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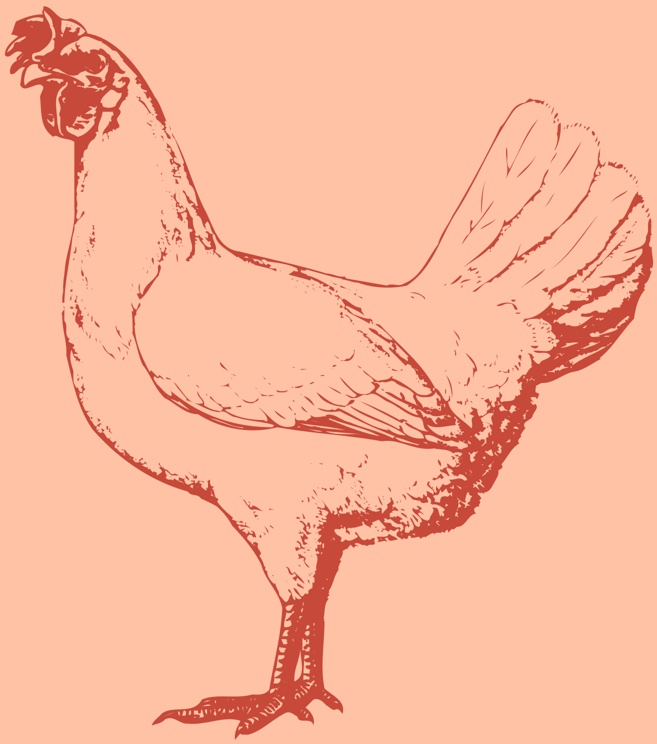

EGG-TYPE LAYER FLOCK

CARE PRACTICES

California Poultry Workgroup
University of California ◆ Cooperative Extension

FOREWORD

"Egg-type Layer Flock Care Practices" is one of a series of University of California publications addressing the issue of animal care relating to food production in California. This publication is a joint effort of the Poultry Workgroup, Cooperative Extension, and industry representatives.

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ACKNOWLEDGMENTS

The authors would like to thank the following members of the poultry industry for their assistance in reviewing this publication:

Ms. Jill Bensen, Cal Eggs, Salida, California
Dr. Gregg Cutler, Consulting Veterinarian, Moorpark, California
Mr. Gene Gregory, United Egg Producers, Atlanta, Georgia
Dr. William Jasper, United Egg Producers, Tehachapi, California
Mr. Dale Long, Embly Ranches (producer), El Cajon, California

Published by the University of California, Davis; Second Edition, May 1998.

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INTRODUCTION

Egg-type layers are defined as chickens maintained for the production of table eggs. Eggs may be produced for human consumption in the shell form (sold in cartons) or may be broken out of the shell for use in the production of liquid, frozen or dehydrated products.

It is estimated that California has 200 commercial egg production farms and another 40 farms devoted to the rearing of replacements for the table egg industry. The egg production farms maintain approximately 25 million layers (1998) or an average of 125,000 hens per site.

The commercial table egg industry in California produces between $300 and $400 million in gross receipts each year - depending upon the price of eggs. In 1996, table eggs were listed as the 15th leading agricultural commodity in California. California now (1998) ranks as the number two table egg state in the U.S. (behind Ohio) with approximately 10% of the nation's flock. Egg production in 1998 is estimated to provide California consumers with 90% of their need for table eggs. The remainder are imported from other regions of the U.S., particularly from the Midwest.

Poultry require constant care and attention. This care should be performed by experienced personnel. Novices who wish to raise poultry should obtain detailed information on proper care before chicks are obtained. Help and information is available from the University of California Cooperative Extension, experienced industry representatives, and through many books and publications.

MANAGEMENT PRACTICES

Producers utilize many management practices which may affect the flock's performance, profitability or welfare. In general, concern with a flock's welfare will economically reward the owner. Flocks which are mistreated rarely perform to the standards of the industry and therefore such practices tend to lower profits and increase costs. Care must be taken not to prejudge practices which may outwardly appear to be harmful to the flock's welfare. Many such practices are used because they have been shown through research to be of overall benefit to the flock's productivity, livability, and welfare.

