence of active nesting sites in attics, in cracks in concrete slabs, under cages, in manure, in corners, or by burrows around the foundation walls. Fresh droppings may be observed around the inner perimeter of the poultry house. Outdoor burrows may be closed by filling with soil and observed for reopening of entrances. The frequency of catching rodents in traps may also be used to assess the level of infestation. A continuous integrated program to control rodents includes rodent-proofing of buildings, elimination of nesting places, appropriate management and sanitation, and chemical and nonchemical elimination. Preventing access to feed,

water, and shelter is an important part of a rodent-control program. Chemical methods to control rodents include bait and tracking powder. All rodenticides are poisonous at various levels for poultry, livestock, and humans. Caution in the use of rodenticides is required, and manufacturer's label instructions should be strictly followed.

Rodenticides are available for single- or multiple-dose application. A single-dose rodenticide will kill rodents after one feeding if an adequate amount is consumed. Most single-dose compounds are toxic to nontarget animals and should be kept out of reach of children, pets, poultry, and livestock. Only extreme situations call for the use of a single-dose rodenticide with high toxicity. Multiple-dose compounds have a cumulative effect and will kill rodents after several feedings. Bait has to be available continuously, and other feed sources must be removed. The rate of rodent kill depends on the type of rodenticide and the dose consumed. Some products kill within 1 hour, and others require 4 to 7 days after ingestion.

Baits are available in dry or wet form, in powder mixed with grain, in pellets, micro-encapsulated, in paste, in wax, or in water. For maximum effectiveness, bait should be available in both feed and water. Bait should be offered at stations located in the activity zone of rodents, in the routes between the nesting site and the common food source, and at the entrance to active burrows.

Bio-securities for Hatcheries-

- Biosecurity is an important aspect of hatchery design and management.
- Require for maximum hatchability rates and chick quality.
- Protection of hatching eggs and day old chicks from contamination.

Routine bio-security procedure in hatcheries-

- Choice of a suitable area to ensure an isolated site.
- Proper hatchery design with separation of major operation.
- One way flow of work within the hatchery.
- Adequate ventilation of each room.

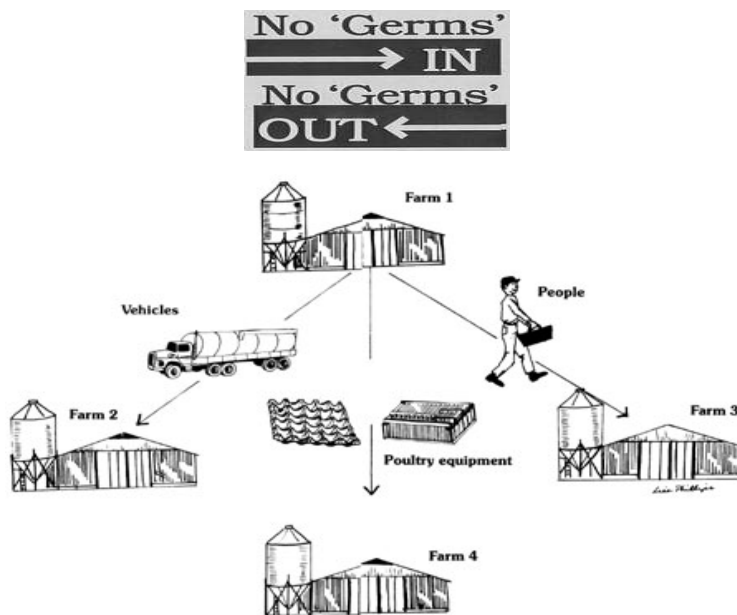
Farm disinfection procedure-

- Complete removal of litter before entering new flock.
- Burning of cages as well as feather remains in the litter.

- Cleaning of pipelines, washing of shed, terminal disinfection of total shed including curtains also.

Checklist of bio-security-

- Keep clean clothing and smooth soled rubber boots at the farm, wear them in production areas.
- Clean and disinfect all equipment as you move between houses.
- Change foot pan solution at each houses entrance daily.
- Follow direct to maintain effective rodents and insect control programs.
- Work through poultry house in a specific order;-this order depends on the health of the flock in each house, visit the healthy flock first.
- Do not drive farm vehicle near areas where poultry is handled.
- All connecting road within the farm should be provided with facilities like cleaning, washing of vehicles and footwear to prevent the spread of microbes.



Unit-9

Egg Collection

Egg collection, cleaning and grading

Egg collection from farm is essential, timely and regular process because of any disturbance like dirty, broken, climatic condition and cannibalism may reduce hatchability of egg. Mostly egg is preferred to be collected at morning time twice daily before noon. The clean egg collect first then floor one. The collector hand should be clean and collect only unbroken shell egg.

In laying operations, most of the eggs are generally laid within five hours of the first light in the morning. Collect eggs often — twice in the morning and once in the afternoon — to help decrease the number of dirty and broken eggs and start cooling eggs (Big bee and Froning, 1997). Collection should be more frequent in very hot or cold weather. Eggs should be held at 60°F and 70 per cent relative humidity before cleaning. Eggs stored at room temperature, about 75°F, can drop as much as one grade per day. Embryos can start to develop in fertile eggs held at a temperature above 85°F for more than a few hours (Parkhurst and Mountney, 1988).

Cleaning

Eggs are cleaned to remove debris and stains and reduce the microbial load. Excessively dirty eggs should not be cleaned, but rather discarded.

Dry cleaning-

A slightly dirty egg can be brushed with an egg brush or rubbed with a sanding sponge and sandpaper.

Wet cleaning-

Naturally, the egg has good defenses to help protect the embryo during incubation. The shell is covered by a waxy layer (the cuticle) that helps prevent microbes from entering the pores that allow the passage of gases. The cuticle is not impenetrable and water on the surface of the egg shell can undermine these defenses because water helps bacteria pass through the shell pores into the egg. If the period of contact between egg and water is short, there will be little microbial penetration into the egg (Zeidler, 2002).

Therefore, it is important to limit the amount of time that the shell is wet. Soaking eggs in water for as little as one to three minutes can allow microbes to penetrate the shell (Zeidler, 2002).

Grading

Grading involves sorting eggs based on quality, size and weight standards. Quality is based on shell quality, the air cell, the white and the yolk. For example, the highest quality Grade AA has a clean, unbroken, unstained shell; the air cell is 1/8 inch or less in depth; the white is clear and firm; and the outline of the yolk is only slightly defined and free from defects such as blood spots. The USDA Egg Grading Manual describes how grading is done under the USDA (USDA, 1990).

Grading also involves sorting eggs into weight classes or sizes including peewee, small (less than 53gm), medium (53gm), large (63gm), extra-large (73gm) and jumbo. The USDA Egg Grading Manual explains the required individual egg weight and how much a dozen eggs need to weigh for each weight class. Consumers notice size variation within a carton but not as much from carton to carton. Most states do not require small-scale egg producers to grade eggs and cartons usually must be marked as ungraded.

Egg packaging, storage, transport and marketing

Packaging

Nature has given the egg a natural package - the shell. Despite its relative strength, the egg is an extremely fragile product and even with the best handling methods, serious losses can result from shell damage. Economical marketing generally requires that eggs be protected by the adoption of specialized packaging and handling procedures.

Functions of packaging-

Packaging is an important component in delivering quality eggs to buyers. It embraces both the art and science of preparing products for storage, transport and eventually sale. Packaging protects the eggs from:

Micro-organisms, such as bacteria;

Natural predators;

Loss of moisture;

Tainting;

Temperatures that cause deterioration; and

Possible crushing while being handled stored or transported.

Proper handling and storage help control moisture loss, but appropriate packaging may also help prevent it. Eggs also need to breathe, hence the packaging material used must allow for the entrance of oxygen. The material used must be clean and odourless so as to prevent possible contamination and tainting. Authentic egg packaging materials can be reused, but careful attention must be paid to possible damage, odours and cleanliness. The packaging must be made to withstand handling, storage and transport methods of the most diverse kind and to protect the eggs against temperatures that cause deterioration and humidity. Finally, consumers like to see what they are buying, especially if it concerns fresh produce. An egg package should be designed so that the customers not only recognize the product as such, but can also see the eggs they are buying. Many factors must be taken into consideration for packaging eggs. It is important to obtain information regarding the necessary requirements for a particular market, such as:

- quality maintenance;
- storage facilities;
- type of transport;
- distance to be travelled;
- climatic conditions;
- time involved; and
- costs

Egg packages-

There are many different types of egg packages, which vary both in design and packaging material used.

Type 1: Packing eggs with clean and odourless rice husks, wheat chaff or chopped straw in a firm walled basket or crate greatly decreases the risk of shell damage.

It is also be possible to pack eggs in a simple basket. The basket has no cushioning material such as straw and therefore damage to the eggs may occur more easily. This

kind of packaging may be fit for short distance transport.

Type 2: A very common form of packaging is the filler tray. The fillers are then placed in boxes or cases.

Filler trays are made of wood pulp moulded to accommodate the eggs. They are constructed so that they can be stacked one on top of the other and can also be placed in boxes ready for transport. Filler trays also offer a convenient method for counting the eggs in each box, without having to count every single egg. Usually the standard egg tray carries 36 eggs. Therefore, if a box holds five trays, for example, the box has a total of 180 eggs ($36 \times 5 = 180$). The cases used may be made of sawn wood; however, they are more commonly made of cardboard. When using cardboard cases, special care must be taken in stacking so that excessive weight is not placed on a case at the bottom of a stack.

Fillers can also be made of plastic as seen in Photograph 19. The advantages of using plastic egg fillers are that they can be reused and are washable. The fillers can be covered with plastic coverings and be used as packages for final sale to the buyer. More importantly, however, plastic transparent fillers allow for the inspection of eggs without handling or touching the eggs.

Type 3: Eggs can also be packed in packages that are smaller and specific for retail sale. Each package can hold from two to twelve eggs. These cases can be made of paperboard or moulded wood pulp. It is also possible to pack eggs in small paperboard cases and cover them with plastic film. Egg cases have also been developed from polystyrene. The advantages of using polystyrene are superior cushioning and protection against odours and moisture. The package is also resistant to fungus and mould growth. The use of small cases is restricted by availability and cost considerations. However, small cases are good for retailers and customers. They are easy for the retailers to handle and customers are able to inspect the eggs.

Storage of Eggs-

- The storage of shell eggs during the main laying season, in order to conserve them for consumption when they are scarce, has been practiced for many centuries.

- For the successful storage of eggs, the following conditions must be met.
- The eggs placed in storage must be clean; they must not be washed or wet.
- Packaging material used should be new, clean and odorless.
- Loss of water due to evaporation should be reduced to a minimum.
- The storage room must be free from tainting products and materials and should be cleaned regularly with odorless detergent sanitizers.
- The storage room must be kept at a constant temperature and humidity must be checked.
- There should be air circulation in the storage room.
- Eggs should be stored so that they are allowed to breathe.
- As far as possible, interior quality should be monitored; there should be a good proportion of thick white, the yolk should stand up well, and the flavour of white and yolk should be good.
- If all of the above requirements are to be met, refrigerated storage is necessary.

Cold storage of eggs

In the tropics, eggs can deteriorate very quickly unless they are stored at low temperatures. The ideal temperature for storage in such climates is 13°C or lower (usually between 10° and 13° C). Here refrigeration is a necessity for successful commercial storage; however, it may be unavailable or the costs too high. The most important factors in successful cold storage are as follows.

- The selection and packaging of eggs.
- The equipment and preparation of the cold store.
- Proper temperature, humidity and air circulation.
- Periodic testing for quality.
- The gradual adjustment of eggs to higher temperatures when removed from storage.

The selection and packaging of eggs for storage-

Eggs for storage must be clean, of good interior quality and have a sound shell. If they are to be stored for more than a month, they should be equivalent to the U.S. grade A . Therefore, it is best to candle all eggs before storage. It may also be advisable to take a sample and to break out these eggs as a further quality check . The period of time

between laying and storage should not be more than a few days. The eggs should be kept cool during that time.

Packaging materials used for storage should be new, clean, odourless and free from damage. When packaging material is reused, it is extremely important that it is clean, odourless and free from damage. It is important that the material used allow the eggs to "breathe" and to be free from tainting odours. It should also be sturdy in the event that the cases have to be stockpiled on top of one another.

The equipment and preparation of the cold store-

The storage room should have a concrete floor that is washable. Walls and ceilings must also be washable. Wooden buildings have been found to be satisfactory, provided they do not impart foreign odors or flavors to the eggs. The room should be scrubbed thoroughly with hot water and soap or an odorless detergent sanitizer before being used. A final rinse with a hypochlorite solution will help greatly in deodorizing the storeroom. A liberal application of freshly slaked lime to unpainted plaster surfaces will also help. The storage room should be aired and dried out thoroughly after cleaning, then closed up and the refrigeration turned on. It is best to allow several days for the temperature and humidity to stabilize before introducing the eggs.

Proper temperature, humidity and air circulation-

Careful and accurate control of the air condition is essential. A temperature between - 1.5° and - 0° C is recommended. At a temperature of - 2.5° C eggs freeze. The room should be well constructed and insulated and the refrigeration should be capable of maintaining an adequate uniform temperature in all areas. The cases of eggs should be separated by wood-strips and kept well away from the walls so as not to obstruct air circulation. Aisles left for the convenience of handling specific egg cases also help air circulation. Periodic ventilation of the storage room is advisable to promote air exchange.

