

Overview of the Poultry Industry

Lesson I: Overview of the Poultry Industry

The poultry industry makes up a large portion of Missouri's agricultural system. It provides millions of people with affordable and nutritious meat and eggs and other useful products such as fertilizers and livestock feed additives. The industry has grown tremendously in the last few decades. It began as small backyard farming systems and has now developed into large commercial enterprises with millions of birds.

What is Poultry?

Poultry is defined as economically important birds used either for food or show. This includes chickens, turkeys, quail, ducks, geese, and guineas. Other birds, such as pheasants, partridges and peafowl, can be classified as poultry. The following is poultry-related vocabulary.

Pullet - a young female chicken.

Hen - a sexually mature female chicken, usually more than 10 months old, that has started to lay eggs.

Chick - a baby chicken of either gender.

Broiler or fryer - a young male or female chicken, tender-meated with flexible breastbone cartilage, marketed at 6 to 8 weeks of age.

Roaster - a young male or female chicken, tender-meated with breastbone cartilage somewhat less flexible than a broiler or fryer, usually marketed at 7 to 10 weeks of age.

Capon - a surgically unsexed male chicken, usually under 8 months old, used for specialty markets.

Cockerel - a male chicken less than one year old.

Rooster - a sexually mature male chicken.

Poult - a male or female baby turkey.

Economic Importance of Missouri's Poultry Industry

The poultry industry is very strong in Missouri. The statistical information in Table I.1 illustrates the effect on Missouri's economy.

Poultry and eggs accounted for 27 percent of the total livestock cash receipts in Missouri in 2006. In comparison, meat animals, which include cattle, hogs, and sheep, accounted for 60 percent of total livestock cash receipts in Missouri during 2006. Total pounds of broiler meat produced was 1,075,000 pounds in 2006 and total pounds of turkey meat was 589,600 pounds.

Missouri's large scale poultry industry provides many people with careers in production and marketing. In addition, manufacturing companies support enterprises with equipment and facilities. The industry as a whole provides people with excellent dietary sources of vitamins and protein in the form of poultry and poultry products.

Table I.1 Effect on Missouri Economy

Product	Rank in U.S.	Total Production	% of U.S. Total	Value of Production
Turkeys	5th	20 million	7.6%	\$236 million
Broilers	10th	250 million	3.2%	\$403 million
Eggs	14th	1.9 million	2.1%	\$85 million
All Chicken (except broilers)	16th	9.4 million	2.1%	\$1.6 million

Introduction to Poultry Production

Evolution of the Poultry Industry

The poultry industry began with early settlers who raised small flocks of birds around their homes. At first, raising birds for meat and eggs was considered a small enterprise on the farm. Soon demands for poultry and poultry products increased due to the growing population. By the 1800s, farmers began to specialize in poultry production that developed further with the onset of poultry shows by the 1850s. The American Poultry Association was founded in 1873 with the goal of establishing a distinctive set of standards for showing birds. This organization published the American Standard of Perfection in 1874.

Today the poultry industry in Missouri and in the United States is a highly specialized system of producers and hatcheries with few small home flocks. Many of the hatcheries in Missouri have continued to be productive entities in the state, shipping young poultry worldwide. Much of the poultry industry is concentrated in the southeastern and midwestern part of the United States where the climate is mild and feed sources are nearby.

The four major commercial enterprises in the United States that constitute the modern poultry industry are egg production, broiler production, turkey production, and raising pullets for replacement purposes. Since the late 1960s, there has been a decrease in the number of farms that raise laying hens; however, the size of flocks and farms has grown significantly. The total number of laying hens has decreased but egg production has been steady due to an increase in rate-of-lay per hen. Rate-of-lay refers to the total lifetime production of a hen. Egg consumption per person has decreased due to alternative breakfast foods, such as cereals, and concerns about negative health effects of eggs in relation to cholesterol intake. U.S. per capita production of eggs appears to have stabilized and has been increasing since 1990 with expansion in midwestern states.

Production of broilers and turkeys for meat has skyrocketed since the late 1960s. There has been an increase in consumption per person due to further processing of poultry meat into products like chicken

nuggets and precooked breast fillets. Also, since poultry meats are considered a low cholesterol food, public interest in a low cholesterol diet has also played a role in the growth of the industry.

As the different industries have grown, so has the demand for pullets, broiler chicks, and poults. Broiler chicks and poults production facilities are typically located close to the specific production facility, with breeder flocks somewhat isolated from the production farms. They consist of large hatcheries that incubate fertilized eggs, hatch, and deliver chicks or poults to the farms. Some hatcheries may provide other services such as vaccinations, egg injections, and beak trimming. Pullets and turkeys are sexed at the hatchery.

Common Breeds and Production Lines

For identification purposes, poultry is divided into breeds, varieties, types, and classes. A breed is a group of birds that share the same characteristics and have a common origin. A variety is a subdivision of a breed that is based on a group of specific traits, such as color or comb shape. Type describes the purpose for which the bird is used; the two general types are egg-type and meat-type. The class associates the bird with its place of origin. There are four general classes of poultry that include Mediterranean, American, English, and Asiatic.

Poultry raised from commercial producers are identified by breeder strains. Strains are families or breeding populations possessing common traits. They may be subdivisions of a breed or variety or may even be systematic crosses. However, a strain shows a relationship more exacting than that for others of similar appearance. Strain crossing refers to crossing of different strains of the same variety. The commercial poultry industry today is based almost 100 percent on the strain approach. Many commercial strains exist. Examples of chicken strains are Cobb, Hubbard, DeKalb, Hyline, Babcock, and Shaver. An example of a turkey strain is Nicholas. Strain breeders are constantly looking for additional material for gene pools.

The *American Standard of Perfection*, published by the American Poultry Association, lists more than 300

Overview of the Poultry Industry

different breeds and varieties of poultry. Of the many different species listed in the publication, very few are used commercially, but it is an excellent reference for birds raised for showing purposes.

Most commercial breeds and strains of chickens used for meat and eggs are a product of cross mating, crossbreeding, or inbreeding. Cross mating involves mating birds within the same breed. Crossbreeding is mating birds of different breeds or varieties. In an inbreeding system, birds that are very closely related to each other are mated to get specific traits.

Some chicken breeds are used primarily for commercial egg production. The most common commercial white, egg-layer hen is the Single Comb White Leghorn (a Mediterranean breed) for her excellent egg production. Some smaller flock owners choose to raise dual-purpose, brown egg-producing strains because they use them for both egg and meat production.

The most common bird used for meat production was originally a cross between the male Cornish of the English class and the female White Plymouth Rock of the American class. Hens produced by this cross have a low rate of egg production but are very efficient in meat production.

Turkeys are usually bred from a definite line or strain. Turkeys are typically referred to as their strain name rather than by their variety name. Common examples of commercial production strains are the Broad-Breasted Large White, Beltsville Small White, Nicholas, and British United Turkey (BUT).

Types of Poultry Enterprises

Three types of enterprises exist in today's poultry industry: commercial, backyard, and niche markets. A commercial enterprise raises birds in quantities of 100,000 or more. Backyard enterprises raise smaller amounts. The niche market enterprise raises birds in an alternative manner to the commercial industry. It produces products that are restricted to specific guidelines, such as utilization of special medications, facilities, or production process.

The three types of commercial enterprises include egg production, broiler or turkey production, and raising pullets and poult for replacement, which supplies the other two enterprises with replacement birds. The use of vertical integration is very common in the commercial poultry industry. Vertical integration means that one enterprise owns and controls more than one type of production operation. For example, a farmer may choose to purchase a feed mill, therefore supplying his own flocks with ready-to-eat feed. This system dramatically increases the size of operations and efficiency. A vertical integration system is run by poultry processors or manufacturers who are in charge of the majority of management decisions and problem solving. Nearly all meat production systems are produced under vertical integration and about 50 percent of egg production uses this system. The poultry meat industry is unique because most of the products are sold under a brand name, such as Holly Farms, Tyson, Cargill, or Con-Agra.

Commercial broiler fowl and laying hens are produced by specialized genetic companies that own breeding fowl. These companies incubate and hatch commercial layers and broiler chicks. Such operations usually provide producers with the bird, vaccinations, feeding, lighting, and pullet-growing program. They also provide veterinary and technical field services.

Commercial egg production systems are very large. They usually have a minimum of 100,000 head and many farms have up to 1,000,000 birds at a time. Hens are kept in cages with environmentally controlled housing. This controlled housing has specific lighting programs and computers that control the ventilation. Egg collection and feeding is completely automated.

In backyard enterprises, people choose to take advantage of the efficiency of poultry and raise their own smaller flocks. Maintaining a chicken flock requires a minimal amount of space and many people enjoy having the fresh eggs and meat available to them from their own backyard. Breeds recognized for dual purposes, such as the Rhode Island Red, Plymouth Rock, New Hampshire, Wyandotte, and Orpington, are popular among small flock owners because they are relatively efficient in both egg and meat production.

Introduction to Poultry Production

Niche market enterprises provide meat and eggs grown in an alternative manner. Systems such as these may raise their birds cage-free and organically. The term “organic” has had many different definitions. In general, organic refers to products produced free of synthetic chemicals and drugs. Current standards exist but vary from state to state. There are more than three dozen different certification organizations within the United States that try to define organically grown meats and produce. The USDA Agricultural Marketing Service developed a National Organic Program.