Genetics and Strain/Breed Selection

The selection of the strain or breed of chickens for commercial egg production varies throughout the world because of consumer demands. Europe and the New England states are strong consumers of brown shelled eggs, thus the breeds used in these regions are almost exclusively brown shell varieties. On the other hand, the remainder of the U.S. and countries like Japan are consumers of white shelled eggs; therefore producers use the White Leghorn breed.

Within breeds, individual breeders have selected strains for certain performance characteristics which are desirable or in demand by the commercial egg industry. Strains may have unique performance characteristics such as egg numbers, egg weight, or livability. All three traits are obviously of extreme importance, but each breeder places different emphasis on what they consider important to customers and to the profitability of the birds.

Beak Trimming

Flocks may exhibit various vices such as feather pecking and cannibalism. Commercial egg producers commonly trim the beaks of growing pullets before such vices begin. Trimming may be done once at a very early age (first week of age) or twice (a second permanent trimming at 6 to 12 weeks of age). When done correctly, this provides a life-long reduction in the incidence of these problems and also reduces feed waste.

Beak trimming has very minimal effects on the young chicken when performed before six weeks of age. Later trimming tends to affect the birds by depressing feed consumption resulting in lower body weights during following weeks. Careful beak trimming assures desired results. This requires a detailed analysis of the technique to be used, constant monitoring of the crew to assure they are applying all the procedures precisely, and finally, an assessment of the control of cannibalism in the adult flock. To be successful, all parts of the procedure must be adhered to carefully. This includes the age of the flock, amount of beak to remove, sharpness of the blade, temperature of blade, and angle of the cut. Departures from any of these may result in incorrect trimming and less-than-desirable performance in the laying house.

Moving Programs

Most flocks are moved as day old chicks to a rearing farm and subsequently once or twice before they are finally in the layer house. Moving has always been considered to be stressful to a flock. The degree of stress is dependent upon many factors including age of the flock, concurrent stressors, moving distances, similarity between before and after conditions, environmental factors during the move, and the experience and care exercised by the moving crew.

The moving of day-old chicks often involves shipment over distances of several hundred miles requiring a day or more. It is essential that such shipments be made in temperature controlled trucks equipped with a high quality air circulation system. Delays should be avoided, loading done quickly in temperature controlled facilities, and prompt unloading to assure that the chicks receive water and feed as quickly as possible.

Moving of ready-to-lay pullets should be done before first egg production commences in order to minimize the damage to the more precocious birds coming into lay. Special care should be taken when removing birds from cages, placing them into moving racks or cages, unloading from the traveling containers, and placement into layer cages. The crew needs to be carefully trained in the proper procedures for catching and removing the birds from cages. Depending upon the cage door size, the fewer birds removed at one time, the less chance for injury.

Moving should also include the proper preparation of the new facilities to receive the birds. Feed should be fresh and deep in the trough. Water should be readily available and preferably from the same system used during the growing period. Many producers choose to fill water cups immediately prior to arrival of the new pullets in order to attract them to the water source.

Recycling Layers

Traditionally, layers are kept through one year of egg production and sold for meat at 18 to 20 months of age. By this time, egg production rates are commonly in the mid 60% range and egg interior and shell quality become very marginal. This practice of selling a flock after one cycle of lay is economically justified during high egg price periods, when replacement pullet costs are low and mature hen prices are high. Lower profit margins dictate a second look at the question of optimum selling age. Many producers have found it more economical to recycle their flocks into a second or even a third cycle of lay. Egg production improves after a rest of 3 to 4 weeks, egg quality returns to a much higher level and the flock's life is extended from 6 to 12 additional months.

Flock recycling is accomplished by stopping the flock's egg production, providing it with a suitable rest and bringing it back into production beginning about 4 to 5 weeks after the initiation of the program. Many systems to accomplish this have been used, but most involve reduced day length and some form of nutrient restriction or fasting. In order to achieve the best results, flocks are generally fasted for seven or more days without removing water. Careful monitoring of the flock's condition is required to assure that body weight and mortality losses do not exceed breeder guidelines. Following the fast, a low calcium-low protein diet is fed to cause the flock to remain out of production during the desired period of time (usually 2 to 4 weeks). After the rest, the flock is returned to a normal lighting program and nutritionally balanced diets which support egg production. Egg production resumes in a few days.