The relative humidity should be between 80 and 85 percent at a cold storage temperature of - 1° C. At cold storage temperatures of about 10° C the relative humidity should be between 75 and 80 percent. In such instances, on average, egg weight loss should not exceed 0.5 percent per month. During the early stages of storage when the packaging material is absorbing moisture at a high rate, the floors should be

sprinkled with clean water several times a day. If forced-air circulation is feasible, a controlled temperature water-spray air washer may be used. If the humidity becomes excessive, part of the air can be cycled through a unit containing calcium chloride. Where eggs have been oiled less attention can be paid to the humidity level.

Periodic testing for quality-

Periodic quality checks are essential if the risk of heavy egg losses is to be avoided. Every month or so a sample of eggs should be selected from the various lots and tested. Usually a sample of about 1 percent of all eggs in storage may be sufficient. For example, if 3 000 eggs are kept in storage, 30 eggs sampled from various egg cases will enable a good estimation of the general quality level of the eggs. If there is evidence of excessive deterioration, it is best to dispose of the eggs quickly, after eliminating those that are unfit for consumption.

The gradual adjustment of eggs to higher temperatures-

Care must be taken in removing eggs from storage to avoid the condensation of moisture on shells. This is minimized by raising the temperature slowly or by moving the eggs through rooms with intermediate temperatures. If condensation occurs, the eggs should be held under conditions that allow the moisture to evaporate within a day or so.

As indicated earlier, eggs should not be stored with products that may taint them. For the long term, eggs are best stored alone, while for the short term they may be kept with dairy products such as milk and mild-flavoured cheese. The average storage life for eggs is between six and seven months.

Transport of Eggs-

For the successful transport of shell eggs three essential requirements must be met.

1. The containers and packaging materials must be such that the eggs are well protected against mechanical damage.
2. Care should be taken at all stages of handling and transport. Workers handling eggs should be instructed so that they appreciate the need for careful handling. The provision of convenient loading platforms at packing stations, loading depots and railing stations, and handling aids, such as hand trucks and lifts, are

of great help.

3. The eggs must be protected at all times against exposure to temperatures that cause deterioration in quality as well as contamination, especially tainting.

The permissible range of temperatures during loading and transport depends on the local climatic conditions and the duration of the journey. Table 8 shows recommended temperatures for transport and loading. Care is needed to avoid excessive shaking, especially where roads are bad. Egg containers should be stacked tightly and tied down securely to minimize movement. Covers should be used to protect them from the heat of the sun, rain and extreme cold where applicable. Where bicycles are used, a device such as a special carrier suspended on springs may be helpful.

Recommended temperatures for loading and transport-

	Transport over 2 or 3 days	Transport over 5 or 6 days
Maximum on loading	+6° C	+3° C
Recommended for transport	-1° to + 3° C	-1° to + 1° C
Acceptable for transport	1° to + 6° C	1° to + 3° C

A basic prerequisite for all long-distance transport is that arrangements be made for proper reception, handling and storage at the end of the journey. This is especially important where large lots are delivered to a relatively small market. Without access to suitable storage facilities, the eggs may have to be marketed quickly under adverse climatic conditions, which may cause substantial quality deterioration and price losses. Delivery of high quality eggs over long distances, especially in hot climates, generally calls for refrigeration. Requirements for the successful operation of refrigerated transport equipment are rather rigid especially as regards the following factors:

- efficiency and durability of insulation;
- adequacy and reliability of the cooling mechanism; and
- Adequate circulation of air within the vehicle or container so that variations of temperature are slight.

Decisions on the establishment of new refrigerated transport services for eggs should be based on thorough economic as well as technical evaluations. The following criteria

should be taken into consideration.

- The need for a managerial and operational staff that is competent in all the operations involved in assembling, loading and distributing.
- The necessity of a sufficient volume of trade throughout the year.
- The possibility of making up loads with other compatible products, e.g. dairy products.
- The possibility of carrying return loads, once eggs have been distributed.
- The degree to which the demand for refrigerated transport is concentrated geographically.

Egg selection for hatching-

The quality of hatching eggs is one of the important contributing factors for efficient hatching. The following care should be taken while selecting eggs for hatching. Fertile eggs should be selected for hatching. For this one has to ensure that potential proportion males (proper sex ratio 1:15-16 for layers and 1:10-12 for broilers) have been mixed in breeding flocks of hens. The eggs having medium size, weighing 50-55g, 65-70g and 80-85g respectively for chicken, duck and turkey, be selected for hatching. Eggs which are too small or too large cause difficulties in setting them in incubation trays and don't hatch efficiently due to under or over nutrition.

The eggs to be selected for incubation should have normal ovoid shape for proper setting in incubation trays. The abnormal shaped eggs like round, flat, elongated, conical etc. are rejected as they again cause problems for setting. The eggs selected for hatching should have sound, clean, smooth and thick shells. The excessive soiled and dirty eggs can contaminate atmosphere in incubator. Similarly weak and cracked eggs may break during incubation and spoil other eggs in incubator. Further eggs to be selected for incubation and hatching should possessed high internal qualities. They should be practically free from any defects including blood and meat spots along with excellent yolk and albumin quality.

Handling and care of hatching eggs-

Once again handling and care of hatching eggs before setting into incubator during storage is also one of the major contributing factors to obtain optimum hatchability with strong healthy chicks. At any stage before and during incubation, hatching eggs

should be handled gently and with care. Rough handling at any time during operation can kill the developing embryos which may lead to high mortality. Frequent gathering for collection of hatching eggs should be adopted and they may be immediately cooled to physiological zero, i.e. temperature of 20°C to arrest development of embryo before setting for incubation. The moderately soiled eggs should be gently dry cleaned with rough cloth or sand paper. Now a day's transporting of hatching eggs is not practiced as most of hatcheries are attached with parent rearing. Further, transported eggs should be allowed to settle for 24 hours before setting.

Generally immediate setting within a day is advised to get efficient hatchability by eliminating storage problems. The storage duration and conditions like temperature, humidity etc. adversely influences hatchability. Therefore, efficient hatcheries don't store hatching eggs for more than 3-4 days. Maximum possible period advised for storage is 7 days. For less than 4 days hatching eggs can be stored at 18.3-25°C and for 7 days at 15-16°C. The recommended humidity during storage of hatching eggs is around 75-80 percent.

Incubator and its operation-

An incubator should to be able to regulate factors, such as temperature and humidity, and to allow air renewal and egg turning, providing the perfect environmental conditions for embryonic development, aiming at achieving high hatchability of healthy chicks, which is directly correlated with the survival and performance of individual chicks in the field. Currently, incubators capable of incubating different numbers of eggs of different species of birds are commercially available, with more or less sophisticated of temperature, humidity, ventilation, and egg turning control systems. Modern state-of-the-art commercial hatcheries are provided with automatic systems controlling all the physical factors of incubation: egg turning; environmental temperature set according to eggshell temperature determined by thermo-sensors; air relative humidity and egg water loss determined by egg tray weight using weight sensors; and air quality (O₂ and CO₂ levels). However, as already pointed out despite the technological advances of the modern incubation machines, the success of incubation still depends on the quality of labor both inside and outside the hatcheries, which requires training.

Physics of egg incubation: an integrated process-

From a macroscopic point of view, although the external and egg internal environments seem to be completely isolated, the eggshell participates in and allows exchanges between those two environments, as determined by the interaction among temperature, relative humidity, ventilation (air quality) and egg turning during incubation, which are essential for the success of embryonic and fetal development. The physical exchanges between the egg and the external environment (egg and air of the incubator) include heat transfer and the exchange of O_2 , CO_2 and water. Egg characteristics (size, composition, and shape, and eggshell thickness, porosity, and heat and water vapor conductance), embryo metabolism rate and physical incubation conditions, as well as pre-incubation conditions, may cause deviations from the optimal values of these physical agents. Such deviations may can interfere with, or even hinder, *in-ovo* development, resulting in negative effects on hatchability and on the quality of the hatchlings and their subsequent performance, phenotype, and survival. In contrast, optimal physical incubation conditions benefit egg hatchability and chick quality, with possible survival and performance benefits.

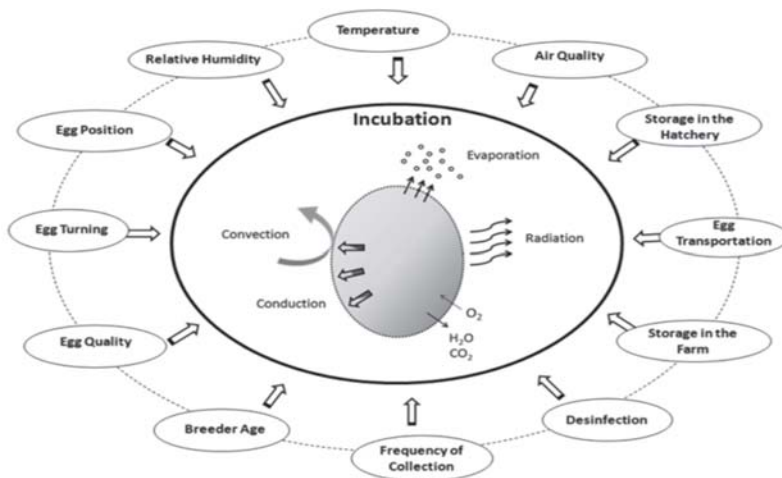


Figure: Physical exchanges of the eggs with the environment during incubation (heat transfer, water loss and gases exchanges) depend of the egg characteristics (size, composition, form, and eggshell thickness, porosity and heat and water vapor conductance), embryo metabolism rate and physical incubation conditions, but also of the pre-incubation conditions.

Egg heat transfer

Heat transfer occurs when there is a temperature difference between two regions or media, and always on the thermal gradient. Eggs present four mechanisms for heat transfer: conduction, radiation, convection, and evaporation (Meijerhof & van Beek, 1993; French, 1997). However, eggs gain or lose heat only when there is a temperature difference between the environment and the eggshell, and this is influenced by several factors associated with egg quality (breeder age; egg size, composition, and shape; and eggshell characteristics), water loss, and incubation conditions.

Egg Water transfer

Water diffusion is a physical process that, according to Fick's laws, is the movement of water molecules down a concentration gradient. The diffusion flow is given by concentration gradient and by temperature: the higher the gradient and the temperature, the faster is the water diffusion. Eggs lose water by diffusion through the eggshell as a result of the water pressure differences between the inside and the outside of the egg, as determined by the temperature and relative humidity of both sides. Egg water loss depends of eggshell porosity (Deeming, 2002), given by its pore number, diameter, length, and shape. Therefore, it is higher in eggs laid older breeders or larger eggs from a same breeder age incubated at high temperatures and/or low relative humidity levels (Morita et al., 2009, 2010; Sgavioli et al., 2015). Although the velocity of the air on the egg surface has no direct effect on water loss (Meijerhof & van Beek, 1993), as previously mentioned in this review, it allows continuous conductive-convective heat dissipation, and therefore, indirectly influences egg water loss.

Egg O₂ and CO₂ exchanges

In-ovo development requires that all embryonic, fetal, and embryonic annex cells are supplied with the energy required for their survival, proliferation, migration, and differentiation. Energy utilization demands aerobic respiration, efficient oxygen supply, and carbon dioxide elimination. The demand for gas exchange increases during incubation as a result of the increasing metabolic rate of the embryo, according to its different developmental stages, i.e., embryo morphogenesis, fetal growth, and hatching. In order to ensure efficient gas exchange during in-ovo development, different surfaces are used. During the first three days of incubation, gas exchanges

are carried out directly by the embryonic cells. As the embryo develops, the amniotic cavity is formed, which makes the direct gas diffusion from the embryonic cells inefficient, demanding the establishment of gas transport systems. From the third day of incubation, with the emergence of the embryonic circulatory system and yolk vascularization, gas exchange is exchanged through the vitelline vessels. Yolk vascularization continues as the embryo develops, increasing the surface area of gas exchange. However, fetal development requires greater O₂ supply than that provided by vitelline gas exchange. Furthermore, vitelline circulation disappears as the yolk sac is incorporated in the fetal abdominal cavity, and its contents start to be absorbed exclusively by the intestinal route. Therefore, by days 10-12 of incubation, gases start to be exchanged by the allantoic vessels, which supply the high oxygen requirements for increased fetal metabolism thereafter (Hamburger & Hamilton, 1951; Tazawa, 1980; Deeming, 2002; Mortola, 2009). After internal pipping, gases gradually begin to be exchanged via the pulmonary respiratory system (Decuypere & Bruggeman, 2006; Mortola, 2009), and O₂ deficit and CO₂ saturation inside the egg air chamber are the main factors that induce external pipping and hatching per se (Mortola, 2009). In addition to changes in the gas exchange surfaces, hematological adjustments also occur, increasing gas exchange capacity during incubation: red blood cell counts (RBC), hematocrit (Ht) values, hemoglobin (Hb) levels increase, while mean corpuscular volume decreases (Morita et al., 2009; Tazawa et al., 2011, 2012).