Career Opportunities

The poultry industry provides many people with a variety of careers from marketing to research sciences. The poultry industry has grown significantly over the years and the systems of production have become very specialized. As technology and research continues to develop, so do the employment opportunities in the poultry industry. Many positions within the poultry industry require specialized training and/or certification. Examples of these occupations are chick sexers, artificial insemination technicians, blood testers, and sanitation workers. Other occupations require a college degree for employment. Examples are poultry breeding, field service personnel, waste systems managers, personnel officers, and accountants. Some occupations require an advanced degree. Examples are poultry geneticist, scientist, or veterinarian.

Summary

In general, poultry is any bird raised for food or show. The poultry industry in the United States has grown from small, family-owned, backyard flocks into large commercial enterprises. These enterprises are very important to the economy of Missouri and the United States. The different types of poultry enterprises include the commercial, backyard, and niche market. There exist many different breeds and strains of poultry, but only specific crosses of birds are used in the poultry industry. The size and diversity of the poultry industry offers employment opportunities to many people with varied experience and skills.

Credits

Missouri Farm Facts. Columbia: Missouri Agricultural Statistics Service in cooperation with the Missouri Department of Agriculture and the United States Department of Agriculture, 2004.

Field, Thomas G., and Robert E. Taylor. *Scientific Farm Animal Production*. 6th ed. Upper Saddle River, N.J.: Prentice-Hall, Inc. 1998.

Gillespie, James R., *Modern Livestock and Poultry Production*. 5th ed. Albany: Delmar, 1997.

Hall, Michelle A., ed. *Introduction to Avian Bowl*. Clemson University: Clemson, SC, 1997.

Kelly, Debi. Personal Communication. MO Alternative Center, University Extension. University of Missouri: Columbia. 20 March 1998.

Moreng, Robert E. and John S. Avens. *Poultry Science and Production*. Prospect Heights, Ill.: Waveland Press, 1991.

Statistical Highlights of U.S. Agriculture, 1997/98. Missouri Agricultural Statistics Service in cooperation with the Missouri Department of Agriculture and the U.S. Department of Agriculture, 1998.

USDA AMS National Organic Program. 1999. 7 July 1999. <<http://www.ams.usda.gov/nop>>.

Lesson 2: Selection and Evaluation

Selecting high quality poultry is a skill that is important to egg and meat production. By evaluating and selecting the most productive birds, overall improvement of the flock is achieved. It is important for commercial operations to develop and produce quality poultry in order to remain profitable and to maintain a positive reputation in the industry.

Poultry Parts

Figure 2.1 and Figure 2.2 identify the parts of a chicken and the parts of a turkey. It is important to be familiar with the common terminology of poultry to select and evaluate high quality birds.

Selecting Broiler Breeder Poultry

Broiler breeders are the parent stock used to produce hatching eggs for commercial broiler production. When selecting broiler breeders, look for evidence of a healthy, productive bird. The criteria includes general health, body weight, conformation, and performance data. Conformation is the type, form, and shape of the broiler. It includes feathering, fleshing, fat, and freedom from defects. Performance data is used to determine the genetic superiority of the breeding flock.

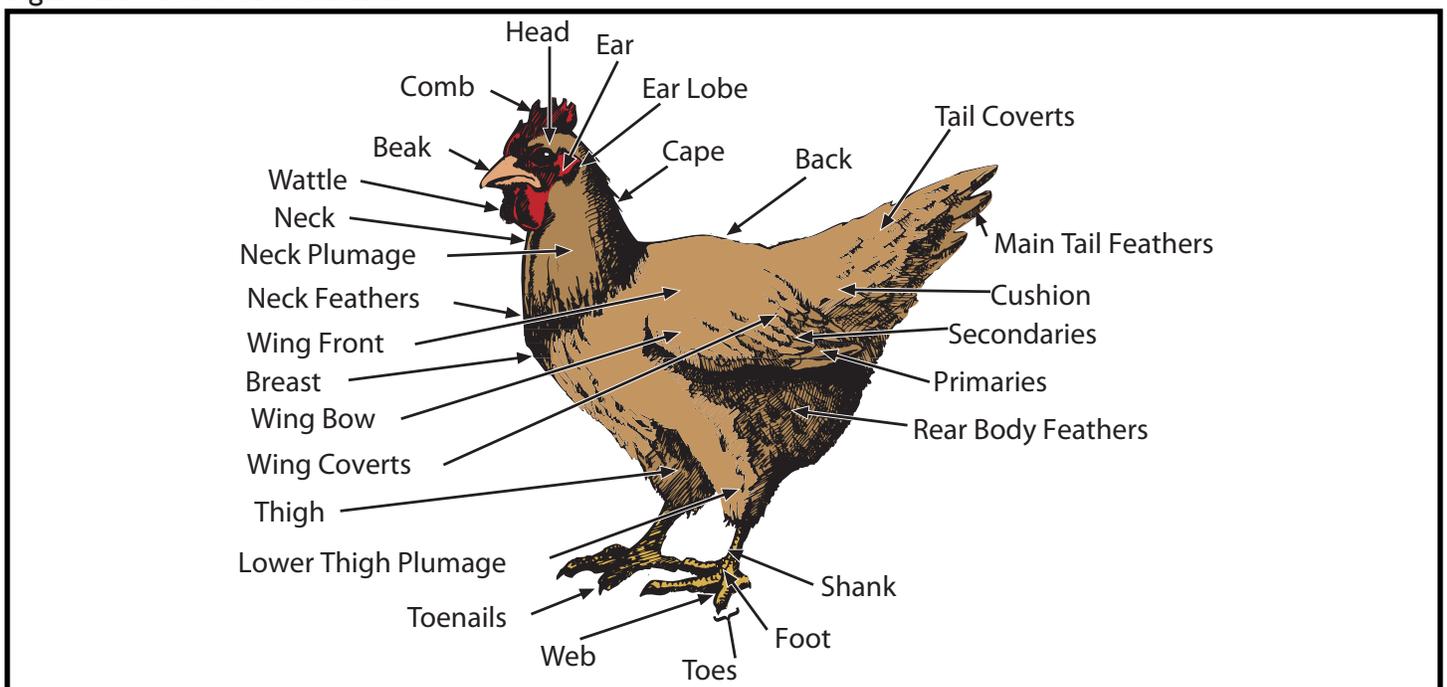
General health refers to indications of disease or other abnormalities that may indicate that the bird is not fit for humans to eat. In general, a bird in good condition has no severe abnormalities such as unusual growths or lumps, bloody diarrhea or yellow to green-tinted feces, bodily discharges, lameness, or fever.

A healthy bird is very vocal. Its rounded, bright eyes are very alert. The comb and wattles are bright red, with a smooth, sturdy, and waxy texture. The feathers around the vent (posterior opening, anus) are clean and dry as the rest of the body plumage is close-fitting and clean. An unhealthy bird may exhibit sluggish behavior. The comb may be coarse, discolored, and darker or lighter than normal. The feathers around the vent may be dirty and damp, and the body feathers may be disarranged. Figure 2.3 shows the head of a healthy chicken compared with an unhealthy chicken.

Body weight of offspring is closely related to the weight of the broiler's parents at seven weeks. Evaluate birds at seven weeks and select only the larger birds.

Conformation refers to the general shape of the bird. The preferred shape of a broiler includes a crescent-shaped back, broad breast, and upright head. A bird with poor conformation has a wedge-shaped body, hunched back, crooked breasts, backs, and legs. The