Lighting Programs

Since many of the inherent chicken responses common to wild birds have been bred out of the domestic chicken, responses to lighting programs are far less pronounced than in the past. Seasonal influences on performance are less noticeable and only small differences are noted between lighting programs of widely divergent descriptions. Nevertheless, all commercial producers use lighting programs. Replacement pullets are commonly reared on constant day length programs in environmentally controlled housing, or on decreasing day length patterns in open-type rearing houses. Pullet growers avoid patterns of increasing day length common to the spring months to prevent early sexual stimulation of the flock into egg production. Early sexual maturity can result in an increase in prolapse of the oviduct which commonly results in death.

Laying flocks are usually boosted to at least 13 hours of light when egg production is desired with additional weekly increases of 15 to 30 minutes until a maximum of about 16 hours of total day length is reached. Light intensity is an important part of a lighting program with 0.5 foot-candles considered ideal for rearing pullets and 0.5 to 1 foot-candles recommended for layers. Decreasing light intensity or duration is considered to be detrimental to high sustained egg production rates and should be avoided.

Records and Flock Monitoring

In order to follow the progress of a flock, numerous records are kept by the poultry producer. Such records involve documentation of daily events (temperature, eggs produced, mortality, feed consumption, etc.), periodic sampling of conditions or performance (vaccination dates, body weights, egg weights, etc.), and flock summaries over extended periods (costs, profitability, total performance, etc.).

Additionally, many producers routinely graph many of these measurements to gain a better perspective of their flock's progress.

Progressive producers are now monitoring their houses and flocks electronically with sensing devices and computers. Sub-optimum performance of systems or flocks is immediately noted and corrections are implemented automatically or following the notification of management. House sensors are able to monitor temperature patterns within the house and to adjust ventilation rates of air inlet openings to correct problems. Feed consumption is monitored daily and nutrient intake is compared to requirements on a daily basis. Feed formulas are adjusted to compensate for variations in feed consumption rates, costs of ingredients, ingredient composition, or changing requirements.

ENVIRONMENT

Housing

The principal requirement for housing is to protect the flock from inclement weather conditions including rain, wind, and temperature extremes. Additionally, housing allows closer supervision of flocks, protection from natural predators, and the concentration of poultry populations to allow improved feeding, health promotion and management programs. As a result, chronic health problems are minimized, mortality rates are decreased, productivity is increased and flock profitability is greater. The flock benefits from an optimum environment, the producer benefits from improved returns, and the consumer benefits from improved egg quality and lower prices.

Housing requirements differ with environmental conditions and the desires of the operator. To protect the flock from rain and snow, the house must provide "shelter" and this requires a roof. Roofs should be designed with ample overhang so that rain will not be driven into the interior of the building. Long overhangs are also helpful to keep early morning or late afternoon sunlight from entering the building. Direct sunlight, when temperatures are high, may be life threatening to birds. High light intensities are also conducive to pecking problems.

Roofs are generally made of steel or aluminum and are designed to reflect away the hot summer sun rays. Insulation under the roof is commonly provided to minimize radiant heat reaching the birds from the hot roof and to conserve the in-house temperatures in the winter months. Some producers choose to build their houses with an attic and a flat ceiling, while others may retain an open ceiling to the roof. Variations in design of roofs, as well as of the entire building, result from the use of different building materials, size of house, support requirements for interior equipment and ventilation systems.

Floors are commonly constructed with concrete to facilitate waste removal, accommodate equipment for servicing and moving birds, and enhance the producer's ability to sanitize the building for disease prevention programs. Some facilities use a daily or weekly waste removal program to reduce odor problems and house flies. For such programs to be successful, concrete floors are essential for complete removal of waste. Concrete walkways are also important for employee safety, and to minimize damage to the building and equipment when mechanized equipment is brought into the house to feed, move birds, or remove wastes.

Walls may be relatively open (to allow fresh air into the house), protected with adjustable curtains or totally enclosed for maximum control of environmental conditions. California's environment varies considerably from one poultry area to another and housing types adjust for these differences and the management style of producers.

Regardless of the system, the walls must protect the flocks from cold winter winds and hot summer conditions. For California egg producers, this means a minimum of a plastic curtain for wind protection. More elaborate facilities will include thermostatically controlled, automatic raising and lowering of curtains. A substantial number of houses utilize solid, insulated walls with thermostatically controlled mechanical ventilation for the ultimate in all-season control of environmental conditions.