Factor affecting Incubation

Air relative humidity

As mentioned above, egg water loss during incubation is essential for adequate in-ovo development; however, water losses outside a normal range may result in chick abnormalities or death in ovo. Low air relative humidity during incubation may cause excessive egg water loss, resulting in embryo dehydration and death (Reinhart & Hurnik, 1984) or the hatching of small and dehydrated chicks (van der Pol et al., 2013), due to fluid deficit in the amniotic and allantoic cavities, which impairs embryonic development and hatching. However, hatchlings with low body weight, as a result of skin and muscle dehydration, may present compensatory growth between 7 and 10 post-hatch, and normal development thereafter (Davis et al., 1988). On the

other hand, if the air relative humidity is too high, the incubation period is shortened, and the chicks are wet at hatch and residual albumen may be present (Taylor, 1999; Decuyper et al., 2002; Tona et al., 2003)

Egg turning, egg position, and ventilation

The associated effects of egg turning, egg position, and ventilation influence several processes, including gas exchange and heat transfer between the eggs and the external environment, egg water loss, adhesion of the embryo to the extra-embryonic membrane structures (corium, amnion and allantois), and nutrient availability.

Egg turning is a natural behavior of birds during incubation, and therefore, this practice was included in the artificial incubation process. Egg turning allows the diffusion of gases inside the eggs and between the eggs and the external environment. It is critical particularly during the first week of incubation, due to the long distance between the embryo and the shell, and to the high albumen density. During this period, the embryo depends on the diffusion of gases through the eggshell and the albumen to obtain O₂ and eliminate CO₂, because the embryo develops on the yolk surface and gases are exchanged directly by the embryonic cells. After the emergence of the circulatory system (~36 h of incubation) and the formation of the amniotic cavity and yolk vascularization, gases are exchanged through the vitelline vessels. The allantois begins to protrude out of the embryo body around days 3-4 of incubation, and continues to grow in size, surrounding the amniotic cavity, where the fetus develops. As both fetus and allantois grow, the allantois comes closer to the eggshell, reducing the distance traveled by the gases and allowing gas exchange via allantoic vessels by diffusion through the eggshell pores. Gas exchange through the allantoic arteries and veins begins on days 11-12 of incubation. By days 13-14 of incubation, fetal metabolic heat production increases, and egg turning aids the circulation of air in the inner surface of the egg (external shell membrane) and air chamber, and allows heat loss by conduction, convection, and evaporation. However, egg turning is also important to prevent dehydration and incorrect embryo development (Wilson, 1991). Moreover, egg turning moves nutrients, facilitating their absorption (Brinsea, 2006).

Air quality: O₂ and CO₂ concentrations

Maintaining of adequate O₂ and CO₂ concentrations in the setter room is essential for

efficient gas exchange between the eggs and the incubation environment. As previously mentioned, the diffusion of O₂ into the eggs and diffusion of CO₂ and H₂O out of eggs depends on the presence of pores in the eggshell and the gas concentration gradient between the internal and external environment of the eggs. Moreover, gas diffusion rate can be influenced by the physical characteristics of the eggs (surface area, pore number and geometry) and incubation conditions. In this context, larger egg surface areas, higher pore number and diameter, and thinner eggshells increase the rate of gas exchange between the eggs and the environment. This indicates that large eggs (typically laid by older hens) present greater gas exchange potential than small eggs (laid by young hens) (Morita et al., 2009). Gas diffusion increases with increasing temperature, according to the principles of physics. This means that the diffusivity of water vapor and gases through the eggshell increases as the incubation temperature increases (Booth & Seymour, 1987; Morita et al., 2009).

Conclusion

Physical exchanges between eggs and environment are required for in-ovo development. Deficient exchanges negatively affect the incubation process, while excessive exchanges may improve incubation efficiency. Physical exchanges depend firstly on eggshell porosity and conductance and on temperature and relative humidity differences between the eggs and the environment. These factors are maternally influenced by egg quality (weight, size, chemical composition, and eggshell porosity, surface area and conductance), egg storage conditions (temperature, relative humidity, air velocity) and duration, and the incubation conditions (temperature, relative humidity, egg turning and position at setting, and air velocity and gas concentrations). The maternal effects on the physical exchanges show that the optimal storage and incubation conditions vary with breeder age and egg weight. However, optimal storage and incubation conditions as a function of egg weight or weight range still need to be established. Although this proposal seems to be unrealistic at first sight, it may be feasible as the control systems of incubation physical conditions (e.g., controlling egg weight loss, setting incubation temperature according to the eggshell temperature) are further technologically developed, allowing their easier and quicker determination. In addition, incubation conditions, which are essential for maximizing the production efficiency of hatcheries, may be optimized.

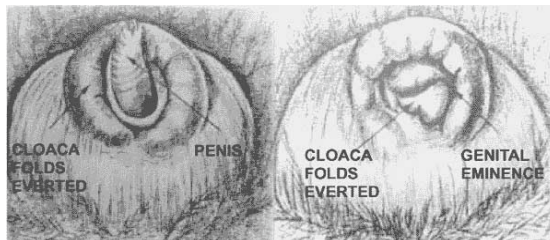
Unit-10

Sexing of Day Old Chicks, Culling and Selection of Layers

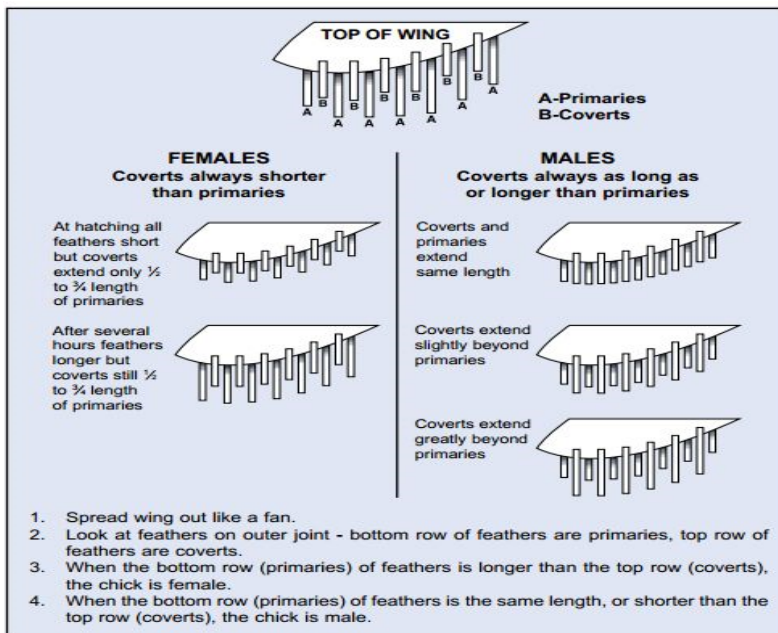
Sexing of day old chicks:

The process of determination of sex of individual bird is called sexing. It is very important routine procedure for egg laying birds which is conducted by well skilled and experience person. There are two common way of sexing namely Vent and Feather/auto sexing.

Vent sexing: The male chicks have small rudimentary testes in cloaca.



Feather sexing: The male have same length of primaries (lower layer) and converts (upper layer).



Culling of poultry and effect of culling on egg production

Culling

Procedure of removal of birds that are unproductive and poor producers is known as culling. Such birds are uneconomical for further maintenance in the farm. It is very important job for running poultry farm profitably. Identifying the culls begins from chick stage and continues throughout the year of production. So culling is an interrupted process of identifying unwanted birds that do not conform to physical characteristics required for profitable egg and meat production. Rigorous and periodical culling helps farmer to maintain the production excellent and also to reduce the cost of feed per dozen of egg via. the healthy flock. Culling depends on strain of birds, availability of replacement of pullets, price of feed, disease incidence, and availability of records on bird's performance and skill of farmer.

Reasons for development of culls

- Overcrowding
- Inadequate feeding and watering facilities
- Imbalanced feed and underfeeding
- Avoiding or improper de-beaking
- Genetic makeup (allow 1-2% culls)

Losses due to culls

- Culls keep on consuming feed (80-85gm/day/bird) without producing eggs, which is total loss without any return
- As culls are weak they remain as focus of infection, which result in mortality during severe stress
- Culls occupy space and avail managerial facilities without return, which reduces profit of margin

Care during culling

- Avoid undue stress during operation due to unnecessary excitement and rough handling
- Heavy culling (5-10%) should be preferably done in the evening or night
- Birds that have laid well for short period but have stopped laying for one reason or other should be culled
- Culls can be identified easily with some practice and experience, which will ease

the operation and minimize the stress

Culling during rearing period

- Feed cost increases during second months of arrival of day old chicks
- So farmer should be clever to identify the culls in 1st weeks from the flock
- Crippled and weak chicks with pasty vents should be culled

Culling during growing period

- Inferior, crippled, injured, deformed, stunted, and unhealthy birds should be removed in this stage
- Use catching hook and remove them quietly one day each week

Culling during laying period

- Individual unproductive and inferior pullets should be removed from the pens during laying period
- Remove the birds with a hook about once a week
- Do not catch entire group to remove culls

The character that should be taken into consideration for distinguishing good and poor layers is as follows:

Character	Good layer	Poor layer
Vigor	Strong and active	Weak, unthrifty, inactive
Breed type	Wedge shaped body	Shallow and tendency toward rocker keel
Head		
Beak	Slightly curved and short	Long and straight
Ear lobe	Full and complete, velvety	Incomplete, shrunken and coarse
Eyes	Full bright, alert	Dull and sleepy, semiclosed
Comb and wattle	Velvety and red	Colorless, very long, thin and sharp pointed
Neck	Short	Long
Body	Capacious	Less capacious
Back	Broad	Narrow

Skin	Soft and oily	Rough
Feathers	Bright, moist	Dull, dry
Abdomen	Free from fat, large	Contains fat
Keel bone	Long and curved	Straight and short
Distance between keel bone and vent	More than three fingers	Less than two fingers
Distance between pubic bones	More than two fingers	Less than 2 fingers
Vent	Large and moist	Dry and small
Leg		
Distance between legs	More	Less
Shank	Thin	Thick
Claws	Short and curved	Long and straight
Moulting	Late start but finishes fast	Earlier starter but late finisher
General behaviors	Active, alert and friendly	Shy, nervous and depressed

Unit-11

Poultry Waste Disposal and Its Handling

The rapid expansion of poultry production has caused an increased production of poultry biowaste, i.e. (mainly) chicken manure. Improper use of chicken manure can result in pollution of air, soil and groundwater. Biowastes are eco-friendly to produce typical nano particles with welldefined chemical composition, size, and morphology. There are recent developments in the production of nanoparticles from biowastes e.g. eggs and shrimp peels etc. Bioprocessing of nano particles from such resources with microbes such as bacteria, fungi and yeasts are being increasingly explored to meet the twin objectives of resource recycling and pollution mitigation

Poultry Farm Wastes

The wastes generated in Poultry farm are:

- Litter waste – Shed cleanout with poultry manure and bedding materials
- Dead birds
- Hatchery waste
- Bio mass wastes like fallen tree leaves, twigs etc
- Bio Medical wastes like syringe, needle, empty vials and other used chemical containers.

Management of Hatchery Waste The waste from the hatchery can be classified as

- Solid waste - Dead chicks, infertile whole eggs and shells from hatched eggs.
- Liquid waste – Water used to wash down incubators, hatchers and chick room.

Disposal of litter waste

The litter waste from poultry house removed in each respective lots in deep litter system and every days in cage system. The waste is converting into manure after 6-9 months. It is used to produce electricity, biogas, as vermin-culture, feed source for pig and fish, composting and recycling as feed nutrient for poultry.

Disposal of Dead birds

S.N.	Method	Advantage	Disadvantage
1	Burial	<ul style="list-style-type: none"> ● Predominant disposal option for catastrophic mortality events or infectious outbreaks ● Simplest and economical methods ● Safe method 	The poor site selection as sandy soils or areas with high water tables, may pose a threat to groundwater
2	Burning	Easy and economic	Atmospheric pollution
3	Incineration	<ul style="list-style-type: none"> ● Most effective methods for destroying potentially infectious agents ● Eliminating the threat of disease ● The residue is mostly harmless and does not attract rodents or insects 	<p>The air emission process conditions, and the disposal of solid and liquid residues need to be strictly controlled</p> <p>It requires proper sources of fuel and supervision, otherwise smoke and odor can create nuisance complaints.</p> <p>Expensive method</p>
4	Composting	<ul style="list-style-type: none"> ● Resultant products are much more environmentally acceptable than raw litter for land application ● Economic method ● Kill pathogens, control disease outbreaks. ● Reduces the risk of nitrogen and phosphorus entering the water systems 	<p>Loss of nutrient like nitrogen.</p> <p>Land area required for the composting</p> <p>Odor problems</p> <p>Emission of greenhouse gases such as methane and nitrous oxide</p>
5	Rendering	<ul style="list-style-type: none"> ● Rendering products can be used as feed, fertilizer ● Fat product can be used for soaps, washing powders, 	Emission of gas and odor leads environment concern

		cosmetics, fuel.	
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Disposal of hatchery waste

Hatchery industry is working for the supply of day old chicks to the Poultry Industry. Quality chicks are produced by hatcheries for the production of meat and eggs to fulfill the protein needs of the people. In hatchery working operation there is production of hatchery waste which is to be properly disposed as per recommendations of the regulatory authorities of the country.