Figure 2.1 - Parts of a Chicken



Introduction to Poultry Production

Figure 2.2 - Parts of a Turkey

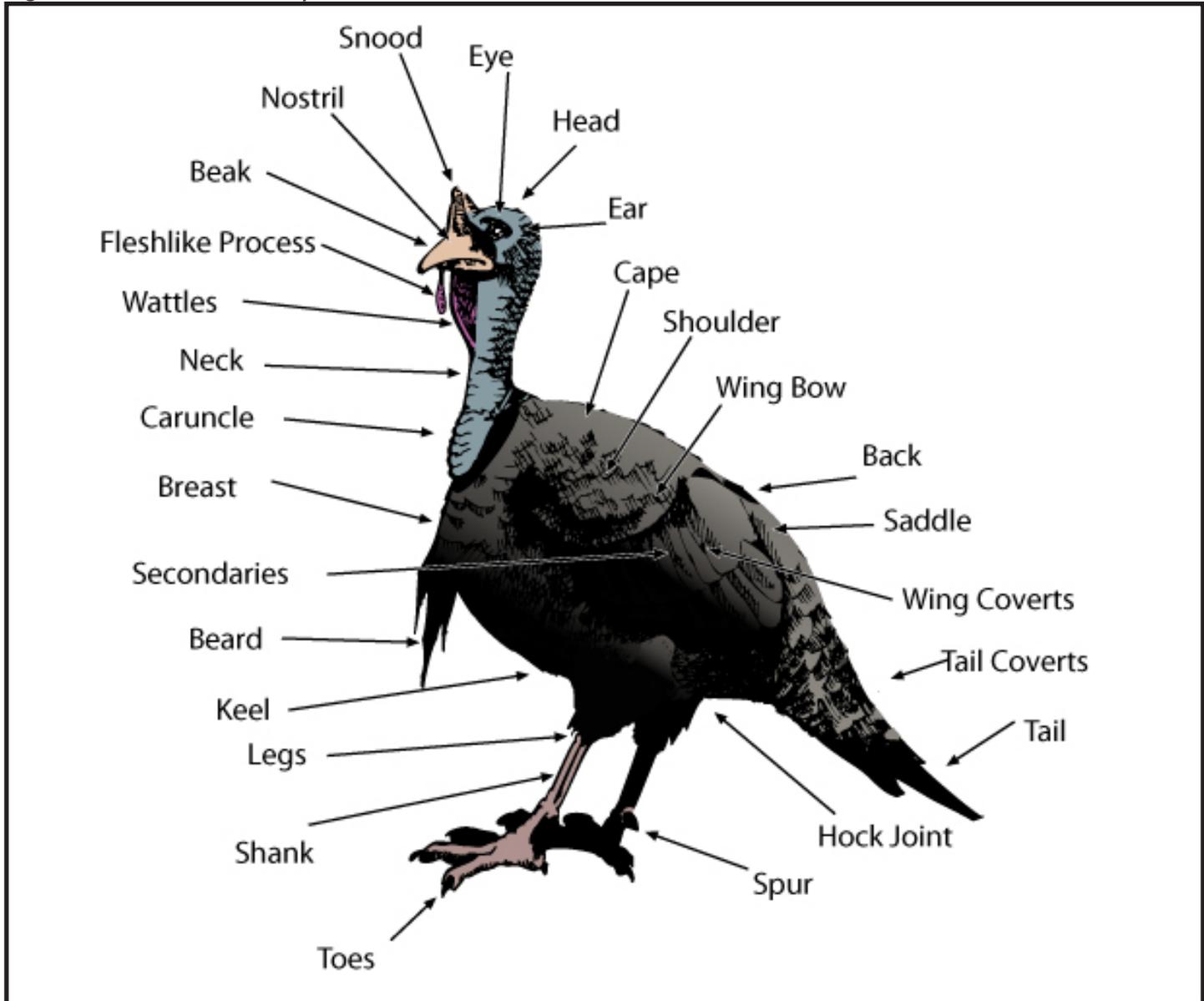
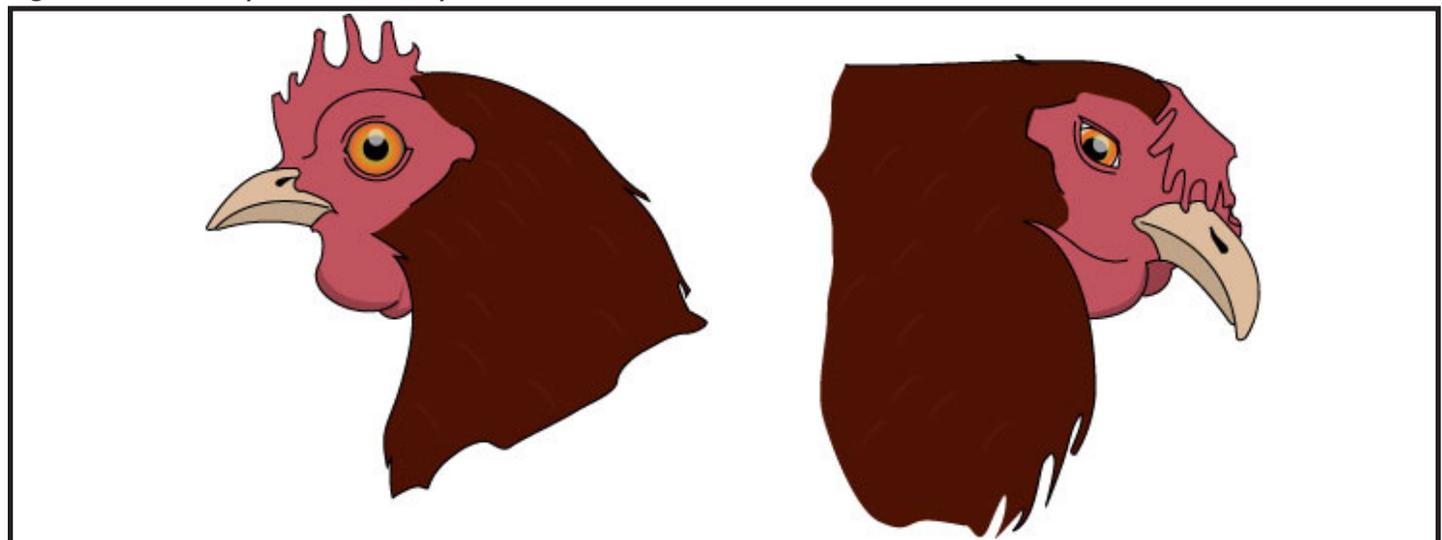


Figure 2.3 - Healthy and Unhealthy Chicken Head



feathers should lay well, be close fitting, smooth, and unbroken. A chicken with poor feathering may have twisted feathers, broken quills, or bare spots on the skin, which may result in sunburns. The most important factor when evaluating feathering is the presence of pinfeathers. These are the feathers just coming through, or still under the skin. The less pinfeathers, the better the quality of the bird. Pinfeathers are difficult to remove during processing.

Fleshing refers to the commercially important muscles that make up the shape of the bird. Quality meat poultry will have thick, rounded breasts that are wide through to the keel. The back will be toned all the way down the length of the vertebrae. The legs are thick and meaty. A bird with poor fleshing may have a breast that is inverted instead of protruding. Also, the legs and back may be thin.

The most common problem associated with fat coverage in broilers is a lack of the healthy layer of subcutaneous fat. Evidence of little fat can be seen by either thin skin over the abdominal area, the area where the skin over the thigh is connected to the breast, and under areas with heavy feathers. Fat can be easily measured by gently pinching the skin of the abdomen. Hardness indicates fat; softness indicates little fat.

Defects in broilers are damages caused to the bird that result in downgrading of the meat. When selecting birds, avoid those with defects that includes insect bites, bruises, calluses or watery blisters on the breast. Discoloration and bare areas, a result of the bird picking, are also considered defects.

Such defects of birds are often a result of improper handling or raising of the bird. For this reason, it is important to handle birds properly while examining for selection.

General disqualifiers include black feathers found in cockerels, green or black pigment found on the shanks, crooked toes (greater than a 90-degree bend), swollen hock joints, and infected foot pads.

Performance data for selection of broiler breeders is measured by the growth rate. Rapid growth reduces the time to market and results in feed consumption savings. A positive growth rate often reflects good breast width, body depth, and fleshing.

Turkey Breeder Selection

The criteria for selection of broiler breeders can also be applied to the selection of turkey breeders with only a few slight differences. Conformation is even more important because turkey carcasses are often marketed whole and at higher weights. Rather than watching for a droopy, coarse-textured wattle and comb, an unhealthy turkey may have sagging caruncles. Caruncles are the fleshy protuberances on the naked portions of the head, face, and neck of the turkey. Turkeys are susceptible to certain diseases and infections. Vaccination records should be checked for all breeding stock.

Selection of Commercial Layers and Pullets

Commercial layers are selected and evaluated by their pigmentation, general health, and conformation.

Layers lose yellow pigmentation from the skin and shanks as they lay eggs. This loss of color is called "bleaching." The pigment bleaches from the pigmented areas in a definite order according to the approximate number of eggs she has laid. When a hen ceases to produce, the pigments return to the body. Bleaching occurs in the following order: vent, eye ring, ear lobe, beak (corner of the mouth toward the tip), bottom of the feet, loss from front, back, and sides of shank, and the hock and top of toes.

A highly productive hen will have good general health. The comb and wattles of a productive bird are bright-red, waxy, smooth, and full. The eyes are bright and round, and the eyelids and eye ring are bleached. The beak should be in the process of bleaching or already bleached.

The vent should be fully bleached, supple, and moist. An unproductive laying hen will have small, scaly, discolored wattles and comb. The eyes will be droopy

Introduction to Poultry Production

and sunk in, the beak will be yellow, and the vent will be dry and yellow.

The conformation of a quality hen with a high rate-of-lay will have a broad head, smooth face, large body capacity, soft and flexible abdomen, supple skin, and flat, smooth shanks. The pubic bones should be thin, flexible and spread wide enough to fit two to four fingers between them. A hen with a poor rate-of-lay will have a long, crow-shaped head, thin back, poor body capacity, hard abdomen, leathery skin, and round, scaly shanks. The pubic bones will be close together and not flexible.

Pullets are sexually immature chickens that are less than 22 weeks of age. The pullet should show signs of reaching sexual maturity by good comb and head development. They are evaluated for their potential to be highly productive layers. A healthy pullet shows no sign of disease. The eyes are round and prominent and the head should have smooth skin of a normal color associated with the breed. A strong, wide back, broad body, and roomy heart girth indicate quality body conformation. Pullets should have smooth feathers with no bare spots, and the skin color on the shanks should be of normal color for the breed. Legs should be straight and even with no abnormalities in the feet and toes.