In recent years there has been renewed interest in the "free range" method of keeping table egg-type poultry. In some European countries, the trend to this system is quite sizable and a significant number of eggs are sold as "free range eggs". Free range implies that the flock is allowed outdoors for at least a part of the day. Interpretation of the system varies from one facility to another. In many cases, the system merely provides outlets from the house to a small yard so birds can move around freely.

Equipment

Equipment for poultry is used for a wide variety of purposes and includes cages (for confinement), feeders, drinkers, brooders (for heat), egg gathering belts, scrapers and belts for waste removal, lights, ventilation and cooling systems, stand-by power, and other systems. Equipment must be effective in accomplishing its basic function, safe for the operator and not harmful to the birds. Care should be taken to avoid sharp metal edges which may injure the workers or the birds. Equipment should be designed so that birds will not get caught in cages or moving machinery. Doors to cages should be large enough to facilitate moving chickens in and out without injury to their legs or wings.

Cages - Cages have been the preferred way of housing table egg layers since the mid 1940's. Cage sizes and shapes vary and therefore their management varies to allow for different bird responses. Performance can be affected by different floor space allowances and access to feeders and waterers.

Cages became popular in response to the need for improved sanitation practices. Housing layers and replacement pullets in cages removed the bird from its own feces and eliminated many of the feces-related parasite and health problems, especially coccidiosis which has plagued the industry for centuries. As a result of caging, flock nutrition could be better addressed, wastes handled more effectively, and products (eggs) kept cleaner.

A 1991 survey of California farms indicated that nearly 100% of the layers were housed in cages; while nearly 38% of the replacement pullets were raised in cages from one day of age. Additionally, most of the remainder of the replacement pullets were placed in cages by at least 6 to 8 weeks of age.

Cages for replacement pullets are designed with flat bottoms and narrow wire spacings to provide support for the growing pullet while allowing ample space for wastes to fall through. Wire spacings are commonly 1 inch x 1 inch or 0.5 inch x 1 inch compared to the usual 1 inch x 2 inch used for layers. Paper is usually placed on the floor for the first week to give additional support for small chicks.

Because of the smaller size of the starting chick (0.12 pound) compared to the 18 week-old pullet (2.75 pounds), space allowances change over the course of the rearing program. Most producers choose to start their chicks at one day of age in one-half the space (or half of the available cages) and then to increase their space allowances at about four weeks of age. Allowances for the first four weeks are commonly about 25 square inches and for the remainder of the rearing period about 40 to 50 square inches. The allowances during the latter half of the rearing period depend upon the size of the chickens when moved (16, 18 or 20 weeks.) When replacement pullets are reared on litter, space allowances are usually in the range of 1 to 1.5 square feet per bird ranging up to 16 to 20 weeks of age. Wood shavings, chopped straw, rice hulls or other materials are commonly used to absorb moisture and to provide a comfortable material for the birds to rest upon.

Layer cages are designed with sloping floors to assist in the roll out of the egg for collection. The slope should be approximately 7.5 degrees; more or less than this will increase the amount of egg breakage. Steeper slopes are also thought to be less comfortable for the chickens. Floor wire spacings of 1 inch x 2 inches give ample support for layers and wastes do not accumulate inside the cage.

Cages for layers come in many sizes but most house from 3 to 10 birds per cage. Recent trends favor cages with 6 to 9 birds. The question of floor and feeder space requirements for caged laying hens has been the subject of extensive research for more than forty years. Recommendations and usage still differ throughout the industry, mostly due to economics. Other complicating factors include cage design, type of housing, and strain of bird used.

In general, more space (up to 72 square inches per bird) is associated with the highest egg production and lowest flock mortality. With good management and attention to light intensity, uniformity of flock, environmental conditions within the house, feed formulation, strain selection and excellent beak trimming techniques, space allowances of 50-60 square inches can give comparable results. In general, during periods of low egg prices or high feed costs more space per bird is usually more profitable.

Feeders - Feeding replacement pullets and layers in cages is commonly done with mechanical feed delivery systems inside a front-of-the-cage feed trough. Other methods include traveling hoppers and mobile feed carts. Young chicks (during their first week) are commonly hand-fed in their cages.