There are many hatchery wastes which include:

1. Egg shell
2. Dead in shell
3. Fluff
4. Infertile eggs
5. Low quality chicks
6. Males chicks
7. C grade female chicks
8. Dead embryos

The hatchery waste is not disposal material. Those wastage have efficiency to convert into highly valuable protein so it is used as source of protein for poultry feed.

Unit-12

Farm Records

Poultry Farm Records

Record is noting of history and information about an incident. In case of production unit like poultry farming, it is noting of information about day to day happenings at farms in all aspects. A good record provides information which can indicate sickness and healthiness of a unit and allow line of action for improvement. So records are guidelines, for management, future planning and expansion

Importance of record keeping

- No poultry farm can be efficiently managed unless proper recording is done.
- It helps to assess productive performance of birds.
- It knows the history of flocks in respects of production, mortality, medication, vaccination, source of purchase, feed intake etc.
- It also helps to evaluate the financial status of enterprise.
- It helps in taking steps for correcting faults in management too improve efficiency of business.
- Selection and culling become easy by proper recording systems
- Helps in different research activities related with different aspects of poultry.

Qualities of a good record

- It must possess qualities like reality, reliability and relevancy.
- It must provide data for control, appraisal or future estimates with definite function with simplicity.

Types of poultry farm records

Mainly poultry farm records are studied in two types which are:

1. financial record
2. performance/ technical record

1. Financial record

These types of record allow financial status of the enterprise. In this record, capital

investment and then daily expenditure and income of various items are recorded. It may be summarized on monthly and yearly basis to derive the conclusions.

2. Performance record

These types of record deal with the performance of the bird or flock. Any mistakes or management faults can be identified and corrected to improve performance of birds.

Preservation of record

This is also an important aspect of poultry farm. Usually poultry farm records are preserved with following four ways:

1. in electronic devices like computer
2. in books with permanent leave
3. loose leaf books or files
4. envelop

Daily record of stock/ mortality

Number of chicks

Number of chicks at this month

Species.....

Age (Days)	Week	Date	Feed consumption(kg)			Total numbe r of chicks	Mortalit y	Sell	Left numbe r	Averag e weight
			Mornin g	Nigh t	Total					
1										
2										
3										
4										
5										
6										

Growth and production record based on hen housed and hen day

Growth record (Pullet)

Number of chicks

Number of chicks at this month

Species.....

Age (days).....

Age (Days)	Week	Date	Feed consumption(kg)			Total number of chicks	Mortality	Sell	Left number	Average weight
			Morning	Night	Total					
57										
60										
61										
62										
Total pullet of this month										
Previous month total number										
Present total number										

Production record (Pullet)

Number of chicks

Number of chicks at this month

Species.....

Production time (week).....

Age (days).....

Total hen first laying

Laying hen of this month.....

Average laying hen of this month.....

month y (ays)	Laying Week	Date	Collected egg number			Feed consumption (kg)			Total number of chicks	Mortality	Sell	Left number	Average weight
			Morning	Night	Total	Morning	Night	Total					
1													
2													

3.....													
.....31													
Total pullet of this month													
Previous month total number													
Present total number													

Feed consumption and conversion

Number of chicks

Species.....

Age (Days)	Week	Date	Feed consumption(kg)			Total number of chicks	Mortality	Average weight
			Morning	Night	Total			
1								
2								
3								
4								
5.....								
.....42								

Health record

Number of chicks

Number of chicks at this month

Species.....

Age (days).....

Age (Days)	Days	Date	Diseases	Symptoms	Medicine used		Vaccination
					Name	Days	
Total expense							

Summary and analysis of records:

Keeping of neat and up to date records in poultry is not sufficient. Their weekly, monthly and yearly analysis is of equal importance. This facilitates assessment of productive performance of birds. It allows pinpointing errors and mistakes in management to correct them to enhance production standard of birds. Similarly, monthly summary and analysis of financial records indicates trend of income and expenditure; giving knowledge of financial status of enterprise in the form of profit and loss. So records should be gathered and analyzed for replying following questions on managerial practices adopted on farm.

- Whether the farm is gaining or losing money?
- Are there any things in which mistakes were made and whether they can be rectified?
- If farm is losing money, what are the items of major expenses and whether they can be decreased?
- If farm is gaining profit or marginal profit then what are the items of major income and whether they can be increased?
- Whether modified or improved management can be adopted to increase the profitability of farming?
- Whether productive performance of bird is up to the standards for specific strains or varieties or breeds, if performance is lacking then it be improved to reach near by standards?
- Whether we are noting the full information required for future planning and expansion?

Unit-13

Live Bird Sale and Disposal

Precautions of handling live bird

- Employer of live bird handling must have skill and knowledge of its importance on public health and poultry health.
- Employees hand should be clean and wash.
- Humane Handling, transport box and vehicle.
- Quarantine certificate issued by registered veterinarian (Live animal Transportation Standard -2064)
- Have minimum bio-security measure
- At shed blue color light is prefer which is blind for poultry.
- During hot weather birds are loaded and transport at night or early morning.
- Chicks should be deliver within 24 hour
- Vehicle design for the safe transport of day-old chick.

Transport

The transport of a day old chicks from hatchery to farm has a critical role to play in subsequent performance. Hatcheries operate in a fully controlled indoor environment, while transport entails the risk of exposing the chicks to uncontrolled, outdoor conditions. There are a number of factors that operators need to consider.

Responsibilities

1) Employers:

Employers have an obligation to train employees in the use of equipment and in the humane care and handling of poultry.

2) Owners:

Owners of poultry operations have a responsibility to provide facilities and equipment that enable bird handling, loading and unloading to take place without causing injury or undue suffering to the birds.

3) Drivers:

The driver of a road vehicle is responsible for the care and welfare of birds during transport.

Plans should be made to minimize any delay that could be stressful to birds.

Minimizing Stress

Stress is a cumulative response of an animal to its surroundings and may be increased when birds are subjected to major changes, as during transportation.

Pre-transport preparation

1) Shelter:

Birds should be protected from the adverse effects of direct sunlight, radiant and reflected heat, wind, rain and hail.

2) Cleanliness:

Cages must be thoroughly cleaned and disinfected before poultry are loaded into them.

3) Transport container design:

- a. Birds may only be carried in properly designed cages or crates.
- b. Cages and crates should be designed, monitored and managed so that birds are not injured when being placed in or taken out. Cage doors should be as large as practical, and not be less than 20 cm wide and 25 cm high.



Fig. Design of crates for the transport of chicken

- c. There should be no protrusions or sharp edges on the framework.
- d. Crates or cages used for the transport of poultry should be of a design that, when

properly maintained and managed, prevents escape from, or the protrusion of any part of a bird through the crate, such that it could be entrapped or damaged during handling or transport.

- e. Cage floors should be rigid or supported to prevent collapse onto structures or crates below.
- f. Containers should be ventilated and of sufficient height to allow poultry.
- g. Containers should be fitted with locking systems that prevent escape during transportation.

4) **Loading poultry:**

Different species of poultry must not be mixed during traveling

5) **Catching and loading:**

- a. Planning the catching and loading procedure well in advance will allow adequate time for birds to be handled quietly in a way that does not cause them injury.
- b. All members of catching and transporting crews should be provided with adequate instructions.
- c. Containers of live birds should be moved in a horizontal position.



Fig. Way to transport a day-old chicken

Loading density of birds

- a. The number of birds per container depends on available floor space, body size of the birds, and the prevailing environmental conditions at the time of transport.
- b. All birds should be able to rest on the floor at the same time and remain evenly distributed.
- c. The minimum space allowance should be increased during summer especially if

the weather is hot and humid.

Care of bird/chicks during transport

Care of chicks:

- a. Chickens should be healthy and vigorous. They should be placed in suitably ventilated boxes without overcrowding.
- b. Care should be taken to ensure adequate ventilation of the boxes, particularly when they are stacked.
- c. Packing materials used inside boxes should be new, clean, dry and non-toxic.
- d. The floor space provided for day-old chickens during transportation should not be less than 21-25 cm² per bird or 400-475 chicks m².
- e. Each consignment should be clearly identified and those responsible for transportation, delivery and placement properly trained in procedures involved in the transportation and delivery of chickens.
- f. Every attempt must be made to avoid chilling or overheating the birds, and any delays in transport must be minimized. They must reach the farm of destination within 48 hours of hatching.
- g. Chicks should be placed in a brooding environment immediately after delivery.

Requirements for Transportation

Category	Magnitude
Floor space for day-old chicks	400-475 chicks per m ²
Minimum Height day-old chicks, ducklings	12 cm
Temperature required	24° C
Humidity	50-60%

Care of adult birds

Adult birds are transported for human food so during transportation person should know the knowledge of food safety and food hygiene.

- Only healthy birds are selected for transport

- Catch the birds slow and steady
- Catch and held by both shank (not thigh and wings)
- Carry only four birds once
- Move birds in small group to loading area
- Optimum temperature is 10-30°C
- Transport density 63kg/m²
- Provide adequate ventilation
- Decrease stress

Systems of poultry/egg marketing

The chicken consumer of Nepal is mostly utilizing freshly slaughter than frozen. So adult birds are transported from farmer/suppliers to slaughter slab. Similarly eggs are also transported from farmer/suppliers to dealer than moved to consumer shop /department store. The broilers are ready for market within 42-45days having weight 2kg. The market consumption ratio determines the rate of live birds average farmer rate is 175/kg and consumer rate of meat is 280/kg.

Unit-14

Nutritional Value of Egg and Meat

Nutritional value of eggs

People have eaten eggs for thousands of years. There are many types of eggs, but the most common choice is that of the chicken. Eggs contain several vitamins and minerals that are essential parts of a healthful diet. In many parts of the world, eggs are a readily available, inexpensive food. In the past, there was some controversy about whether eggs are healthful or not, especially concerning cholesterol. The current thinking, however, is that, in moderation; eggs are healthful, as they can be a good source of protein and other essential nutrients.

Benefits of egg

Strong muscles: The protein in eggs helps maintain and repair body tissues, including muscle.

Brain health: Eggs contain vitamins and minerals that are necessary for the brain and the nervous system to function effectively.

Energy production: Eggs contain all the nutrients that the body needs to produce energy.

A healthy immune system: The vitamin A, vitamin B-12, and selenium in eggs are key to keeping the immune system healthy.

Lower risk of heart disease: The choline in eggs plays an important part in breaking down the amino acid homocysteine, which may contribute to heart disease.

A healthy pregnancy: Eggs contain folic acid, which may help prevent congenital disabilities, such as spina bifida.

Eye health: The lutein and zeaxanthin in eggs help prevent macular degeneration, the leading cause of age-related blindness. Other vitamins in eggs also promote good vision.

Weight loss and maintenance: The protein in eggs can help people feel full for longer. This can reduce the urge to snack and lower a person's overall calorie intake.

Skin health: Some vitamins and minerals in eggs help promote healthy skin and prevent the breakdown of body tissues. A strong immune system also helps a person look and feel well.

Nutrition

According to the United States Department of Agriculture (USDA), one medium boiled or poached egg weighing 44 g can provide the following nutrients:

Energy:	62.5 calories
Protein:	5.5 grams (g)
Total fat:	4.2 g, of which 1.4 g are saturated
Sodium:	189 milligrams (mg)
Calcium:	24.6 mg
Iron:	0.8 mg
Magnesium:	5.3 mg
Phosphorus:	86.7 mg
Potassium:	60.3 mg
Zinc:	0.6 mg
Cholesterol:	162 mg
Selenium:	13.4 micrograms (mcg)
Lutein and zeaxanthin:	220 mcg
Folate:	15.4 mcg

Eggs are also a source of vitamins A, B, E, and K. Egg white and yolk are both rich sources of protein. Around 12.6% of the edible part of an egg is protein. The 2015–2020 Dietary Guidelines for Americans recommend that adults aged 19 and over should consume 46–56 g of protein each day, depending on their age and sex. This should represent 10–35% of their daily calories. In 2018, one researcher concluded that eggs contain high quality protein and that eating eggs is unlikely to lead to heart disease. While meat can also be a good source of protein, it may contain high levels of

less healthful elements, such as saturated fat.

Calories in eggs

Fats

One medium egg contains about 4.2 g of fat, of which 1.4 g are saturated. Most fat in an egg is unsaturated. Experts consider this to be the best type of fat for a balanced diet. Total fat should make up 25–35% of a person's daily calories, and saturated fat should represent less than 10%. This means that a person who takes in 2,000 calories a day should consume a maximum of 22 g of saturated fat.

Omega-3 fatty acids

Eggs also supply omega-3 fatty acids, mainly in the form of docosahexaenoic acid (DHA). DHA helps maintain brain function and vision. These fatty acids are most common in oily fish. Eggs can provide an alternative source for people who do not eat fish.

Vitamin D

Vitamin D is an essential nutrient, and low levels can lead to weak or brittle bones. Eggs naturally contain this vitamin, and some are fortified with vitamin D through hens' feed. The body synthesizes most of the vitamin D that it needs from sunlight. However, people also need some vitamin D from dietary sources. A medium egg contains around 0.9 mcg of vitamin D, all of which are in the yolk.

Cholesterol

One medium egg typically contains 162 mg of cholesterol. In the past, experts recommended limiting the intake of eggs for this reason.