Proper Handling Techniques

Proper handling is crucial in selection and evaluation of poultry. Handling poultry provides the ability to observe areas of the bird that are impossible to see from observing a standing bird. Appropriate handling helps reduce defects and injuries to the bird. Chickens and other commercially important poultry are naturally nervous creatures. It is important to have good control of the bird so it cannot get away and possibly injure itself.

To catch a bird, gently put one hand above the back of the bird and quickly, yet gently, pin the bird down. (Figure 2.4)

Slide the other hand under the breast until it is resting in the palm of the hand. Steady the bird by putting a

Figure 2.4 - Catching the Bird



Figure 2.5 - Steady the Bird

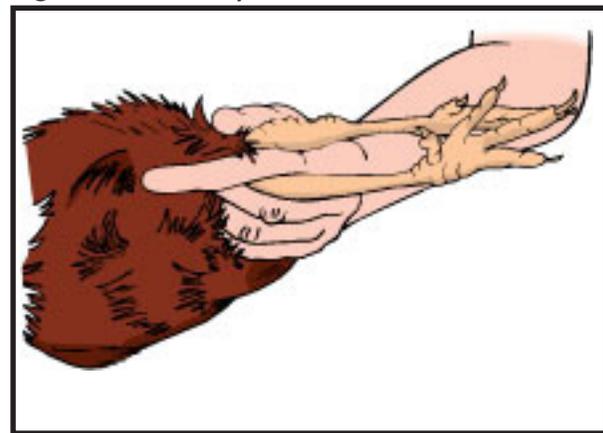


Figure 2.6 - Measure Abdominal Capacity



hand on its back and holding the wings down. Place the index finger between the hocks. Put a thumb around one leg and the rest of the fingers around the other leg. (Figure 2.5)

Gently lift the bird while keeping the other hand on its back. Hold the bird's head down with the back resting against the examiner's stomach. This will allow observation of the vent, abdominal capacity, and bleaching of the feet and shanks. The pubic bones and the softness of the abdomen can also be checked. To measure the abdominal capacity, place fingers between the keel bone and the pubic bones. Count how many fingers fit; this is the abdominal depth. To measure the abdominal width, turn the bird towards the examiner with the head under the elbow. Repeat measurement with fingers at a 90-degree angle. (See Figure 2.6)

To check for molting in wing feathers, keep the hen tucked under the elbow. With the other hand, gently open the wing and count the feathers. Return the bird to the coop with the breast in the palm of the hand and fingers holding the legs as before. Place the bird in head first and be sure both feet are completely on the floor before releasing it.

Summary

In the poultry industry, birds are selected and evaluated on their general health, conformation, body weight, and performance data. The qualities in a broiler breeder will vary from the layer and pullets but the same criteria is evaluated. Turkey breeder selection is very similar to selection of the broiler breeder. Handling the birds is an important part of the evaluation process. It must be done properly to avoid injuring the birds during the examination.

Credits

Field, Thomas G., and Robert E. Taylor. *Scientific Farm Animal Production, 6th ed.* Upper Saddle River, N.J. Prentice Hall, 1998.

Gillespie, James R. *Modern Livestock and Poultry Production, 5th Ed.* Albany: Delmar, 1997.

Moreng, Robert E., and John S. Avens. *Poultry Science and Production.* Prospect Heights, Ill. Waverly Press, Inc. 1991.

National 4-H Avian Bowl Manual. Cooperative Extension Service, Clemson University. Clemson, NC. 1992

National Poultry Judging Manual. National 4-H Poultry and Egg Conference Extension Committee. Nebraska Cooperative Extension. 1998.

Introduction to Poultry Production

Lesson 3: Production

The production and management of poultry products is one of the most specialized agricultural systems. Everything from housing to feed is the result of decades of research that has helped make the commercial poultry industry a very efficient, high-yield business.

Production and Management Practices

The four major commercial production systems are broiler production, turkey production, egg production, and pullet production for replacement purposes. Each system features specific management and production practices to reach maximum profitability. The commercial poultry industry has developed into a system referred to as vertical integration. Vertical integration is when two or more stages of the production, processing, and distribution are controlled by a single firm. For example, feed manufacturers and processing plants (referred to as the contractor) provide the financial needs and control management decisions while producers/growers provide the facilities and labor.

Broiler production is well suited to assembly line techniques. As a result, broiler production has developed into a highly integrated industry with 99 percent of broilers produced under contract. A typical integrated firm will provide the chicks, feed, processing, vaccinations, supervision, and transportation. The producer/grower provides housing, grow-out equipment, (feeders, waterers, and brooder houses), utilities, labor, and management. With improvements in production practices, the time to produce a broiler has decreased thus reducing the feed consumption costs. Broiler units are highly automated for feeding, watering, lighting, and ventilation. Commercial slaughter operations are regulated by state and federal inspections.

Turkey production is following a trend of fewer but larger farms and processing plants. Traditionally, turkeys have been raised on the range, but confinement rearing with highly automated feeding and watering systems is standard. As with broiler production, turkeys are grown using the vertical integration system.

Layers used for egg production are being raised by fewer but larger flocks. Producers strive for maximum egg production at minimum costs. A good average for a high-producing strain is 285 to 310 eggs over a 12- to 14-month laying cycle. Layers are produced primarily on an integrated or contract arrangement. Environmentally controlled housing is used with regulation of the light and ventilation.

Replacement pullets can be raised by egg producers or they are purchased from pullet growers just prior to placing in the layer house. The trend is moving toward specialization with egg producers only producing eggs while other specialists only raise replacement pullets. Pullets can be raised on floors, in cages, or a combination of starting on the floor and moving to growing cages at 6 to 10 weeks. Sanitation is very important when raising starter pullets to avoid disease and contamination. Ages and strains of birds should not be mixed with other birds in the same house and all sanitation and disposal rules should be strictly followed.

Facilities and Equipment

Proper housing of poultry is important to achieve a healthy and productive flock. Also important is the convenience and ease of the producer to maintain the greatest profit. The major factors to consider in facility planning are temperature, moisture, ventilation, and lighting.

Small chicks are started in facilities referred to as brooders or brooder houses. All chicks, whether they are broilers or replacement pullets, will start in brooders. Special heating equipment is necessary to keep the chicks warm until well-feathered. Small, trough-type feeding and watering equipment suitable for day-old chicks is used. Fresh air must be provided but with no drafts on the floor. Lighting can be provided by either heating equipment or room lights.

Pullets can be raised in the same house used for brooding or they may be moved to separate housing. They may be grown in partial cage systems or complete cage systems. The partial cage system starts the pullets out on the floor for the first 6 to 10 weeks and then they

Introduction to Poultry Production

are moved to cages. The complete cage system grows the pullet entirely in cages. Lighting must be regulated closely because it will affect the sexual maturity rate of the pullets. Feeders and waterers should be placed throughout the house in convenient locations. Pullets can also be raised on the range but this method is better suited for smaller flocks.

Layers used for egg production may be housed in cage systems or in open- or slat-floor systems. Cage systems are the most common method for commercial operations. Cage systems are typically multiple-bird cages usually holding 5 to 10 birds in one cage. Egg production in an open-floor system is not very efficient for commercial egg producers. Open- or slat-floor systems result in dirty or broken eggs, stress to hens competing for food, extra cost for litter, and more labor to collect eggs by hand up to three times a day. Laying houses must provide hens with adequate temperature and ventilation. Fresh, clean food and water may be provided automatically or by hand. Lighting must be closely regulated for optimum egg production with a minimum of 14 hours and a maximum of 17 hours of light per day. Laying houses also need to provide an egg room to hold eggs in a cool and dry environment while being held for market.

Broilers typically are raised in large confinement facilities. Single houses may hold 20,000 to 28,000 birds with .75 or .8 square feet allowed per bird. Partial house brooding is utilized with one end of the house restricted until the chick is three weeks old. This helps to maintain and monitor the heat available to the birds while they are young. After that, the chicks are allowed full range of the house. Automated feed and water is provided. Natural and artificial lighting is used.

Turkey poults are raised in clear-span, metal-roofed buildings. These buildings are built without poles through the interior area to make it easier to move cleaning equipment through the building and provide better ventilation. Brooding, growing, and finishing, or a combination of all, take place in the same building. They typically have dirt floors that are covered with an absorbent litter material.

Nutritional Requirements

Poultry are very different from other farm animals in regards to their nutritional needs. Birds use nutrients every hour of the day. Egg production, in particular, places a high demand for nutrient use to produce an egg. The digestion system of poultry is very rapid and respiration and circulation are fast. Poultry grow at a rapid rate and are more sensitive to environmental influences. Body temperature is higher than other farm animals and they mature at an earlier age. These factors place a great strain on their nutritional needs.

In poultry, efficiency of production is directly related to proper feeding. Birds are fed complex rations containing the essential ingredients for maximum meat or egg production, fertility, and body maintenance. The feed system is composed of five nutrient classes: energy (carbohydrates and fats), proteins, vitamins, minerals, and water.

The energy provided by carbohydrates powers the movement of muscles and produces body heat. Extra energy is stored within the body as fat. Sources of energy include animal products, such as fats, and plant products, such as grains (yellow corn, oats, milo) and vegetable oils. Protein provides amino acids which are the building blocks for cell growth (i.e., bone growth, tissue growth, or egg production). Vitamins are made up of fat- or water-soluble organic substances that aid the birds in digestion, absorption, and metabolism of nutrients. They also regulate the formation and development of new cells. Minerals are inorganic elements that help the bird develop bones and eggshells. Water helps to absorb nutrients from the digestive tract and aids in metabolic reactions.