Feed delivery systems should be designed to allow complete access to the entire length of the trough adjacent to the cage with adequate space for all birds. It must be installed at the proper height (or be adjustable) for each class of chickens. Thus, in brood-grow cages, adjustments should be made for chicks from one day of age to pullets at 18 weeks of age. In general, at least 2 inches of feeder space is recommended for each growing pullet and 2.5 inches or more for each adult layer.

In addition to location and space allowances, the producer must also be concerned with the consistency of the feed delivered, the quantity available and the frequency of the feeding program. Feed is formulated to provide the average chicken with specific levels of nutrients relative to its stage of life or production level (e.g., layers). To assure that each chicken is being treated equally, it is imperative that the feeding system provide uniform feed to all points in the feeding system. Ample feed should be available throughout the day and all chickens, even the most timid, given ample opportunity to feed. Feeders which separate feed components should not be used as this results in an unbalanced diet. Proper feed depths must be maintained to assure that all nutrients are consumed and the build-up of moldy feed is minimized. Pullets raised on the floor are commonly fed from troughs equipped with mechanical feeders or from hanging pan-type feeders. In either case, at least 2 inches of feeder space per bird is recommended.

Waterers - Like feeding systems, waterers should be accessible, dependable without stoppage or leakage, and able to provide fresh, cool and clean water required for a healthy and productive flock. Proper installation includes consideration of the normal drinking position of chickens (at back level or higher), protection of the system from excessive heat which may inhibit the quantity of water consumed, and slope of the house which could result in unequal water pressures within the house and non-uniform water consumption patterns.

Nests - Egg production flocks maintained on the floor require nests. Most producers provide one nest for each 4 to 5 birds. Nests should be cleanable, convenient and of adequate size (12 inches x 12 inches). In addition, nests should be kept fairly dark to reduce egg eating and be closed at night to prevent birds from defecating in the nests.

Miscellaneous Equipment - Effective brooders (heaters) are capable of maintaining chick rearing areas at 85 to 90^{0}F in the coldest weather. In floor brooding systems, where multiple heaters are used, extra brooders and spare parts should be available during this very critical period and constant monitoring is required to assure uniform flock comfort and conditions for the first few weeks. Routine servicing of mechanical belts and manure scraping devices avoids costly shut-downs of very essential systems. Availability of extra parts and motors minimizes the period of shut-down. Eggs should be collected on time to avoid excessive breakage and manure removed on schedule to maintain proper air quality.

Commercial replacement pullets and layers require reliable artificial lighting systems. Such systems should be designed to provide uniform light intensities throughout the house. Clean and properly spaced lighting fixtures will provide all locations throughout the house with optimum light intensities. Insufficient intensity can reduce egg production rates; excessive intensities are expensive, and may result in higher levels of cannibalism and feather pecking.

Ventilation and cooling equipment selection is based upon the needs of the region and the equipment's ability to operate dependably at maximum capacities. The air delivery system should be designed to provide each portion of the house with comparable air volume, temperature and air quality. Constant monitoring of air quantity and quality is necessary. Short air routes are more desirable than longer pathways. Frequent well-spaced inlets and outlets are required to maintain uniform air conditions. Uniform low volume air delivery for winter conditions is a special problem and deserves careful consideration when designing new poultry houses.

Cooling systems commonly used in the egg industry include foggers (misters), and pad and fan evaporative cooling for environ- mentally controlled houses. Both systems are effective in lowering maximum temperatures by 10 to 20^{0}F or more depending upon the system design and weather conditions. To be effective, these systems must be carefully restored to optimum operating conditions prior to the first heat spell and then continuously maintained to assure their operation at maximum efficiencies.

Stand-by generators with alarm systems are a "must" in highly mechanized table egg houses. Such systems should be large enough to supply emergency power for lighting, watering birds, ventilation, feeding, egg collection and manure removal. Alarms indicate power interruption and extreme temperature situations. Alarms may include both high intensity sound as well as telephone calling systems.