Nutritional value of Meat

Meat ranks among one of the most significant, nutritious and energy-rich natural food product, utilized by the humans to fulfill their regular body requirements. It is considered quite important in maintaining a healthy and balanced diet, which is essential in accomplishing optimum human growth and development. Although, few epidemiological studies have also pointed a possible relationship between its consumption and the elevated risks of having cardiovascular diseases, various forms of cancers and metabolic disorders but still its role in the human species evolution,

specifically in its brain and intellectual development cannot be ignored. All non-essential and essential amino acids present in meat.

In accordance with European legislation, meat is defined as the edible portions, obtained from domestic animals including caprine, bovine, ovine and porcine, including the poultry meat, farmed and wild animals. It is a rich source of high value proteins, variety of fats including omega-3 polyunsaturated fatty acids, zinc, iron, selenium, potassium, magnesium, sodium, vitamin A, B-complex vitamins and folic acid. Its composition varies with reference to its breed, type of feed being ingested, climatic conditions and also on the meat cut, which imparts a considerable difference on its nutritional and sensorial properties

Meat cut	Protein (g)	Sat. fat (g)	Fat (g)	Energy (kcal)	Vit. B ₁₂ (mcg)	Na (mg)	Zn (mg)	P (mg)	Fe (mg)
Chicken breast, raw	24.2	0.2	8.5	178	0.39	71	0.9	199	1.2
Beef, steak cuts, raw	21	1.9	4.5	123	1.9	59	1.7	167	1.3
Chicken, raw	22.8	0.6	1.9	113	0.70	78	1.4	202	0.7
Beef, calf, loin, raw	20	3.4	7.3	146	1.1	22	3	193	0.10
Beef, loin, raw	20.9	1.5	3.2	115	2	59	3.7	142	1.6
Pork, chop, raw	18.1	10.8	31.7	353	1	60	1.8	190	1.4
Pork, loin, raw	21.9	1.7	4.9	134	1.1	55	1.9	220	0.7
Pork, leg, raw	20.8	2.8	7.8	155	1.2	84	2.6	164	0.8
Turkey, skinless, raw	19.9	1.8	7.1	136	1.9	42	1.5	209	2.1
Duck meat, skinless, raw	19.4	1.8	6.6	130	2.8	90	1.8	201	2.5
Turkey, breast, skinless, raw	23.6	0.5	1.6	106	1	62	0.5	208	0.6
Chicken breast, skinless, raw	23.8	0.4	1.28	109	0.40	59	0.7	218	0.4
Mutton, chop or meat, raw	20	2.4	4.8	122	2	63	3.6	221	1.9

Source: <https://www.intechopen.com>

Unit-15

Inedible Poultry Products and Their Use

Animal by-products can be considered as those parts (except carcass) released from a slaughtered animal after dressing, and they can be edible or inedible depending on their use as food. Edible by-products can be defined as those products that can be consumed as food by humans (Ockerman and Hansen, 1988). Inedible byproduct in poultry industry include water, manure , dead birds, feather, blood, offal and egg including crack egg those with blood spot, rot and which did not hatch.

Inedible poultry product	Uses
Manure	Fertilizer Re-use as poultry litter For livestock feed Briquettes for fuel Production of gas
Water	Fertilizer
Blood	Adhesive for livestock and poultry feed, pet food fertilizer glue, foam fire extinguishers
Dead birds	Feed meal and pharmaceutical
Feather	Animal feed, Stuffing, Bedding
Offal	Animals feed, heparin, casings, tennis racket string, music strings
Egg	Feed meal

Unit-16

Feed Formulations

Feed contribute ave.70% of total cost. Feed is formulated according to the bird age and species variation (broiler, layers, duck and coiler). So feed should be formulated carefully as per need.

The following points need to be considered while formulating poultry:

1. Feed must contain all essential nutrients in right amount and proportion required for the purpose it is supposed to use.
2. Chickens of different age require different level of nutrients, hence only the recommended or accepted level should be followed.
3. Ingredient to use should be palatable.
4. Feed ingredient needs to evaluate for the nutrient and coat.
5. Chicken have no teeth to grind grain or oil cake, hence the ingredient needs to be crushed properly. Micro nutrient and non nutrient feed additive should be carefully chosen and mixed.
6. Include agro industrial by – product to minimize the cost.
7. Fungal infected ingredients should be avoided.

Steps in Feed Formulation (e.g. Broiler Starter feed):

- 100 kg of least cost feed.
- Fixed minor ingredients and slack space=5kg for nutrient and non nutrient feed additive and natural feed ingredients added at later stage to balance the diet.(Limestone 1.5 kg, bone meal 0.5

Kg, trace minerals 0.4kg, vitamins 0.2kg)

- Level of animals protein source 10kg
Fish meal 7kg CP 2.94 ME168kcal
Meat meal 3kg CP 1.35 ME 72 kcal
4.29 240 kcal
- Level cereal byproduct may be fixed
DORB 8kg (1.08kgCP, 176kcal ME)

- Vegetable protein sources and energy source are added to provide the required amount of protein
- Amount of protein contributed by 23 kg ingredient (animals protein , DORB, slack space) is $5.37(1.08 + 4.29)$.That is remaining 77kg of ingredients are to provide $(23-5.37)=17.63\text{kg}$

SOM and maize are considered as vegetable protein source and energy source. The required protein level can be calculated by algebraic equation or by Pearson's equation

Algebraic equation:

Total ingredient =77 kg

Protein =17.63kg

Let X represents the SOM and Y represents maize. The protein content of SOM 45% and of Maize is 9%.

$$X + Y = 77 \dots\dots\dots(1)$$

$$0.45 X + 0.09 Y = 17.63 \dots\dots\dots(2)$$

$0.09X + 0.09Y = 6.93$ multiply equation (1) by 0.09

$$0.36 X = 10.7$$

Therefore $X = 10.7/0.31 = 29.72\text{kg}$

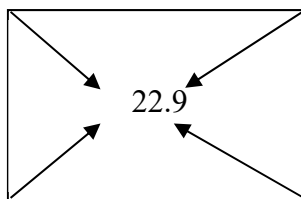
$Y = 77 - 29.72 = 47.28\text{kg}$

Pearson's Method:

Total ingredients =77kg, Protein =17.63kg

Protein as percent = $17.63/77 \times 100 = 22.9$

Protein in maize 9



22.1maize

Protein in SOM 45

13.9 SOM

36

Now maize and SOM are proportional for 77kg

Maize = $22.1 \times 77/36 = 47.26$

$$\text{SOM} = 13.9 \times 77 / 36 = 29.73$$

Types of Poultry Feeds

Poultry feeds are of the following three types:

- **Starting Poultry Feed:** An all mash ration to be fed to chicks up to the age of 8 weeks.
- **Growing Poultry Feed:** A ration to be fed to growing chickens after 8 to 20 weeks or until laying commence.
- **Laying Poultry Feed:** A ration to be fed to laying birds after 20 weeks onwards or after laying commences.

Feeding Broilers

- A broiler grows very fast and can be marketed during the ages between 8 to 12 weeks old.
- Broiler rations are especially formulated in such a way that they promote an early rapid growth.
- Usually broiler rations are prepared in such a way that so that the feed contains relatively high energy and high protein when compared with the feed of chickens other than broilers.
- A protein per cent between 22 to 24 are fed to broilers for the first 5 to 6 weeks to obtain rapid early growth.
- These rations are called broiler starter rations. After this period, broilers are fed with a different type of ration having relatively less protein and more energy for fattening. Such a feed is known as broiler finisher ration.

Methods of Feeding

- Whole grain feeding system:
- Grain and Mass Method
- All Mash Methods
- Pellet Method
- Restricted or controlled feeding
 - The method involves restriction of feeding pullets during 6 – 20 weeks of age instead of *ad libitum* feeding.

- This method is practiced in recent years in most poultry farm. This method reduced in feed cost, delayed sexual maturity but improved egg production curve, with a reduction in the number of small eggs laid is some of the advantages of this system.

Method of feed restriction:

- Skip a- day program
- Alternate day feeding
- Restriction of feeding time

Unit-17

Factors Affecting Incubation

Incubation of hatching eggs:

For successful incubation, optimum and uniform temperature, humidity, gaseous exchange and turning of eggs is very essential.

Temperature

- On an average 37.5- 37.8°C temperature is required
- It is reduced by 1°C during actual hatching and brought to around 36.7°C
- Higher temperature leads to smaller dull and deformed chicks
- High temperature of 46°C for 2-3 hours or 49°C for an hour is lethal for embryos.
- Lower temperature results in delayed hatch and poor hatchability.

Humidity

- Relative humidity around 60% during first 18 days of incubation and 70% in last 3 days should be provided for optimum hatchability.

Ventilation

- There should be around 21% Oxygen in the incubator
- Carbon dioxide concentration should not be more than 0.5%. More than 1% increase in concentration of CO₂ leads to increase mortality. 5% CO₂ for longer time is lethal to all embryos.

Turning of eggs

- To avoid sticking and setting of embryos to shell and death
- Tilting of eggs through 45° angle on both sides
- Eggs should be turned at least 4 times during a day when done by hand and in modern incubator, eight or more times during day in automatic incubator
- No turning of eggs after 18 days of incubation
- Turning must be gentle as vigorous turning leads to blood ring formation with increase mortality

Setting of eggs

- Eggs are set with upright position with broad end up. This type of setting of eggs

hold the air cell in regular positions and controls mal positions of embryos. The position also facilitates development of head of embryos towards air cell due to which it is easy for developing chick to break air cell for commencing of pulmonary respiration. It has been observed that reverse setting results in lowered hatchability by about 8% and quality of chicks is also impaired.

Unit-18

Nutritional Requirements

Nutrients – Their Nature and Function

Poultry nutrients are classified according to the physical, chemical, and biological properties into following groups;

1. Water
2. Proteins
3. Carbohydrate
4. Fats and oils
5. Minerals
6. Vitamins
7. Feed additives (not a nutrient, but added to enhance the quality of the nutrient)

1. Water

- Water makes up 85 % of the body of a day old chicks and gradually decreases as chicken grow older reaching 55 % in 42 mature chicks at 42 weeks of age.
- Normally, chickens consume about 2 to 2.5 g of water for each gram of feed consumed during the starting and growing period.
- The water requirement of laying hen is 1.5 to 2.0 g of water per gram of feed.
- Since an average poultry ration contains no more than 10 % water, a good supply of clean drinking water is essential for poultry and egg production.

2. Protein

- Typical broiler ration contain from 22 to 24 percent protein and in layer 16 to 17 percent.
- In poultry nutrition, essential amino acids that make up the protein are really nutrients rather than the protein molecule itself. Following are the essential amino acid;
- Of the essential amino acids, listed above, Lysine, methionine, agrinine, glycine and tryptophan are referred as “critical” amino acids since these are usually

deficient in ordinary practical poultry ration.

- This is because cereal grains are usually low in critical amino acids which make up a large proportion of a usual poultry ration.
- Therefore it is must to include animal protein like fish meal , etc in poultry ration to insure the inclusion of all critical amino acids.

3. Carbohydrate

Cereal grains and their grain by product are excellent source of starch and thus need to be a bulk in poultry ration.

4. Fats

Lying hens with diets deficient in lenoleic acid will lay very small eggs that will not hatch well.

5. Minerals

The common mineral supplement in poultry feeds are-

- Limestone
- Bone meal
- Oyster shell
- Sodium chloride
- Dicalcium phosphate
- Manganese sulphate
- Potassium iodide
- Superphospha

6. Vitamins

Vitamins commonly functions as coenzyme, and regulators of metabolism. Important vitamins are described in “Principle of animal nutrition” and suggested to refer.

Feed Additives

A. The feed additives that promote feed intake are;

- Antioxidant
- Flavoring agent
- Pellet binder

B. Feed Additive that Enhance the color or quality of the Marketed product

- Xanthophylls
 - Canthaxanthin @ 2 – 10 grams /tonne of feed
- C. Additive that Facilitate Digestion and Absorption
- Grit: Oyster shell, limestone are common grits
 - Chelates: EDTA used to increase the availability and absorption of certain minerals. In chick zinc absorption is enhanced through addition of EDTA
 - Enzymes: Agrozyme, Diazyme, Porzyme and Avizyme etc.
 - Antibiotics: Tetracyclines, Aureomycin (50 to 100 grams/ tonne feed).
- D. Additives that alter Metabolism

Hormones: Dienestroidiacetate at a level of 0.0023 to 0.0035 % in the feed for the last 4 – 10 weeks to improve the carcass quality of broilers and roasters. The practice must be discontinued at least 48 hours before slaughter. It must not be fed to laying hens or breeding stock.

- E. Additives that affect health status
- i) Antifungal additives: Sodium propionate, Sodium benzoate, acitic acid, nystatin or copper sulphate
 - ii) Anticoccidial: Bifuran, Amprol-25%, Embazin, Zonamix, Nitrofurazone, Furazolidone are common coccidiostats.
 - iii) Antihelminthic Drugs:

Factors affecting the nutrient requirements of poultry

The nutrient requirements of poultry are affected by a large number of factors, including:

Genetics (the species, breed or strain of bird) – Different species, breeds or strains of birds have different average body sizes, growth rates and production levels and will absorb and utilise nutrients from feed with different levels of efficiency. Therefore, they will require feed with different nutrient compositions. The genetics of commercial poultry is constantly changing, and as a result, so are their nutrient requirements. Consequently, breeders of commercial poultry provide information on the specific

nutrient requirements for the birds they sell.