Wastes and Byproducts

Manure, carcasses, and eggs are just a few examples of the wastes and byproducts produced by commercial poultry operations. An operation with 30,000 laying hens can produce 40 tons of manure a month or 480 tons a year. Proper handling, storage, and application of manure from poultry operations can protect water resources and increase profits of bird and crop enterprises. Animal wastes are an important source

of plant nutrients for crop production. Manure can also be dried and used as animal feed for other livestock. Dried manure is high in protein, calcium, and phosphorous.

Selection of a waste management system is based on location, size, type and use of cropland, number of birds, and type of housing. Typical housing systems include cages above dry or liquid pits, floors with litter, and outdoor ranges.

Cages with layers or pullets are in rows of decks. Manure falls through the pit directly or is scraped from dropping boards below the cages. Deep pit systems can develop into solid manure if kept dry enough. Air blowing across the pits dries the manure under the cages permitting solid manure handling. Manure is scraped or flushed with water from the pits directly to a spreader or to a storage area. If kept dry, manure can accumulate in pits for at least a year and often longer.

Broilers and turkeys are typically raised on concrete or earthen floors. Litter management includes removing caked manure from around waterers, stirring to increase drying, and adding new litter. Periodically, tractor loaders remove the manure-litter mixture and the area is cleaned and disinfected.

Summary

Poultry production systems utilize facilities and nutritional needs that are the result of decades of research that help achieve optimal production results. Commercial poultry operations are generally operated on an integrated or contract arrangement. Facility planning includes controls for temperature, moisture, ventilation, and lighting. Nutritional requirements are extremely important to the health and growth of poultry. Chickens have a high demand for nutrient use. Feed and watering systems are typically automated and are part of the poultry facility system. Poultry wastes and byproducts need to be managed properly to avoid pollution of water resources. Manure can be used as fertilizer for crops and processed into feed.

Credits

Ensminger, M.E., *Poultry Science*. 3rd ed. Danville, IL: Interstate Publishers, Inc., 1992.

Field, Thomas G. and Robert E. Taylor. *Scientific Farm Animal Production*. 6th ed. Upper Saddle River, NJ: Prentice-Hall, Inc. 1998.

Gillespie, James R., *Animal Science*. Albany: Delmar Publishers, 1998.

Gillespie, James R., *Modern Livestock and Poultry Production*. 5th ed. Albany: Delmar Publishers, 1997.

Moreng, Robert E. and John S. Avens. *Poultry Science and Production*. Prospect Heights, IL: Waveland Press, 1991.

Poultry Manure Management Planning (ID-206). (1994). 18 May 1999. Cooperative Extension Service, Purdue University. West Lafayette, IN.

<<http://www.agcom.purdue.edu/AgCom/Pubs/ID-206.html>>.

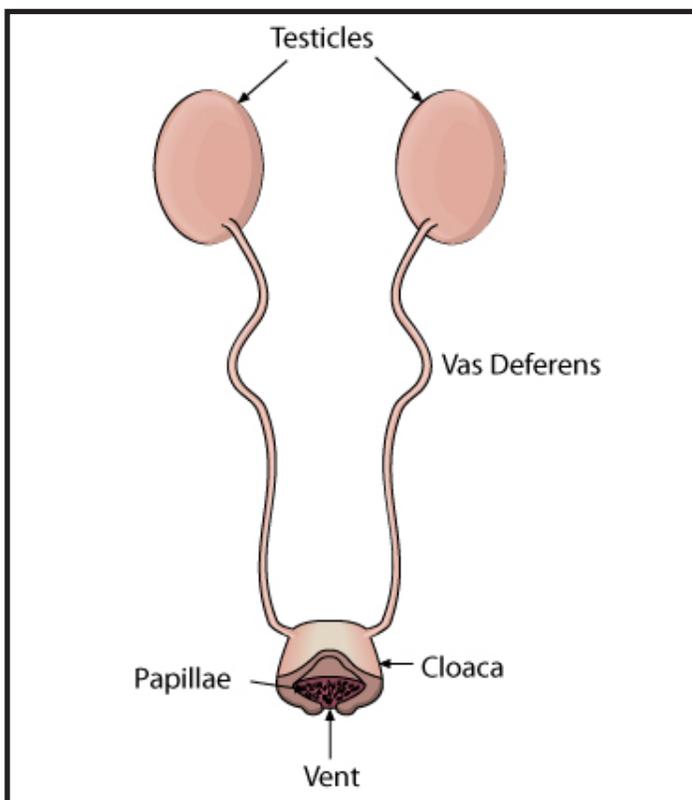
Lesson 4: Reproduction

The male and female reproductive systems in poultry are very different from other livestock. The most obvious difference is that the egg is fertilized in the hen, surrounded by a hard shell, and expelled from the body. In other livestock, eggs are fertilized and grow within the female until birth.

Male Reproductive Tract

The male reproductive system of poultry is completely contained within the body cavity. Figure 4.1 is a diagram of the male reproductive tract. The testicles are located along the backbone within the abdominal cavity. There are two testicles and they are made up of ducts that produce and secrete sperm. The testicles are connected to the vas deferens, which is a tube that transfers semen to the cloaca. The cloaca is the common area where the reproductive and digestive systems meet. The male cloaca joins the female cloaca in the mating process. Attached to the wall of the cloaca is the papillae. The papillae transport the sperm to the female reproductive tract during mating. The

Figure 4.1 - Male Reproductive System



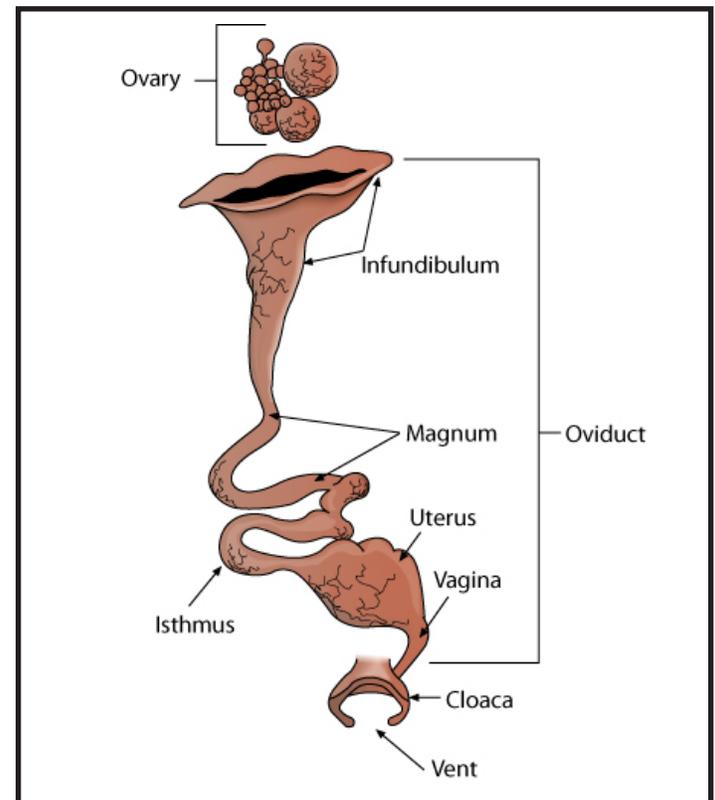
vent is the opening of the cloaca and releases the reproductive and digestive products.

Female Reproductive Tract and Egg Development

The female reproductive tract of poultry is made up of the ovary and the oviduct. Figure 4.2 is a diagram of the female reproductive tract. The ovary produces the ovum, or “yolk,” which is the female reproductive cell. Poultry have two ovaries, but only the left one is functional. It is located in the body cavity near the backbone. The female chick has several thousand ova (plural of ovum) at the time of hatching. These may develop into full-sized yolk as the hen matures.

At maturity the ova are released from the ovary to enter the oviduct. The oviduct is a long tube made up of different sections where the remaining membranes are added to form the rest of the egg. The oviduct consists of the infundibulum, magnum, isthmus, uterus, and vagina.

Figure 4.2 - Female Reproductive System



Introduction to Poultry Production

The infundibulum is the funnel-shaped upper yolk from the ovary. The yolk spends about 15 minutes in the infundibulum. If live sperm are present, this is the area where the yolk becomes fertilized.

The yolk then moves into the magnum, which is where the albumen is secreted and forms various layers of egg white. The yolk remains in the magnum about three hours.

Next, the egg travels to the isthmus, which adds two shell membranes. The inner and outer shell membranes form to represent the final shape of the egg. At some point, the shell membranes separate and an air cell is formed, usually in the large end of the egg. The membranes act as a barrier to protect from outside organisms and prevent evaporation of the egg contents. The egg remains in the isthmus about an hour and fifteen minutes.

Once the shell membranes have formed, the egg is passed to the uterus. The uterus, also known as the shell gland, adds a thin, white shell. The developing egg remains in the uterus for about 20 hours while water is added through the shell membranes to the albumen, or egg white. Meanwhile, tiny particles of calcium carbonate are laid onto the shell membranes forming the hard outer shell.