Waste Management

Manure is a natural by-product of any poultry operation. Poultry manure can be a valuable component of a well integrated agricultural operation. When properly handled, manure may be used as an excellent soil amendment which generates additional revenue to the poultry producer. The method of manure management will vary with the type of operation under consideration.
In cage systems, the manure should not be allowed to accumulate to such an extent that the birds have access to it.
For floor type operations, the combined litter and manure must be kept in such a condition that it is neither too wet nor too dry. Wet litter can result in high ammonia levels and foot pad and leg problems. Excessively dry litter may lead to high levels of dust which are irritating to both birds and employees.

Manure may be collected in dry or wet forms on a daily, weekly or periodic interval based upon the system used. Mechanical scrapers, collection belts or mobile handling equipment are used to remove the wastes from the house. High-rise houses (two stories) may be used for longer term manure storage (periods of one year or more). Wet systems include wash-out houses into a pond and underground tank systems with frequent removal.

Manure management is just as important once the manure is removed from the house and stored. The producer should take the appropriate steps to insure that the stored manure does not result in any nuisances (run-off, odor, flies, etc.). Particular concern is the potential for polluted drainage from storage units or percolation into ground water. Care must be taken to assure that run-off does not enter streams, ponds, and/or cross property lines. If storage ponds are utilized, there also can be a problem of odor generation. Whatever the type of manure management, the operator must be well informed on local, state, and federal regulations and must be ever vigilant.

NUTRITION

The feeding of replacement pullets and layers is a finely tuned, science based program. Recommend- ations are well-researched resulting in rations which meet the flock's daily nutrient requirements for optimum growth and egg production at the least cost.

Poultry are fed diets comprised primarily of grain, protein supplements (e.g. soybean meal), minerals, vitamins and fat. Byproduct ingredients such as wheat bran, bakery byproduct meal, meat meal or dried brewers grains, are sometimes used when they are cost effective. Approved growth promoters (e.g. bacitracin) and coccidiostats may be added to feed in small amounts. Mold inhibitors are often added to prevent development of mycotoxins which are harmful to poultry. Hormones are not approved for poultry and are never included in the feed or water of commercial poultry.

Most commercial pullet growers carefully monitor their flock's growth progress on charts provided by the breeder to assure the success of the resulting layer flock. Likewise, egg producers monitor their flock's performance with dozens of measurements to compare both performance and nutrient intake to the models established by the breeder for optimum flock performance and welfare. The producer is vitally concerned that the flock receive a properly balanced feed to assure that the flock's performance will be optimized and higher economic returns will be realized.

Basically, the objectives of a feeding program are to provide the flock with all required nutrients (not feedstuffs) to satisfy the flock's physiological needs each day. To implement this objective, information is required concerning flock requirements (based upon age and productivity), nutrient availability of feed components, uniformity of feed consumption and feed intake. The farm must also have a system for delivering uniform, well-formulated palatable diets to all birds.

Economic feed formulation and feeding take into account cost differences between ingredients, reliability of the ingredient in supplying required nutrients, and management systems which may affect the usage of the feed such as optimum temperature, uniformity of temperature, and air quality.

Nutrient requirements are affected by the age and productive status of the flock. Young pullets in the growing stages require much lower levels of calcium than laying hens because of the calcium required for egg shells. The production of large numbers of marketable eggs requires careful formulation to assure adequate levels of amino acids, minerals, vitamins, and energy.

HEALTH MAINTENANCE PROGRAMS

The scientific definition of health in an animal is the "absence of disease". Bacteria-free chickens in isolation under laboratory conditions grow approximately 15% faster than similar chickens in a "conventional" environment. This ideal is economically impossible to achieve commercially. The use of immunization, sanitation, preventive medicine and biosecurity are recommended as the major preventatives for infectious disease, with only occasional alternatives such as therapeutic medication.

Immunization

The planned deliberate induction of immunity by vaccination is one of the most beneficial and effective management tools available for the prevention or suppression of infectious disease (as compared to the natural induction following unpredictable exposure to field infection). Numerous infections, sometimes in combination, can kill or debilitate susceptible poultry causing pain and suffering in addition to losses in performance.

Immunity is of two broad types: passive or active. Passive immunity occurs as antibody in the yolk of developing embryos; it is derived from the maternal bloodstream and is present until metabolized (for 2-4 weeks) in the blood of newly hatched chicks. The presence and level of passive immunity in the chick is therefore dependent on the presence and level of antibody in the maternal parent. Some vaccination programs are aimed at producing high levels of passive immunity in chicks, e.g., for avian encephalomyelitis and infectious bursal disease. Passive immunity is generally effective against viral diseases, but less so or ineffective against bacterial infections, e.g., mycoplasmas or salmonellae.