Age – Nutrient requirements are related to both body weight and the stage of maturity in bird.

Sex – Prior to sexual maturity, the sexes have only small differences in their nutrient requirements and males and females can usually be fed the same compromise diet to achieve acceptable growth rates. Differences in nutrient requirements are larger following the onset of sexual maturity and significantly different diet formulations are then required for each sex.

Reproductive state – The level of egg production in hens and sexual activity in males will affect nutrient requirements.

Ambient temperature – Poultry have increased energy requirements to maintain normal body temperature in cold ambient temperatures and the opposite in hot ambient temperatures. Food digestion processes produce body heat, the amount of which will vary according to the nutrient composition of the diet. This is called the heat increment of the diet. In cold temperatures it may be desirable to formulate a diet with a higher heat increment and the opposite in hot temperatures.

Housing system – The type of housing system will influence the level of activity of the birds and therefore their energy requirements.

Health status – Birds experiencing a disease challenge may benefit from an increase in the intake of some nutrients, most commonly vitamins.

Production aims – The optimal nutrient composition of the diet will vary according to production aims, such as optimizing weight gain or carcass composition, egg numbers or egg size. Poultry that are raised for breeding purposes may need to have their energy intake restricted to ensure that they do not become obese

Energy Requirement

Factors that affect individual feed requirements are;

- Environment
- Breed
- Live weight

- Balance in nutrient in diet and
- For layers on the rate of eggs production.

The requirements are expressed in term of ME. The energy requirement for certain nutrients are influenced by the concentration of energy in the diet and for this reason, the diet contain around 2.8 Mcal ME/kg which is considered representative of poultry diets.

Energy for Growth

- The feed intake of growing chickens will in general increase as the energy content of the ration is decreased. The requirements of the energy are given in Table 1.

The Protein Requirement

Grower

- The protein can be assessed by amino acid analysis of rapidly growing chicks at weekly interval. It is important to express the amino acid requirements in direct relation to the caloric level which is to be used.
- Amino acid must be supplied in appropriate balance.
- Excess of one or more amino acids may depress the growth due to toxicity. In practice, the protein level in starting ration for chicks can be fixed at about 20 percent and even the protein level can be decreased to 15 percent.

Principle of Poultry Feeding

- Poultry feeding is one of the important components of poultry rearing because the feed alone accounts for 60 to 65 % of the total farm expenses.
- High cost involved in poultry feed force to formulate the ration using the low cost ingredient without compromising its nutrient quality. While computing ration for poultry birds, following facts should be considered.
 1. Birds needs more concentrate as they do not have lips and teeth.
 2. Birds are having simple and short digestive tract so the digestion is quite rapid. It takes about two and half hour for feed to go from mouth to cloaca in the laying hen, and 10 hours in the non laying hen. Therefore the nutrient requirement of poultry are more precious.
 3. Unlike ruminants, where micro organisms synthesize a sizable portion of amino

acid, Vitamin B complex, Vitamin K in the stomach. The poultry completely dependent upon the dietary source for all such nutrients.

4. Poultry birds are fed collectively rather than individually.
5. Due to higher rate of metabolism, poultry require a more exact ration.
6. Care should be taken to select optimum C/P ratio for the purpose for which feeds are compounded.

Table 1: Need of C: P ratio

C:P ratio = Metabolizable energy in Kcal/kg diet	
% Protein in the diet	
The recommended C:P ratio for the diet of various classes of chickens are as under:	135:1
● Starter ration (0 to 8 weeks)	140: 1
● Grower chicken (8 to 20 weeks)	175: 1
● Layer chicken (20 Weeks onward)	135: 1
● Starter broiler chicken (0 to 6 weeks)	155: 1
● Finisher broiler chicken (6 week onward)	

Note: C: P = Calorie: Protein (C/P)

Nutrient Requirement for chicks and pullet:

Nutrients	Units	Starter	Grower	Finisher
		0-10 days	11-24 days	>25 days
Protein	%	22-25	21-23	19-21
	Mj/Kg	12.60	13.30	13.50
Metabolisable energy	Kcal/kg	3010	3175	3225
Total Arginine	%	1.48	1.31	1.11
Digestible Arginine	%	1.33	1.18	1.00
Total Lysine	%	1.44	1.25	1.05

Digestible Lysine	%	1.27	1.10	0.92
Total Methionine	%	0.51	0.45	0.39
Digestible Methionine	%	0.47	0.42	0.36
Total Methionine +Cystine	%	1.09	0.97	0.83
Digestible Methionine +Cystine	%	0.94	0.84	0.72
Total Threonine	%	0.93	0.82	0.71
Digestible Threonine	%	0.80	0.70	0.61
Total Trypophan	%	0.25	0.22	0.19
Digestible Tryptophan	%	0.22	0.19	0.17
Total Valine	%	1.09	0.96	0.81
Digestible Valine	%	0.94	0.83	0.70
Calcium	%	1.0	0.90	0.85
Av.phosphorous	%	0.50	0.45	0.42
Sodium	%	0.16	0.16	0.16

Nutrient Requirement for broiler:

Nutrient	Units	Developer Pre-Layer			
		Starter 0 – 6 wks	Grower 6 – 12 wks	12 – 15 wks	15 wks – Prod.
Protein	%	Min20.0	17.50	15.50	16.50
Metabolisable Energy	Mj/Kg	11.5-12.4	11.5-12.6	11.3-12.4	11.4-12.4
Metabolisable Energy	Kcal/Kg	2750-	2750-	2700-	2725-2980
	Kcal/Lb	2970	3025	2970	2725-2980
		1250-1350	1250-1370	1225-1350	1235-1350

Lysine	%	Min1.10	0.90	0.66	0.80
Methionine	%	Min0.48	0.41	0.32	0.38
Methionine	+				
Cystine	%	Min0.82	0.71	0.58	0.65
Tryptophan	%	Min0.20	0.19	0.18	0.19
Threonine	%	Min0.73	0.55	0.52	0.55
Calcium	%	Min1.00	1.00	1.00	2.75*
Av Phosphorus	%	Min0.45	0.43	0.42	0.40
Sodium	%	Min0.18	0.18	0.18	0.18
Chloride	%	Min0.18	0.18	0.18	0.18

*At least 30-65% of the added limestone should have a minimum particle size of 2250 Microns.

Source : www.poultryhub.org

Unit-19

Impact of poultry on environment and methods to mitigate

The thermo-neutral zone is defined as the temperature zone in which the birds are able to keep their body temperature constant with the help of physical heat regulation. This temperature zone depends on feeding level and housing conditions of the birds and other factors. The lowest temperature in the thermo-neutral zone is called the lowest critical temperature (LCT). If temperatures fall to under this temperature the bird will start to use feed energy to warm itself (i.e. maintain its body temperature) and will consequently consume more feed. The highest temperature in the thermo-neutral zone is called the highest critical temperature (HCT). If the temperature rises above this temperature the birds can no longer dissipate their heat. They will start to consume less feed and production will drop as a result.

The highest and lowest critical temperature depends very much on:

- Age
- Body weight
- Housing system
- Feeding level
- Relative humidity
- Air velocity
- Health

Physical heat regulation mitigation to cold

When temperatures are not within the comfort zone, birds have several mechanisms which enable them to keep their body temperature constant without having to produce extra heat. This is referred to as physical heat regulation and factors that influence physical heat regulation include:

Tissue insulation – If birds have a layer of subcutaneous fat, they can afford to let their skin temperature drop. Only if the animals are fed properly can they deposit a subcutaneous fat layer when temperature decreases.

Feathers – Feathers have an insulating effect and decrease the amount of heat that is lost to the environment.

Changing body position and huddling – Birds can effectively regulate heat loss through body position. Heat loss can be minimized by huddling close together. In hot weather, on the other hand, the birds increase their body surface as much as possible.

Flow of blood through skin and mucous membranes – The flow of blood to the skin and mucous membranes can be controlled through the contraction and widening of blood vessels. The larger the flow of blood is, the more heat is lost and vice versa in cold.

Physiological Effects of High Ambient Temperature

Exposure of poultry flocks to ambient temperature above the zone of minimum metabolism results in an increase in endogenous heat production. Convective transfer of heat is the major thermo-regulatory mechanism of chickens and depends on movement of air by natural fan-powered ventilation. An increase in convective heat transfer as a result of air movement is proportional to velocity up to 100m/minute, provided ambient air temperature is below body temperature.

Hyperpnea (panting) occurs in mature chickens exposed to temperatures exceeding 30°C. Respiratory rate can increase from 22 breaths / minute to 200 b/ minute when ambient temperature is increased from 27°C to 45°C within 20 minutes. Panting facilitates evaporative cooling, and above 38°C, chickens are almost entirely depended on latent heat loss for thermo-regulation. Prolonged hyperpnea results in excessive excretion of carbon dioxide resulting in respiratory alkalosis. Exposure to high ambient temperature has a profound economic impact on liveability, growth rate, egg production, egg shell quality, and feed conversion efficiency. Exposure to high environmental temperature for extended periods will suppress the humoral immune response of chickens, reducing antibody titer. It is presumed that a reduction in circulating antibody is associated with a corticosteroid-induced change in serum ions. Cellular immunity is also suppressed by prolonged exposure to temperatures in excess of 36°C. This effect is mediated through T-cell or regulatory amplifier cell response.

Design of Housing in Tropical Countries

Convection-ventilated housing is most frequently used in temperate and tropical areas where moderately high seasonal temperatures occur. Structures should be designed to permit passive airflow over the flock. Size and siting of houses in relation to local topography are critical to achieving satisfactory results. The significant design characteristics for convection-ventilated houses relate to internal dimensions, provision of adequate air inlets, and insulation. Convection houses should not exceed 12 m in width to facilitate cross flow of air at low velocity. Houses should be oriented in an east-west direction to limit solar heat load, and the interior height at the apex should not be less than 4 m to reduce air temperature at bird level. Roof overhang should extend at least 0.8 m to limit solar gain through the side walls. The lateral ventilation openings should comprise 60% of the wall area and should be fitted with impervious side curtains. In more sophisticated units, the size of the opening can be controlled automatically by a thermostatically activated motorized winch with an emergency high temperature release mechanism in the event of power failure. General recommendations for insulation in tropical countries should specify values of 2.5m² °C/W (R = 14) and 1.2 m² °C/W (R = 7) for roof and wall structures respectively. Fiberglass blanket insulation or polyurethane panels should be coated with a reflective radiant barrier of aluminum film on the exposed outer surface and should be provided with an impervious plastic protective coating, lining the inner surface.

Convention-ventilated houses are economically justifiable in many warm-climate areas with developing poultry industries. Although stocking density is generally low (eight to ten broilers or pullets or two to three mature breeders per square meter) compared with more advanced housing, capital and operating costs are acceptable. The simple mechanical and electrical installations and elementary technology involved in management and maintenance favor the basic convection-ventilated unit in tropical and subtropical areas. To overcome high environmental temperatures, it is necessary to increase the rate of air movement in the house.

When daily ambient temperatures exceed 30°C with any frequency, mechanical ventilation is necessary. This can be achieved either by installation of fans in closed housing or by selecting an appropriate configuration of air inlets in relation to the dimensions of convection-ventilated units. Air movement facilitates convective heat

loss by the bird. The efficiency of this process is proportional to the velocity of the air stream and the temperature differential which exists between the bird and its surroundings. Egg production, fertility, and feed conversion are improved in heat-stressed flocks provided with a direct stream of air. Evaporative cooling may be used to reduce the severity of heat prostration in areas where the maximum temperature exceeds 35°C with seasonal regularity. All systems function on the principle of adiabatic cooling as water is converted from liquid to vapor. The physical relationship between dry bulb temperature, relative humidity, and heat content of air is depicted in psychometric charts. Generally, low humidity improves the efficiency of adiabatic cooling at high ambient temperature, but evaporative cooling can avert heat prostration even in extremely hot and humid areas. Air at 45°C and 15% RH could theoretically be cooled to 25°C assuming complete saturation. Due to restraints associated with the process of evaporation, commercial equipment functions with an efficiency ranging from 60 to 80%. Air at 45°C and 15% RH could be cooled to a dry bulb temperature of 30°C with an elevation in relative humidity to 60%. The simplest evaporative cooling system comprises low-pressure fogger nozzles. These deliver up to 8 to 10 l/hr at a pressure of 5 to 8 bar. Nozzles are positioned in close proximity to turbulence fans to provide one discharge point for each 500 birds. This system is used in the U.S., where low cost is compatible with existing convection-ventilated houses. The low-pressure fogger nozzle produces a coarse spray. Although systems are capable of achieving a 5°C reduction in temperature with ambient air of 37°C and 30% RH, low-pressure fogger nozzles are inefficient with respect to the cooling effect relative to water consumed. Systems require frequent cleaning and descaling and the litter becomes saturated in the vicinity of the nozzles. The system should only be operated when humidity is below 70% RH and with fans displacing 5 m³/ hr per broiler. Generally, the coarse-nozzle system is unsuitable for Middle Eastern countries due to blockage of nozzles by mineral contaminants in the water.