Finally, the egg is passed into the vagina, which serves only as a passageway, where it remains for a brief period before passing through the cloaca. The egg is held briefly in the cloaca as it rotates so the large end is expelled first. The egg will then pass through the vent and out of the body.

Parts of an Egg

The newly laid egg consists of four primary parts: the shell, membrane, albumen, and yolk (Figure 4.3).

The shell consists of three layers. The first shell is an inner mammillary layer consisting of sponge-like, calcium crystals. The next shell layer is made up of hard calcium crystals. This layer is more compact yet has thousands of microscopic pores that allow moisture and air to enter and exit the egg. Finally, the shell is

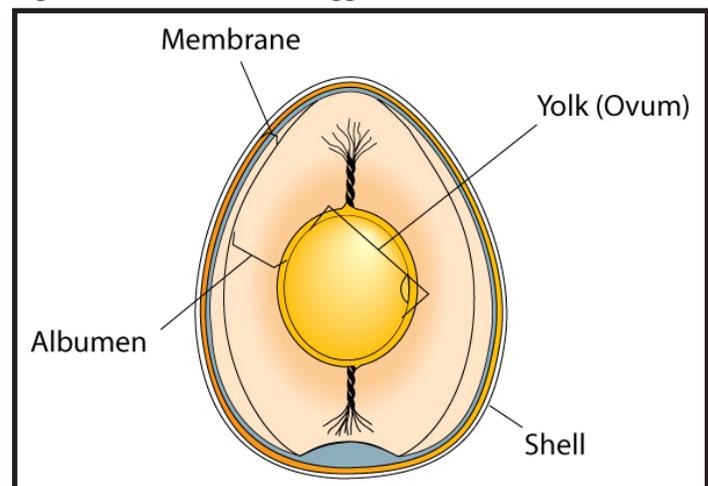
covered by the cuticle, which is a protective layer that helps prevent microorganisms from entering the egg.

Two paper-like membranes made of protein fibers exist inside the shell. The inner membrane holds the contents of the egg tightly together and the outer membrane is connected to the shell. The membranes act as a barrier to outside contaminants and reduce evaporation of the egg contents. The air cell forms at the large end of the shell where the two membranes separate.

The albumen (egg white) consists of four different layers: the outer thin, firm, inner thin, and chalaziferous. The yolk is surrounded by the chalaziferous layer. This layer extends into the chalazae, which are two twisted cords extending from opposite ends of the yolk. The chalazae helps to keep the yolk in place. The chalaziferous layer is surrounded by the liquid inner thin layer, then the more firm dense white, then the outer thin layers.

The yolk, or ovum, contains a germ spot, which is the female reproductive cell. The rest of the yolk is made up of layers that are a record of daily growth. The layers get their orange-yellow color from a substance called carotene, which is found in feed. Lighter colored layers reflect growth while the hen is not eating during the night. Darker colored layers indicate daylight hours when the hen is eating and has higher levels of carotene within her system. The yolk is surrounded by a membrane that helps maintain its spherical shape.

Figure 4.3 - Parts of an Egg



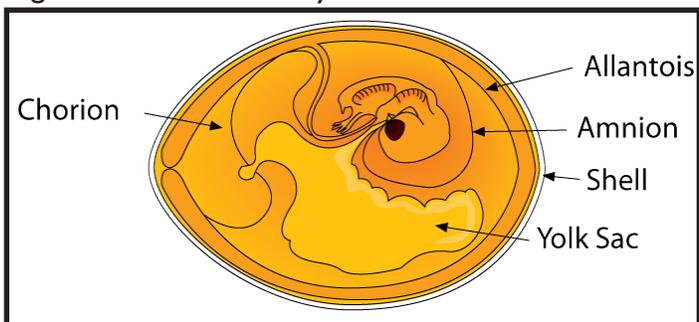
Embryo Development

Embryonic development in chicks is an extremely rapid process. The entire embryonic development of a chick from fertilization to hatch is approximately 21 days. The embryo of a fertile egg starts the cell-division process as the egg passes through the warm oviduct of the hen that lays it. The embryo is alive.

Within three hours after fertilization the blastoderm, or fertilized egg, has already divided into two cells. After more cell division the blastoderm is divided into two different layers: the ectoderm and the entoderm. The ectoderm will form the skin, feathers, beak, claws, nervous system, lens and retina of the eyes, lining of the mouth, and lining of the vent. The entoderm will become the lining of the digestive tract, respiratory tract, and other secondary organs. A third layer develops, called the mesoderm, and develops into the bones, muscles, blood, reproductive organs, and excretory system.

Once the egg has lost connection with the mother's body, the embryo continues to support itself with membranes that will help to utilize food material. These membranes are the allantois, amnion, yolk sac, and chorion. Each of these membranes serves a specific purpose for the developing embryo. Figure 4.4 is a diagram of these membranes in an embryo at approximately 10 days.

Figure 4.4 - Chick Embryo



The allantois serves as the circulatory system. It absorbs oxygen through the pores in the shell and oxygenates the blood and removes carbon dioxide. The allantois also removes wastes from the kidneys, aids in digestion of albumen, and absorbs calcium from the eggshell.

The amnion is filled with amniotic fluid and serves to protect the embryo during development. The yolk sac surrounds the yolk and provides nourishment for the embryo to grow. The yolk sac is then drawn into the body cavity just before hatching and serves as temporary nutrition for the newly hatched chick.

The chorion fuses with the inner shell membrane and forms a protective layer around the allantois while it completes its metabolic functions.

Reproductive Differences of Poultry From Other Livestock

A primary difference in the reproductive process of poultry from that of other livestock is that it occurs more rapidly. For example, the length of time from fertilization to birth for cattle is 281 days; swine is 114 days. The average incubation period for chickens is 21 days and 28 days for turkeys.

Another significant difference is a large portion of the embryonic growth and development of poultry takes place outside the mother's body. The hen prepares the egg but it is expelled from the body in about 24 hours. After the egg is laid, the hen serves only as an incubator until the chick hatches. In other livestock, the entire reproductive process takes place inside the mother.

Poultry differs from other livestock in the parts of the reproductive system. A major difference in the male reproductive system is that the testes of the poultry are located within the body cavity along the backbone. The testes of other mammals are located in the scrotum, which hangs from the body. In the female reproductive system of poultry, only one of the two ovaries is functional, whereas both ovaries are functional in other mammals.

Summary

Reproduction of poultry is different from other livestock in many ways. Male reproductive parts are all located within the body cavity and consist of two testicles, the vas deferens, papillae, and vent. The

Introduction to Poultry Production

female reproductive system includes the ovary and the oviduct. The ovary produces the ova, or yolk. The oviduct, comprised of the infundibulum, magnum, isthmus, uterus, and vagina, develops the membranes that make up the rest of the egg.

The main parts of an egg are the yolk, albumen, shell, and membranes. These components work together to form the fully developed egg. An ovary that becomes fertilized develops into a chick. Embryonic development begins from the time of fertilization and terminates after 21 days when the chick hatches from the egg. The embryo is supported by the yolk sac, amnion, allantois, and chorion.

The major differences in the reproductive process of poultry from other livestock is the length of time the ovum develops into a mature egg and the development of the egg outside of the mother's body.

Credits

Ensminger, M.E., *Poultry Science*. 3rd ed. Danville, IL: Interstate Publishers, Inc., 1992.

Gillespie, James R., *Modern Livestock and Poultry Production*, 5th ed. Albany: Delmar Publishers. 1997.

Introduction to Animal Reproduction (Student Reference). Instructional Materials Laboratory, University of Missouri, Columbia. 1996.

Moreng, Robert E. and John S. Avens. *Poultry Science and Production*. Prospect Heights, IL: Waverly Press, Inc. 1991.

Lesson 5: Health Issues

Maintaining poultry flock health is important in the poultry industry. The greater the number of birds, the greater the risk of disease in the flock. Risks from viral and bacterial diseases and parasite infestation are ongoing problems. Through improved sanitation and medical technology, producers can maintain a healthy flock.

Maintaining a Healthy Poultry Flock

Good management of the poultry flock is very important in raising a healthy flock. A good preventive maintenance program reduces flock stress and prevents disease. The poultry flock should be checked daily for any signs of disease. Any changes in feed and water consumption could be a sign of a disease outbreak.

Strict sanitation guidelines should be followed. Housing and equipment must be thoroughly cleaned and disinfected between each new group of birds. Flocks used for different production purposes should be isolated from each other. It is advisable to bring all the birds onto the farm at once and remove them all at the same time. To avoid bringing in outside diseases, only the caretaker of the flock should enter the housing area. Clean overalls and disinfected footwear should be worn. Visitors should be kept to a minimum. Facilities should be free of parasites, lice, mites, and rodents.

Clean, fresh water should be available at all times. Feed should always be easily accessible and set up to reduce competition among the flock as much as possible. The feeders and waterers should be kept clean. Use adequate ventilation to reduce moisture and buildup of noxious gases. A vaccination program to reduce outbreaks of disease should be maintained. All dead birds should be removed immediately and disposed of by incineration, pit, and deep burial according to guidelines established by the United States Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources.