Active immunity occurs when an antigen is introduced to the bird and processed through the bird's immune system, resulting in various protective responses. These responses include antibody production and/or cellular immunity which will act to protect the bird if it is re-exposed to that antigen.

Active immunity can be produced either by living or inactivated antigens, or a combination of the two. Most living bacterial and viral antigens are either naturally occurring strains of low pathogenicity (mild), or pathogenic strains whose virulence has been reduced by passage in laboratory media (attenuated). Live vaccines can be administered either to individual birds, such as by injection or eyedrop, or to large numbers of birds via the drinking water or by aerosol. Building up a high level of immunity often requires a second or third administration of vaccine, usually with a stronger vaccine strain on each occasion. Inactivated vaccines must be given by injection. These usually incorporate potent adjuvants which enhance the local cellular reaction and, therefore, increase the immune response. Immunity against some infections can be induced by injection of vaccine into the egg shortly before hatching, so that active resistance is developing before any exposure can take place.

Development of Immunization Programs

The development of an immunization program should be based on knowledge of the diseases to which birds are likely to be exposed and incorporated into the management system of the flock. It requires knowledge of the presence and level of passive immunity so that immunization can be properly timed. Timing is also important so that vaccines do not detract from each other's responses or exacerbate their clinical effects. Vaccines should not be administered when other stressors are acting on the flock.

Vaccines should be purchased and utilized after full consultation with vaccine manufacturers. Where monitoring tests are available, e.g., serology, these should be routinely utilized to ensure that vaccine responses have taken place.

Limitations of Immunization

When a bird responds to an antigen it diverts energy from growth or production, so protective immunity does have a slight penalty. In addition, responses to antigens are influenced by genetic background and previous management, so qualitative and quantitative variations in resistance are found between immunized individuals in the same flock and between strains and breeds.

Finally, immunization must not be a substitute for proper sanitation and biosecurity. The borderline between clinical good health and disease is very narrow, and immunization programs may not totally protect birds which are stressed or in unhygienic conditions. Such deleterious conditions also reduce productivity because birds cannot prevent their responses to foreign antigens. Thus, animals constantly exposed to environmental diseases do not grow and produce as well as those in clean environments. Many multi-age production systems may be examples of this. It is particularly difficult to control infectious disease on multi-age farms since the sites are rarely depopulated. Live vaccines may travel between age groups and interfere with other vaccines or exacerbate disease.

Farm Security

Biosecurity is the utilization of methods which stop the transfer of infection into or between components of production systems. Major components include:

- allow only necessary visitors to production sites;

- restrict movement of workers and equipment between houses, sites and age groups

- provide sanitizing foot baths, showers and protective clothing at strategic locations;

- maintain cleaning and disinfection programs, especially in hatcheries;

- reduce microbial load on trucks and equipment by washing and disinfecting at critical times;

- locate production sites strategically in relation to other production sites and movement of poultry, thus minimizing transfer of disease;

- restrict contact of workers with other poultry, especially potential carriers of hazardous disease organisms;

- appropriately handle waste and dead birds to minimize the transfer of disease between sites;

- control rodents and wild birds effectively, both are potential disease vectors.

Cleaning and Disinfecting Houses and Equipment

When poultry are removed from houses, the buildings and equipment should be carefully cleaned and disinfected before new birds are introduced. Manure (including litter) should be removed from the immediate vicinity of the poultry houses, preferably to an off-site location.

A successful cleaning and disinfection protocol should include:

1. Removal of all litter and manure.

2. Thorough wash down of the interior of the house and all equipment, preferably using a high-pressure washer.

3. Application of a suitable disinfectant solution.

Careful attention should be given to watering devices and water lines to be sure that these are free of disease agents. Water lines should be flushed and then a disinfectant solution pumped into the lines. These lines are closed and allowed to rest for at least 24 hours, and then thoroughly flushed to remove the disinfectant.