Pad cooling systems are used extensively in the U.S. and Central America, where seasonally high temperatures are encountered. The principal deficiency of the pad lies in the inherently lower efficiency of evaporation compared with the spinning-disc or ultra-high pressure fogger. Modern pads are composed of cellulose material in a

honeycomb configuration to increase surface area. Although this enhances cooling, the system is more sensitive to algae and mineral contamination in water. The efficiency of cooling may be enhanced by spraying pads with water from suitably placed nozzles.

Management of Flocks at High Temperature

The survival of birds at high temperature is influenced by the volume of water consumed. It is evident that water at low temperature functions as a heat sink in the intestinal tract and that surface evaporation from the comb, wattles, and head exerts a cooling effect. It is essential to provide sufficient watering points to facilitate consumption under conditions which prevail in hot climates. Recommendations include 1 suspended drinker per 75 broilers or 50 breeders and 1 cup per cage of up to 5 commercial layers. Insulation of header tanks and supply piping is indicated if the temperature of the water at the point of consumption exceeds 25°C.

Research on the integration of lighting programs and operation of feeders for broilers has been reported from Singapore. Performance was improved in convection-ventilated housing using nocturnal illumination and feeding. This program produced the highest live weight at 56 days, but feed conversion, mortality, and return were lower than with other combinations examined. Various lighting and feeding programs were investigated in Nigeria using medium-strain commercial layers. The use of night feeding with a reversed lighting program (18:00 to 6:00) supported a significantly higher level of egg production than conventional daytime feeding, which was accompanied by exposure to high diurnal temperature.

Unit-20

Economics of Broiler and Layer Production

General Principles

The primary purpose of any enterprise is to maximize return on investment over the long-term. It is therefore necessary to market poultry, meat products, and eggs at a price which allows farmers or integrators to maintain profitability in a competitive market. Cost-effective programs of bio-security and vaccination are necessary to prevent disease.

It is emphasized that the incremental return in the form of enhanced livability, growth rate, and feed conversion efficiency must exceed capital and operating expenditures on disease prevention. There is considerable difficulty in predicting the potential loss arising from a disease or projecting the probability of an outbreak. Risk of exposure and consequences of infection, are the two significant variables required to quantify the decline in production which may follow exposure to a disease. The benefit to cost ratio can be used to relate the expenditure on resources and managerial effort to prevent disease with the monetary value of improvement in performance. Programs of emergency treatment and long-term prevention are justified for severe diseases which have a considerable impact on production. Aggressive counter measures are required with a high risk of infection, or in situations where the prevalence of diseases severely affects production or where the value of eggs and meat is high in relation to expenditure on bio-security and vaccination.

It is necessary to invest capital in both poultry housing and ancillary installations to enhance bio-security. Erecting changing rooms, fences and providing equipment to decontaminate hatcheries and housing are examples of assets which reduce the occurrence of disease. A decision to invest in these improvements which promote bio-security should be based on an anticipation of return within a defined, and preferably short to intermediate time period. The future cash flows, derived from improved performance in the absence of disease, should be calculated for a period corresponding to the operating life of the investment. The net present value (NPV) of an investment in bio-security can be calculated from the annual cash flows, discounted by an

appropriate interest factor. If the NPV exceeds the cost of improvements, the investment can be considered justifiable. The NPV method can be used to select the most beneficial program to prevent disease from among a range of alternatives.

It is emphasized that the validity of any investment decision is dependent on selecting an appropriate risk of infection and accurately projecting the consequences of disease, given prevailing production costs and revenue.

Fixed and Variable Costs in Poultry Production

Costs relating to live bird production can be classified into fixed and variable components. Fixed costs do not change as a result of an increase in the volume of production and include depreciation, interest on fixed capital, salaries, overhead, and lease payments. Variable costs are proportional to the volume of production. Feed, labor, packaging material, fuel, vaccines and medication, purchase of day-old chicks and breeding stock, are examples. The concept of apportioning costs is important in projecting the effects of disease on total production cost. A decrease in broiler weight delivered to a plant associated with increased mortality or depressed growth rate will adversely affect production cost and efficiency. Processing plants, hatcheries, and feed mills operate at a break-even cost approximating 70% to 80% of design capacity due to the relatively high proportion of fixed costs.

Following figure the relationship between total cost, volume of production and profit. Fixed costs which are constant are illustrated by the line parallel to the horizontal (quantity) axis. Total costs are represented by the area which encompasses both fixed and variable costs. In this example, unit selling price is considered constant over volume of throughput and accordingly revenue is linear and proportional to the quantity produced. At the break-even point (quantity Q_0) total revenue is numerically equal to total costs. At this level of production fixed costs represent approximately half of the total cost. At a higher throughput, variable cost assumes a greater proportion of total cost. Offsetting fixed costs by increasing production level is the basis of efficiency through economy of scale, which characterizes progressive integrations and cooperatives in advanced industries. In the context of individual farms, there are limits to increasing production volume. Altering stocking density from 20 to 25 birds/m² increases throughput by 25%. Delaying slaughter of a broiler flock to attain a higher

live mass (1.75 to 1.95 kg) may increase biomass by 11%. Reducing intercrop interval from 10 to 5 days may result in an 8% increase in broiler live mass over a year. Implementing these management changes will increase the risk of disease and intensify the financial impact of infections. The severity of viral respiratory diseases such as bronchitis or laryngo-tracheitis is influenced by environmental and clinical stress. The effect of intercurrent low-grade conditions such as pasteurellosis, mycoplasmosis or coccidiosis may be exacerbated. Secondary infections such as *E. coli* septicemia will intensify losses proportionately to increased biomass. Ventilation, feeding space, and floor area represent the limiting health factors for flocks when output is increased.

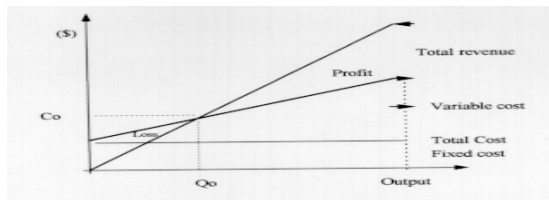


Figure: Conceptual Relationships between Cost And Revenue

Gross marginal analysis

This analytical technique can be applied to relate expenditure on disease prevention with output over a specific time period. Gross marginal analysis allows producers to project the possible outcome of a program under conditions of uncertainty with regard to risks and consequences of infection. The technique evaluates alternative methods of preventing disease in the context of prevailing costs and revenue. The format table for gross marginal analysis is shown in Table 2.2. The inputs required to determine the gross margin attributable to a specific program are listed for an ongoing poultry operation over a specific time period. A series of analyses can be performed reflecting alternative prevention strategies and probabilities of disease exposure. The values calculated from the gross marginal analysis are entered into a pay-off table which depicts the financial result of a selected option.

Table 2.3 considers the effect of three alternative approaches to preventing a disease which has a 0.6 probability of occurrence. The options available to the producer include no action ("base"), vaccination or bio-security. It is determined that the

respective gross margins derived from the flock under conditions of no action are \$3,000 and \$10,000 with and without exposure to disease. The corresponding gross margins generated when flocks are subjected to either bio-security (strategy 1) or vaccination (strategy 2) can be calculated and entered into a pay-off table. The expected monetary value of each prevention strategy is calculated by multiplying the probability factor with outcome as shown. In the given example, vaccination provides the highest return of \$7,400, compared to \$6,660 for increased bio-security and \$5,800 for no action. Expected monetary values are influenced by changes in variable cost, unit revenue, and the probability of infection.

Variation in the impact of a disease can occur due to increased pathogenicity of the causal organism, the presence of secondary agents, immuno-suppression or environmental stress. Changes in these factors would influence the outcome of a disease and require relaxation or intensification of the preventive strategy depending on the circumstances. Expenditure and return from control of disease (Figure 2.4) shows the relationship between expenditure on prevention and control measures (horizontal axis) and the loss associated with introduction of disease (vertical axis). As expenditure on control of velogenic Newcastle disease (vvNCD) by effective vaccination is increased, the loss in output is reduced. The low cost of NCD vaccination and the relative efficiency in improving liveability and enhancing the growth rate or egg production in infected survivors, results in a reduction in losses associated with minimal expenditure as designated by the curve LoL1. Increased outlay on disease prevention and control, such as intensifying the vaccination program and implementing biosecurity will result in an incremental reduction of losses. Eventually the economic optimum is reached (point A) at which a monetary unit of expenditure on control generates only a single unit of return. Additional prevention and control activities will in fact reduce gross margin and generate a negative benefit: cost ratio.

Under certain conditions, such as the need to eradicate a vertically transmitted infection in breeding stock or to suppress a disease of zoonotic significance, control measures are extended beyond the economic optimum. Ultimately the technical optimum (B) is attained. At this point additional efforts to prevent disease will not

achieve any measurable reduction in losses.

This sequence may be illustrated by the intensive programs to eradicate mycoplasmosis by the primary broiler breeders during the 1960's and 1970's. Control measures included pressure-differential treatment of eggs with antibiotics, and injection of embryos and chicks with mycoplasmacidal drugs. These measures together with pre-incubation heat-treatment of eggs to destroy *Mycoplasma* spp and enhanced bio-security and monitoring of pure-line flocks maintained in strictly-isolated small groups achieved eradication of the disease in elite lines.

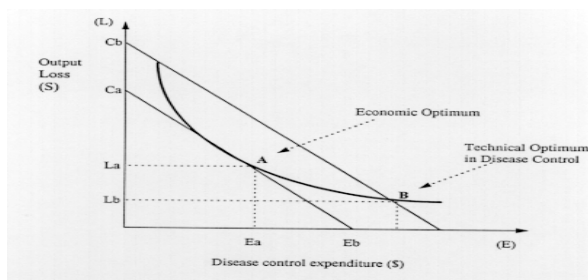


Figure: Relationship between Expenditure and Return from Disease Control

Costs return analysis of Broiler farming

Cost returns analysis of rearing 10000 broilers (8 week for chicks and 2 week preparation of shed) with four times in a year. There are mainly two type of cost like:

1. Recurring cost:

S.N.	Particular	Rate	Estimated cost
A	Cost of chicks	55	550000
B	Feed cost (4kg /birds) = 39200kg (excluding 2% mortality)	64/kg	2508800
C	Labour, Insurance cost, Vaccine/medicine and others overhead charge	3% of total feed and chicks cost	91764
	Total		3150564

1. Non-recurring cost:

S.	Particular	Rate (ft ²)	Estimated
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N.			cost
A	Cost of shed(1 sq.ft/chicks)	150	1500000
B	Cost of feed room(300 sqft)	150	45000
C	Cost of labor quarter(300 sqft)	150	45000
D	Cost of electricity cost	4% of civil work	63600
E	Cost of equipment	20/birds	200000
F	Cost of others expenditure on power, administration and other unforeseen expenditure	5/birds	50000
	Total		1903600

Now,

Income source:

Particular	Rate	Amount
Revenue of Sale of birds (9800 number) each weight 2 kg	200/kg	3920000
Sale of manure	2/birds	19600
Sale of gunny bag(784)	20	15680
3955280		
Capital expenditure D and F		-(113600)
Total Revenue 3841680		
Recurring expenditure		3150564
Gross profit (Revenue-recurring)		691116
Net profit /annum of 4 cycle		2764464
Depreciation on		
Poultry shed 10%		159000
Poultry equipment 15%		30000
Net Profit		2575464

Note:

- Marginal money is calculate as 25% of Sc and St Categories
- Mortality =2%

- Live weight =2 kg
- Feed Consumption 4kg excluding wastage

Costs return analysis of Layers farming

Cost returns analysis of rearing 1000layers. According to market situation the data fluctuation takes. Below data is the critical situation layers date of 2075/076 in an average farmer condition.

There are mainly two type of cost like:

Recurring cost:

S.N.	Particular	Rate	Estimated cost
A	Cost of chicks	55	55000
B	Feed cost		
	Up to 8 week 1.6kg/chicks (5% morlality) = 1520 kg	60	91200
	8-20 week 6.1 kg /hen=5795kg	55	318725
	20-72 week 42.7 kg/hen = 38430 kg (5% morlality)	56	2152080
C	Labour, Insurance cost, Vaccine/medicine and others overhead charge	3% of total feed and chicks cost	78511
	Total		2695516

Non-recurring cost:

S.N	Particular	Rate (ft ²)	Estimated cost
A	Cost of shed(2sq.ft/chicks)	150	300000
B	Cost of feed room(300 sqft)	150	45000
C	Cost of labour quarter(300 sqft)	150	45000
D	Cost of electricity cost	4% of civil work	15600
E	Cost of equipment	20 /birds	20000

F	Cost of others expenditure on power, administration and other unforeseen expenditure	5/birds	5000
	Total		430600

Now,

Income source:

Particular	Rate	Amount
Revenue of Sale of birds (900 number) each weight 2 kg	90/kg	162000
Sale of manure	2/birds	1800
Sale of gunny bag(915)	20	18300
Egg (280)	10	2520000
2702100		
Capital expenditure D and F		-(20600)
Total Revenue		2681500
Recurring expenditure		2695516
Gross loss (Revenue-recurring)		-14016
Depreciation on		
Poultry shed 10%		39000
Poultry equipment 15%		3000
Net loss		-56016

Unit-21

Hatchery Management and Waste Utilization

Hatchery Management

Hatchery management include:-

1. Cleaning and disinfection of incubator

The incubator is to be cleaned thoroughly. The interior of the machine is to be washed with 4% solution of washing soda followed by disinfection with phenyl 0 lys 01.