Prevention and Control of Common Viral Diseases

Viral diseases are microorganisms that require a living cell to survive and duplicate themselves to spread the virus. Viruses can be passed through contaminated equipment, food, clothing, in the air, or through other animals. A virus can easily enter an animal's system through the openings in the body, i.e., eyes, mouth, vent, skin, nose, or through the pores of an egg. Viruses are extremely resistant to sanitation products, which make them even more difficult to control and prevent. Antibiotics cannot kill a virus.

Common Viral Diseases in Poultry

Marek's Disease, also referred to as range paralysis or acute leukosis, affects many different birds but is very common in chickens. The virus is concentrated in the feather follicles and is shed in the dander (sloughed skin and feather cells.) Internal lesions cause massive internal tumors and can result in sudden death. Other symptoms include significant weight loss, diarrhea, and paralysis in the legs, wings, and neck. Most birds are affected between the ages of 6 to 16 weeks. This disease is found all over the world and once it is transmitted there is no treatment. To prevent the onset of Marek's disease, day-old chicks should be vaccinated at the hatchery.

Newcastle disease affects several species of birds, including turkeys and chickens. It is highly contagious and can infect the whole flock within three to four days. Symptoms in young birds include respiratory problems, such as difficulty breathing, sneezing, and gasping. This may be followed by nervous disorders, such as paralysis and tremors. In adult chickens, the respiratory problems are more evident. They may also show a reduction in egg production and shell quality decreases. Symptoms in turkeys are usually mild and may be unnoticed unless nervous disorders develop. There is no treatment for Newcastle disease but vaccination is a successful treatment.

Avian influenza affects the respiratory and nervous systems of both turkeys and chickens. Major symptoms include coughing, wheezing, and gasping for

Introduction to Poultry Production

air. Diarrhea and nervous problems may also suggest avian influenza. Laying hens may produce significantly fewer eggs or misshapen eggs. The death rate is low. There is no vaccine, but the use of antibiotics may help reduce secondary infection. Good management helps in prevention.

Fowl pox affects chickens, turkeys, and other birds. The infection is spread slowly by mosquitos and direct and indirect contact among the fowl. Symptoms include scabbing around the featherless parts of the body, such as the comb, wattles, ear lobes, and eyes. Yellow sores may also be found in the mouth and respiratory tract. Affected younger birds will grow slowly and layer hens produce fewer eggs. There is no treatment, but the disease can be prevented by vaccination.

Infectious bronchitis only affects chickens and is considered the most contagious of poultry diseases. It is spread through the air and through contact with clothing, crates, and equipment. Symptoms are confined to the respiratory system and include difficulty breathing, gasping, sneezing, and watery nasal discharge. Death rates of young chicks less than three weeks of age are high. Laying hens may have a dramatic drop in egg production and lay soft-shelled eggs. It is important to vaccinate laying hens. There is no effective treatment for this disease. Ideal environmental conditions are helpful.

Laryngotracheitis mainly affects older chickens. Symptoms include coughing, sneezing, gasping, and weepy eyes. The death rate is high. Laying hens have a reduction in egg production and soft-shelled eggs. Vaccination is available for prevention. No drug treatment is effective.

Prevention and Control of Common Bacterial Diseases

Bacterial diseases are caused by single-celled, microscopic organisms. Bacteria require certain environmental temperatures, moisture, and nutrition to multiply. Some bacteria are necessary for proper food digestion. Bacterial diseases that are detrimental to animal health need to be isolated to reduce transmission. Bacteria are easily transmitted through

the air, contaminated feed, clothing, equipment, soil, and other diseased animals. Bacterial vaccines are used to prevent hazardous bacteria from multiplying. An immunity to the vaccine may develop so effective measures to maintain a sanitary environment must be developed.

Common Bacterial Diseases in Poultry

Pullorum disease affects both chickens and turkeys but other fowl can be infected. A hen passes the bacteria to her chicks via the egg and then can be spread by contaminated chicks from one to another in the hatchery. Most outbreaks occur in chicks less than three weeks old. Infection in young birds results in ruffled feathers, labored breathing, a chilled appearance with birds huddling together for warmth, and white diarrhea. The disease results in high losses in production due to death of chicks and the survivors can contaminate unaffected birds. The best prevention has been to do blood tests of the breeder flocks and cull the birds that carry the bacteria. Treatment of the disease includes administering many different types of antibiotics and maintaining sanitary facilities.

Colibacillosis (coliform infections) is caused by strains of the *Escherichia coli* (*E. coli*) organism. *E. coli* is common in intestinal tracts and feces of poultry and is a common organism in the birds' environment. Infections range in severity from mild to severe and can result in respiratory disease, blood disease, intestinal infection, or a combination of any or all conditions. Common symptoms include fever, ruffled feathers, diarrhea, and labored breathing. In severe cases, death may occur suddenly and spread through the flock quickly. Infected birds need to be isolated quickly. Sanitation and management practices that reduce organisms in the birds' environment are necessary.

Fowl cholera is the most hazardous infectious disease of turkeys but also infects chickens and many other birds. The organism enters tissues of the mouth and upper respiratory tract. It is not transmitted through the egg. Animals other than birds can be carriers of the disease. Symptoms of the disease include loss of appetite, rapid weight loss, lameness, swollen wattles, difficult breathing, yellowish or green diarrhea, and

development of a purple-colored comb. Medicine exists to lessen the disease but it is not always successful and the birds continue to be carriers of the disease. A rigid sanitation program must be followed to aid in the prevention of the disease.

Infectious coryza (roup) is a respiratory disease that affects many older chickens. Outbreaks usually occur from the introduction of infected or carrier birds into a flock. Once a flock is infected, all birds must be considered carriers. Symptoms include a swollen face around the eyes and wattles, nasal discharge, and sneezing. The disease results in decreased feed and water consumption and egg production is reduced. Antibiotics are helpful for treating the symptoms but the best way to combat the disease is to cull all carriers in the flock. Good management and sanitation with thorough cleaning and disinfecting will eliminate the disease.

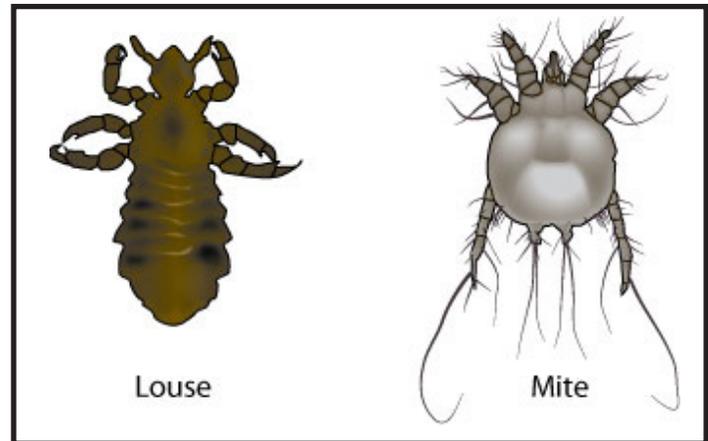
Prevention and Control of Common Parasites

A variety of internal and external parasites cause disease in poultry. Parasites are multicellular organisms that feed off another organism or host. They can be internal or external. Parasites are easily transmitted through contaminated feed, equipment, clothing, and other animals. They consume the nutrients needed to maintain health from the host animal and may eventually cause death. They can survive without a host for a long time and can flourish in hot and humid conditions or cold and dry conditions.

External parasites cause stress to the birds and can cause weight loss and reduce egg production. This results in lower quality and market value. In severe cases, high mortality rates can occur in young poults. The most serious categories of external parasites are lice and mites. Lice (plural for louse) are flat, wingless, fast-moving insects that bite or suck their host. Symptoms are frequent picking, pale head and legs, and loss of weight. Mites are blood-sucking insects that transmit diseases and cause scabbing. Symptoms include reduced egg production, slow growth, damaged feathers, and even death. Prevention of mites and lice

includes periodically inspecting the birds for any signs of external parasites. Effective treatment is administered via dusts and sprays.

Figure 5.1 - Louse and Mite (magnified)



The most common type of internal parasite is intestinal worms that primarily affect birds raised on the range. Worms come in many varieties such as the tapeworm, large roundworm, and gapeworm. They live in the intestines and linings of the bird and cause slow growth and lower production. Treatments for worms are available for each specific type of worm. The flock should be checked periodically for the presence of worms. Rotating flocks raised on the range and maintaining a strict sanitary environment is the best prevention for worms.

Importance of Biosecurity

Biosecurity is a practice designed to prevent the introduction of diseases or parasites into the poultry production operation. This practice will reduce the risk of outside sources of biological organisms, such as viruses, bacteria, and parasites from contaminating the flock. Biosecurity has three major components: isolation, traffic control, and sanitation.

Isolation is the practice of controlling the environment by separating birds by age group. An all-in, all-out system is when a producer brings in all of the birds at the same time and at the same age. The producer then markets the birds at the same time and thoroughly cleans, sanitizes, and prepares the facilities for the incoming flock. Isolation practices also keep out unwanted animals that can carry disease organisms.

Introduction to Poultry Production

Traffic control includes both the traffic on the farm and the traffic patterns within the farm. Only authorized personnel should be allowed in or around the production facilities. Vehicle traffic should be kept to a minimum with necessary vehicles cleaned and sanitized before entering the premises.