Monitoring Mortality

Daily flock mortality records should be maintained and monitored. Mortality rates above breeder's standards should trigger an investigation to determine the probable cause. If the cause is not readily apparent, a sample of freshly dead birds should be examined by management, a qualified veterinarian, or at a diagnostic laboratory. Routine examination of a sample of daily mortality is recommended as a method of monitoring the causes.

Dead Bird Disposal

Successful methods of dead bird disposal must prevent spread of pathogens to surviving birds and should result in appropriate recycling of nutrients without contamination of surface or ground water. Several methods have been acceptable in commercial systems.

Rendering is a very acceptable method from an environmental standpoint, but may expose the farm to pathogens if proper precautions are not taken to restrict the transporting truck from the production houses. The rendering pick-up area must be kept neat and should be screened from public view. This system is flexible and can accommodate a sudden increase in mortality. Storage containers must be fly tight and pick up should be scheduled at least twice weekly.

Composting, if properly done, is a very acceptable method of carcass disposal and results in a valuable compost by-product which makes an excellent soil amendment. Composting should be done on a concrete pad to prevent leaching and under roof to prevent excessive wetting of the compost. The composting process must be managed to assure that an adequate temperature is achieved to destroy pathogens. The system is flexible and can handle a sudden increase in mortality.

Incinerators are effective from a disease control standpoint, but units must meet local air pollution standards. Incinerators are expensive to operate, require energy input and can not handle sudden increases in mortality. Proper disposal of the ash is necessary to avoid pollution problems.

Disposal pits or burial are environmentally acceptable in soils where movement of nitrogen into groundwater is not a problem. Unfortunately, determination of the suitability of a particular site for pit disposal or burial may cost as much as construction of a suitable composter, with no assurance of success. Pits work best with a constant load of mortality and do not handle sudden increases in mortality. Burial is very flexible, but may effect future use of the site.

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For more detailed recommendations, the following publications are excellent sources of information for specific subjects:

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"California Agriculture Statistical Review - 1996," 1997 California Dept. of Food and Agriculture.

"The Egg Industry of California and the USA in the 1990's: A Survey of Systems," D.D. Bell, 1993, World's Poultry Science Journal, Vol. 49, No. 1.

Management guidelines for various Leghorn strains

Bovans, 1471 Lane Creek Road
Bogart, GA 30622

DeKalb Poultry Research, Inc., 3100 Sycamore Rd
DeKalb, IL 60115

Euribrid, Inc., Hisex Division, P.O. Box 719
Troutman, NC 28166-0719

Hyline International, 2929 Westown Parkway
West Des Moines, IA 50265

ISA Babcock, P.O. Box 280
Ithaca, NY 14851-0280

Shaver Poultry Breeding Farms, Ltd. Box 400
Cambridge, Ontario, Canada N1R 5V9

GLOSSARY

Adjuvant Additives to vaccines to enhance their immunological effectiveness.

Antibody A protein molecule capable of combining specifically with an antigen.

Antigen A substance foreign to the host animal, commonly a disease agent or a vaccine which induces an immune response.

Attenuated Process used in vaccine production to modify organisms to induce immunity without causing disease.

Biosecurity A management system to minimize the pathogen exposure of flocks.

Brood-grow cage A cage used for chickens between 1 day of age and start of laying.

Composting A natural decomposition process for organic wastes.

Depopulation Removal of all animals from a premise.

Egg type Chickens that have been genetically selected to produce eggs for human consumption.

Endotoxins Toxins produced by bacteria.

High-rise A poultry house with cages on the second floor and manure storage on the first floor.

Immunity Resistance resulting from previous exposure to an infectious agent or antigen.

Layer A sexually mature female chicken.

Litter An absorbent bedding material for floor managed chickens.

Multi-age farm A farm with more than one age group of chickens.

Pad and fan An evaporative cooling system utilizing wetted pads and fans.

Producer Farmer who raises poultry for commercial purposes.

Prolapse A prolonged or permanent eversion of the terminal end of the reproductive tract with exposure of soft tissues.

Pullet A sexually immature female chicken (in this publication).

Rendering The conversion of carcasses to usable animal feed products by heating.

Replacements Immature females used to replace an older flock.

Serology Laboratory tests to determine pathogen exposure using blood serum.

Table egg Eggs for human consumption as opposed to hatching eggs.

Vector Carrier of a disease agent from one bird to another or even from one farm to another.

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