2. Fumigation

The incubator is to be fumigated with formaldehyde gas [40% formalin and potassium permanganate (KMnO₄)].

3. Testing of incubator

Before actual setting of eggs, the incubator machine is to be tested for its various functions like maintaining desired temperature and humidity, turning of eggs and ventillation mechanism.

4. Other managerial tips

Other managerial tips for hatchery management includes regular for hatchery management includes regular disinfection of hatchery premises, transport vehicles, maintaining strict bio-security around the hatchery and maintenance of strict personal hygiene by the staffs.

(Waste utilization refer unit 11)

Glossary of Poultry Terminology

1. **Beak:** The hard and pointed protrusion composing the mouth and the nose of the chicken.
2. **Beard:** The group of feathers bunched below a bird's beak. See Americana Chicken. The **beard** is usually also found in association with the **muff**.
3. **Bedding:** We use this term to describe the materials spread along the floor of a chicken coop or brooding area for young ducks or chicks. Typical bedding will include: straw, hay, alfalfa grass, wood chips or shavings, etc.
4. **Biddy:** An affectionate or slang word for a hen.
5. **Booted:** A term used to describe chicken breeds that have feathers on both the shanks and toes.
6. **Breed:** A group of species with specific characteristics that distinguish them from other groups within that species. Pure breeds are breeds that will reproduce with others of their own kind will also produce pure breeds of that given species. Hybrids are non-standard poultry formed by cross breeding to produce animals with certain desired attributes. Within many breeds of chicken, there are different color varieties that set them apart from others of the same breed.
7. **Broiler:** A young chicken that is usually less than 12 weeks of age and has been bred specifically for meat production. Also called a Fryer, see Black and Red Broilers. The Jumbo Cornish Cross is the most popular form of broiler chicken and is used for most commercial meat production in the United States.
8. **Brood:** to care for a batch of baby chicks, or a name for the actual chicks themselves.
9. **Brooder:** A heated enclosure that is used to emulate the warmth that a mother hen will give her baby chicks. We often refer to a brooding area as the enclosure you will use when raising your chicks for the first 4-6 weeks. The brooding area is normally a well bedded area with a heating lamp, food and water.
10. **Candle:** To examine the content inside of an intact egg, usually in attempt determine fertilization of the egg.

11. **Cape:** The few narrow feathers that fall between the neck and the back of the chicken.
12. **Caruncle:** Brightly colored skin growths on the throat area of a turkey that turns bright red during courtship or when it is upset or feels threatened.
13. **Clean Legged:** Having no feathers from the Shanks to the toe.
14. **Cloaca:** The chamber just before the vent where the digestive, reproductive, and excretory channels come together.
15. **Clutch:** A group of eggs that are hatched together in a nest or in an incubator. Also used to refer to a group of eggs laid by a sole female bird in one laying cycle.
16. **Cock:** A male chicken or a rooster.
17. **Cockerel:** A male chicken under one year of age.
18. **Comb:** The fleshy and usually red outcrop of skin atop the chickens head. The comb, along with the beak and the wattles, help the chicken regulate body temperature helping them cool themselves. There are eight recognized varieties of combs among chickens
19. **Buttercup Comb:** This comb is set on the top and middle of the head and looks like a cup-shaped crown with a circle of small and regularly spaced points.
20. **Cushion Comb:** A small comb that lies flat on top of the chicken's skull with no discernible pattern.
21. **Pea Comb:** A low comb (toward the forehead) with three wavy or "serrated" ridges, the middle point being the tallest of the three.
22. **Rose Comb:** With a flat top, this comb is solid and broad set low on the chickens forehead. The shape of the rose comb varies in different breeds, and can sometimes be pointed more upwards than straight back.
23. **Silk is (Walnut) Comb:** This comb is a roundish and lumpy comb that is usually wider than it is tall. These will vary from breed to breed, and some generally like to think of it as a rose comb plus a crest.
24. **Single Comb:** This is the most commonly portrayed and recognized comb in

most chicken images and artwork. The Single Comb is thin with smooth textures, and it has a large base reaching from the base of the beak to the back of the head. The comb points upward are usually defined by five or six deeply serrated points. The male chickens typically have much thicker and larger combs. The combs always stand upright in males and can be upright or lopped over in females.

25. **Strawberry Comb:** A very low set comb hanging over the top of the beak. The shape and surface resemble the skin of a strawberry, and it is wider closer to the beak of the bird.
26. **V-Shaped Comb:** Made up of two well formed horns that are joined at the base to form a v-shape. This is one of the most unique and interesting of all comb shapes.
27. **Coop:** A coop is the structure that houses the chickens, and it usually contains one or multiple roosts and nesting boxes for egg laying. Coops can be a wide variety of styles and sizes depending on the flock size and personal preference. We sell both Pre Made Chicken Coops as well as Chicken Coop Plans to help you build your own.
28. **Crest:** A large puff of feathers on the top of certain Crested Breeds' heads.
29. **Crossbreed:** Offspring of a hen and rooster of a different breed. This can also know as a Hybrid.
30. **Crusty Butt:** A slang term for pasting.
31. **Cygnets:** A baby swan
32. **Dewlap:** The large flap of skin that hangs down from the neck of certain breeds of geese.
33. **Down:** The soft and fur-like feathers that cover a newly hatched duckling or chick. Many adult birds will also have small and soft down feathers on certain parts of the bird, usually near the bottom or under wings.
34. **Dual Purpose:** A chicken or duck breed that is recognized to have multiple utility traits such as egg laying, meat production, or foraging abilities.
35. **Dub:** The act of cutting of the comb, wattles, or earlobes of a chicken. Usually, this is done for certain show breeds where it is actually required of that breed.

36. **Dusting:** When a chicken rolls around in the dirt, flinging it on themselves and in between their feathers as a method of cleaning the feathers and discouraging parasites.
37. **Embryo:** A fertilized egg at any stage before hatching.
38. **Exhibition Breeds:** A chicken or duck breed that is bred and raised primarily for showing and ornamental purposes rather than a utility such as egg laying or meat production. Often, most Fancy Breeds fit into the category of Exhibition Breeds.
39. **Feather Legged:** These chickens will have feathers on the chicken's shanks, but not necessarily the toes.
40. **Flock:** A group of poultry. Generally, most poultry will flock together and forage or graze when left to free range.
41. **Fowl:** Domestic birds generally raised for food.
42. **Free Range:** A term used to describe birds that are allowed to roam a yard or pasture at will.
43. **Frizzle:** A plumage feature where the feathers curl out rather lying flat on the chicken's body. Many breeds with these features are bred specifically for them and are called "Frizzles" or "Frizzle Chickens"
44. **Fryer:** A tender young meat chicken, usually a breed bred specifically for meat production.
45. **Game birds:** Several varieties of bird species including Pheasants, Quail, Partridge, or Grouse that have been hunted for food and sport. This term can also be used for various types of wild waterfowl and wild turkeys. These birds can be raised in captivity, but they are not considered domestic poultry and can be released onto their own after a certain number of weeks.
46. **Goose:** The singular of Geese or a female goose. Geese are large waterfowl, and many have utility traits as sentinels or foraging for pests. Many also provide substantial amounts of quality fowl meat.
47. **Gosling:** A baby Goose.
48. **Guinea Fowl:** A breed of poultry that originated in Africa that is raised for a

variety of utilities. They are most commonly raised for their meat as well as pest control, specifically ticks. Their watchfulness and strong territorial instincts make them excellent natural sentinels. They do well when they are allowed to roam wide distances in a flock, and they are only partially domesticated.

49. **Hackles:** The rooster's cape feathers.
50. **Hatchability:** The percentage of fertilized eggs that will hatch under the incubator.
51. **Hen:** A female chicken. Adult hens that are currently laying are usually referred to as Laying Hens.
52. **Hybrid:** A cross breed that is usually bred with the intended purpose of crossing desirable traits of the parent chickens to produce an offspring with unique characteristics. See Production Red Chicken.
53. **Incubate:** Establishing and maintaining hatch able conditions for a fertilized egg.
54. **Incubation Period:** The time in which a fertile egg will need to be incubated in order for the egg to hatch. This time varies depending on the type of poultry, and sometimes even the breed of many types of waterfowl.
55. **Keet:** A newly hatched Guinea Fowl chick.
56. **Knob:** A protrusion from the top of the bill of many different goose varieties.
57. **Large Fowl:** "Regular" sized chickens, as opposed to Bantam Chickens, that usually range between 4 and 13 pounds depending on breed and gender. Chickens are usually categorized into Light and Heavy Breeds. Most Light Breeds are going to be White Egg Layers.
58. **Layer or Laying Hen:** Refers to a female chicken that has begun laying eggs.
59. **Mate:** Pairing a rooster with one or multiple hens, or the act of doing so. Often different types of fowl have different mating habits. Many domestic ducks and chickens will mate with many different females in a flock, but often a gander will only mate with between 1-4 specific geese. Many of the rarer wild adult ducks we sell are sold as "Mated Pairs" because in the wild they are generally monogamous for at least one mating season. Some ducks and geese are

monogamous for life, and there are instances where the death of a mate can traumatize the other to the point where nothing can reasonably console them.

60. **Meat Breeds:** Usually in reference to a broiler or Fryer, these are breeds that have utility of good meat production as either their main or secondary utility trait.
61. **Molt:** When a bird sheds many of its primary feathers and re-grows them. Often this leaves many ducks without the ability to fly for several weeks, and the males often lose their colorful feathers that make them stand out during the breeding season.
62. **Muff:** Usually associated with a beard, these are the tufts of feathers that stick out from the cheeks of the chickens. See Americana and the Salmon Faverolle Chicken. Muffs are sometimes called "whiskers" and can give the chicken quite an amusing look.
63. **Nest:** A place with sufficient bedding that is secluded enough for a hen to feel safe laying and leaving an egg.
64. **Pasting:** Loose droppings that stick to the vent area. This can be dangerous for small chicks that cannot sufficiently clean themselves as it can dry and prevent them from being able to excrete feces. This occurs mostly in young chicks that are raised in confined area with many other chicks. It is important to keep an eye out for this condition when raising sufficient numbers of young chicks. We call this condition "crusty butt". If this occurs, be sure to clean the area with warm water to remove the excess feces from its bottom. And don't forget to wash your hands.
65. **Pheasant:** A game bird that comes in many breeds and varieties that originated in many different regions of the world. Often they are raised and hunted for their food and sport and many breeds of pheasants are raised for ornamental purposes.
66. **Pecking Order:** The social ranks within a flock of chickens. This is often determined when the chicks are juvenile and may consist of a few brief "squabbles", until a clear "alpha chick" is decided.
67. **Perch:** The elevated place for a chicken to sleep at night, also called a roost.

68. **Plumage:** The set of feathers on a bird. You will often see us referring to a bird's "plumage pattern" when describing a particular breed.
69. **Poultry:** A baby turkey.
70. **Pullet:** A female chicken under one year of age.
71. **Purebred:** A chick that comes from a hen and rooster of the same species.
72. **Range Fed:** Similar to free range, this describes poultry that are allowed to graze freely.
73. **Roaster:** A cockerel or a pullet that is suitable for cooking whole in the oven.
74. **Roost:** Same as a perch, this is usually an elevated area where the chickens will sleep at night.
75. **Rooster:** A male chicken. **Saddle:** The region on the back of a bird just before the tail. Sometimes Pomeranian Geese are called Saddle-backed geese because of the brown region of feathers that grow on the saddle of an otherwise white goose.
76. **Set:** To brood or sit on eggs to keep the warm for hatching.
77. **Setting:** The incubation of of the eggs by a hen, also called "sitting".
78. **Sexed:** A chick or duckling that has already been sorted according to its gender.
79. **Sex-Link:** A genetic trait that creates a distinguishable difference between the males and the females. This is usually a color difference and this is most often used for the purpose of distinguishing males from females easily after hatching. See Gold Sex-Link, our most popular sex-link breed.
80. **Shank:** The part of the chicken's leg between the toes and the first (knee) joint.
81. **Sickles:** The long and curved tail feathers of some roosters.
82. **Snood:** The flap of skin that hangs over the turkey's beak, and similar to the caruncle, turns bright red when angered or during courtship.
83. **Standard:** A description of a chicken that fits the ideal characteristics of its breed, as specified by the American Standard of Perfection. This term is sometimes used incorrectly to describe a large breed as opposed to a bantam variety.

84. **Starter or Starter Feed:** Feed for newly born poultry that has a higher protein concentration than normal grower or layer feed for adult chickens. Be sure to always consult your chick supplier or local feed store before purchasing feed for your chicks if you aren't sure exactly what to buy.
85. **Straight Run:** Newly hatched chicks that have not been sexed.
86. **Tom:** A male Turkey
87. **Turkey:** A large game bird that is native to North and South America. There are a few varieties of Wild Turkeys, Commercial Meat Turkeys, as well as domesticated Rare or Heritage Breed Turkeys.
88. **Utility:** For our purposes we use the word utility to describe a breed of poultry in terms of its production or value on a farm, such as egg, meat, or pest control.
89. **Variety:** A subdivision of a particular breed of poultry, usually differing in plumage pattern. **Vent:** The outer opening of the cloaca through which the chicken passes both eggs and excrement (coming from separate channel)

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