Sanitation involves the disinfection of materials and equipment entering the farm and the cleanliness of personnel on the farm. For example, employees should shower on their way in and on their way out when moving from one unit to another, wear special clothing to cover skin and hair, or step in detergents that kill microorganisms when entering and exiting rooms within the unit.

Summary

To maintain a healthy poultry flock, a good preventive maintenance program must be carried out to reduce flock stress and prevent disease. Proper sanitation and clean, fresh food and water are important to maintain flock health.

Common viral diseases include Marek's disease, Newcastle disease, avian influenza, fowl pox, infectious bronchitis, and laryngotracheitis. Common bacterial diseases include pullorum disease, colibacillosis, fowl cholera, and infectious coryza. Many viral and bacterial diseases can be controlled with vaccines. Good sanitation and disinfection are the best ways to reduce poultry diseases.

External parasites, such as lice and mites, and internal parasites, such as worms, are easily transmitted. The flock needs to be checked periodically for any infestations of parasites and treated accordingly.

Biosecurity will reduce the risk of outside sources from contaminating the flock with viruses, bacteria, and parasites. Important components to observe in biosecurity are isolation, traffic control, and sanitation.

Credits

Bacterial Diseases. (1997). 18 May 1999. Cooperative Extension Service. Mississippi State University. <<http://www.msstate.edu/dept/poultry/disbact.htm>>.

Ensminger, M.E. *Poultry Science*. 3rd ed. Danville, IL: Interstate Publishers, 1992.

Gillespie, James R., *Animal Science*. Albany: Delmar Publishers, 1998.

Jeffrey, Joan S., DVM. *Biosecurity for Exotic Fowl*. (1999). 18 May 1999. Texas Agricultural Extension Service. The Texas A&M University System. <<http://gallus.tamu.edu/ratite/biosecur.html>>.

Biosecurity of Poultry Facilities. (1998). 18 May 1999. Texas Agricultural Extension Service. The Texas A&M University System. <<http://gallus.tamu.edu/biofac.html>>.

Viral Diseases. (1997). 18 May 1999. Cooperative Extension Service. Mississippi State University. <<http://www.msstate.edu/dept/poultry/disviral.htm>>.

Lesson 6: Processing and Marketing

Processing and marketing poultry and poultry products has changed dramatically. Poultry meat and egg processing are very specialized systems with strict procedures and sanitation requirements to ensure quality. By adding value to its products and creating new marketing strategies, the poultry industry has become strong and efficient.

Poultry Meat Processing

In preparation for processing poultry, food (but not water) is removed from the poultry house 8 to 10 hours before taking the birds to the processing plant. Preventing birds from eating before slaughter reduces the amount of food in the intestine. Food in the intestine can cause contamination of the carcass during evisceration. Evisceration is the removal of the intestines, lungs, heart, and other internal organs.

When birds enter the processing plant, they are stunned, bled, scalded, picked, eviscerated, chilled, graded, packaged, and labeled.

- Stunning means to electrically shock the birds to render them unconscious.
- Bleeding allows the blood to drain completely. If the bird is not fully bled, the carcass will have an obvious red color that renders it unsuitable for human consumption.
- Scalding involves submerging the carcass into hot water for 1.5 to 2 minutes. This relaxes the muscles that hold the feathers, making it easier to remove the plumage (feathers).
- Picking is removing the feathers from the bird. This is done by a machine that has rotating rubber fingers that pull off the feathers. Any feathers that are left pass by a large flame for removal by scorching. The birds are then rinsed with water to remove any foreign matter, blood, or feathers that may be sticking to the carcass.
- Evisceration removes the organs of the abdominal cavity, lungs, and heart from the carcass. The feet, head, and oil gland are also removed at this time.
- The carcass is rapidly chilled in ice water, graded, packaged, and labeled.

The poultry may be either marked as ice-packed, dry chill-packed, or vacuum-packed frozen. Ice-packing involves setting processed poultry into waxed boxes filled with crushed ice or CO₂ (Dry Ice). Dry chill-packed poultry is placed on a small tray with absorbent paper, wrapped in a plastic wrap, then passed through a blast freezer that does not freeze the meat but chills it. Vacuum-packed frozen poultry is wrapped in plastic bags, and then frozen in the blast freezer. It remains frozen until the consumer thaws the product for cooking.

Further Processing/Added Value

The poultry industry has added value to its products by subscribing to the United States Department of Agriculture (USDA) grading system and by further processing the poultry products. By following the USDA poultry grading system, top-grade meat can be sold at a higher price than nongraded meat. By further processing meats, the industry increases sales and offers added convenience to the consumer.

The industry offers the consumer a variety of poultry items that are easy to prepare. Only a small percentage of broilers are sold as whole carcasses. Most are sold as cut-up parts, cooked, or further processed. Such products include breast fillets, nuggets, hot dogs, cold cuts, ground meat, sausages, frozen dinners, and low-fat/low-calorie items. As the consumer is resorting to fast-food restaurants for quick meals, the poultry industry has provided these markets with cost-efficient food products.

Sanitation and Inspection

To give the public a healthy and safe product, the poultry industry is responsible for maintaining strict sanitation regulations as set by the government. Only producers who follow the USDA grading system and pass strict regulations and quality standards for facility and carcass sanitation may bear the quality symbol of the USDA (see Figure 6.1).

USDA inspectors make inspections of live birds. They are trained to recognize birds that show symptoms of disease or other problems that would make the birds

Introduction to Poultry Production

unsuitable for human consumption. After slaughter, inspections of bird carcasses are performed. Inspectors are trained to look for unusual body conditions that would make the carcass unfit for human consumption. The carcasses are then graded by trained USDA graders. Inspectors also monitor the facilities, employees, plant grounds, and equipment to be sure all meet the strict sanitation standards.

Figure 6.1 - USDA Symbol



Since 1996, legislation requires meat processing plants for all livestock to do routine scientific testing for hazardous bacteria. This is the strictest food safety plan in the history of the meat and poultry industry. The food safety plan, called Hazard Analysis and Critical Control Points (HACCP), is a self-inspection process that focuses on the flow of potentially hazardous foods and how they are handled throughout the operation. The HACCP plan requires:

- Every plant must adopt a plan to deal with specific and potential hazards of the product. The plan will be kept in check by USDA inspectors from the Food Safety and Inspection Service.
- Every slaughter facility must have regular carcass testing for *E. coli* bacteria.
- All plants that produce ground meat products must have routine testing for Salmonella.
- Every plant must write out and perform a sanitation Standard Operation Procedure (SOP) for meeting sanitation responsibilities.

Egg Processing

Eggs require very little processing since they are naturally a prepackaged food. However, to ensure product safety and quality, there are a few procedures a production facility must follow. The eggs are washed in large commercial egg washers to remove any manure or foreign matter stuck to the shell. It is important that eggs are washed in water that is warmer than the eggs themselves. If they are washed in water that is cooler than the egg, the inside will shrink slightly and create a vacuum. The egg would absorb bacteria from the dirty water through its pores and may contaminate the egg. After being washed, the eggs are air-dried.

When eggs are washed, the protective cuticle, or bloom, is removed. The eggs are oiled with a paraffin-based mineral oil to replace the washed away protective layer. A process called candling is then performed. Candle means to examine an egg in front of a light to observe internal characteristics to determine if the egg is edible or hatchable. The characteristics to look for are the air cell size, yolk shadow position, presence of blood or meat spots, and presence or lack of germ development. The eggs are then culled, removing unsuitable eggs. Eggs are refrigerated and then weighed, graded, and packaged for retail.

Egg Marketing

The egg industry has added value to its product by wise marketing and the use of further processing. Fresh and frozen egg products, such as fried or scrambled eggs, crepes, omelets, souffles, quiche, and French toast offer the consumer more convenience. Also, the egg industry provides many fast food restaurants with egg products for breakfast foods.

Marketing strategies have also been effective in the egg market. For example, the American Egg Board has invested in advertising campaigns. This organization promotes the versatility and nutritional benefits of the egg by providing the public with recipes and information. The egg industry also ensures quality by egg grading. Many producers strive for and follow USDA standards because they can sell an egg with the USDA grade symbol at a higher price.

Summary

Major steps in processing poultry include stunning, bleeding, scalding, picking, eviscerating, chilling, candling, grading, packaging and labeling. The industry poultry has added value to its products by further processing meats and eggs into convenient products for the consumer. Processing facilities have strict sanitation requirements and are subject to the HACCP plan that calls for scientific testing for harmful bacteria. Major steps in egg processing include collecting, washing, oiling, and packaging. Eggs are marketed by the American Egg Board with creative advertisements to promote the versatility and nutritional benefits of eggs.

Credits

Ensminger, M.E., *Poultry Science*. 3rd ed. Danville, IL: Interstate Publishers, 1992.

Field, Thomas G. and Robert E. Taylor. *Scientific Farm Animal Production*. 6th ed. Upper Saddle River, N.J.: Prentice Hall, 1998.

Gillespie, James R. *Animal Science*. Albany: Delmar Publishing, 1998.

Gillespie, James R. *Modern Livestock and Poultry Production*. 5th ed. Albany: Delmar Publishing, 1997.

Moreng, Robert E. and John S. Avens. *Poultry Science and Production*. Prospect Heights, IL: Waverly Press, Inc., 1991.

Introduction to Poultry Production
