

Turkey Industry Strategies for Control of Respiratory and Enteric Diseases

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ABSTRACT Current strategies to control respiratory and enteric diseases of turkeys involve sanitation and biosecurity practices to prevent the introduction of infectious agents. In addition, proper husbandry and management practices reduce stress and help maintain a competent immune system. Industry-wide monitoring programs are used in conjunction with isolation,

depopulation, and orderly marketing to eliminate pathogens that cause serious economic loss. Vaccines are available and utilized against some pathogens. Effective drug treatment is available and used for some diseases but is most commonly used to control secondary disease losses when treatment is not available for the primary disease.

(*Key words:* disease, respiratory system, enteric system, turkeys, control strategies)

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GENERAL CONTROL STRATEGIES

A wide variety of viruses, bacteria, and protozoa have been documented as causing significant disease and economic losses in turkeys (Calnek *et al.*, 1997). For respiratory and enteric diseases, control and treatment have been described for the U.S. turkey industry (Poss, 1994; Calnek *et al.*, 1997). The following is a brief summary of control strategies utilized by the turkey industry for respiratory and enteric diseases.

Breeders

Prevention and control of respiratory and enteric disease starts with the basic (primary) breeder and continues through the multiplier breeder operation.

Mycoplasma gallisepticum has been eradicated from turkey breeders through the National Poultry Improvement Plan (NPIP) breeder candidate-testing program. In addition, the NPIP has helped to remove *Mycoplasma synoviae* and *Mycoplasma meleagridis* from the commercial turkey breeder industry. However, these two organisms still occur sporadically and are controlled in the progeny through dipping of eggs in antibiotic solutions.

Salmonella infections are a major cause of enteritis in poults and considerable effort is expended to reduce contamination of the day-old poult. The NPIP Program Sanitation Monitored Program is utilized in turkeys to minimize the transmission of salmonellae from infected

breeders through the eggshell to the poult. Management of egg sanitation and control of bacterial contamination on the farm includes cleaning and disinfecting (C&D) of buildings, use of clean nest material, frequent egg collection, and egg washing with quaternary ammonia and chlorine disinfecting solutions. Formaldehyde use has declined in the last few years, but is available for use if Occupational Safety and Health Administration (OSHA) safety guidelines are followed. The egg sanitation practices used to control salmonellae also help to control other eggshell-transmitted pathogens such as *Escherichia coli*.

Vaccines are routinely administered to prevent fowl cholera (FC), Newcastle Disease (ND), paramyxovirus Type 3 infections (PMV-3) and avian influenza (AI). *Salmonella* bacterins are utilized to reduce the shed of specific serotypes in many turkey operations.

Hatchery

Physical cleaning, washing, and disinfection is a high priority to control hatchery disseminated pathogens. Phenolic disinfectants are most commonly used and are administered by foggers in work areas. Microbiological monitoring is done to measure efficacy of C&D. Aspergillosis occurs in some areas of the country, mostly due to contamination of eggs in the nest using contaminated litter. Clinifarm,² smoke disinfection in the incubator has helped control microbial contaminants

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Abbreviation Key: AI = avian influenza; AMDUCA = Animal Medicinal Drug Use Clarification Act; C&D = cleaning and disinfecting; FC = fowl cholera; FSIS = Food Safety Inspection Service; ND = Newcastle disease; NPIP = National Poultry Improvement Plan; OSHA = Occupational Health and Safety Administration; PEMS = Poult Enteritis Mortality Syndrome; PMV-3 paramyxovirus Type 3; TCV = turkey corona virus.

when egg sanitation practices are inadequate. Injection of antibiotics, such as gentamycin or spentinomycin, in day-old poults is used to control eggshell-transmitted bacterial infections such as Arizonosis, paratyphoid, and *E. coli*. Antibiotic injection also helps to counter stress-related bacterial infections, which are common in the young poult.

Brooding

Flock depopulation (all-in, all-out schedule) and complete C&D of the housing environment are high priorities. A two-step process of washing first and then disinfecting after a period of drying is preferred in some operations to improve the kill of pathogens. Increased usage of concrete floors has improved efficiency of C&D. Phenolic and cresylic acid disinfectants are favored for dirt (soil substrate) floors. However, formaldehyde is available for use as long as OSHA safety precautions are followed. Environmental swabs for *Salmonella* are used to monitor the efficacy of C&D.

Ammonia control is a high priority in all turkey operations, but particularly in colder climates where thermostatic control of ventilation rate minimizes air exchange to maintain house temperature. Ammonia irritates the lining of the respiratory tract and increases susceptibility to disease-causing agents. Levels in the air as low as 10 ppm, which are not detectable by the human nose, have been shown to have negative health effects on young turkey poults. Ammonia is absorbed into the circulatory system and reduces the ability of monocytes to engulf and destroy bacteria in the blood stream. It significantly reduces the immunological response to *E. coli* infections, a primary contributor to respiratory disease.

The key to ammonia control is proper litter management. Control methods include removal of wet litter, mixing of old litter by rototilling and rebedding of litter, and management of heat, ventilation, humidity, and water fountains. Nipple water fountains have improved water sanitation, reduced water spillage, and improved litter management in broilers, but nipple drinkers have not been well accepted by the turkey industry. Turkey poults have a more difficult time getting adequate water if nipple drinkers are used. Pine shavings are the preferred litter material. In addition, a number of feed or litter additives for ammonia reduction are available and used in some operations such as saponin products and preparations that control pH (Ammonia Hold,³ and Poultry Litter Treatment⁴).

Colibacillosis, as a secondary disease, may be triggered by a number of primary diseases which must be controlled to prevent losses from colibacillosis. Coccidio-

sis, hemorrhagic enteritis, turkey coryza (*Bordetella avium*), and ND are considered to be the most common predisposing agents. All of these diseases cause immunosuppression, which can be compounded by ammonia in the environment. Vaccination or the use of a coccidiostat in the feed or water controls clinical coccidiosis. Turkey coryza is controlled through vaccination and sanitation of the environment and drinking water system. Continuous chlorination of drinking water is widely practiced, but shock chlorination or acid cleaning of the entire water delivery system between flocks can be very important. Hemorrhagic enteritis is controlled through vaccination at 3 to 5 wk of age. Other diseases can be involved in precipitating colibacillosis such as AI, *Ornithobacterium rhinotracheale* infections, and pneumovirus infections.

Darkling beetles and their larvae can be a source of most pathogens that cause disease in the turkey brooder environment. The beetles can carry pathogens with them when they move into the walls and floors of the building between flocks. Their infected larvae return to the building after the C&D is done. When feed and water are available, they emerge to infect the next flock. Control is important and various insecticides are available. Insecticides are used between each cycle in most operations and are often rotated to improve effectiveness and coverage. Some examples are organophosphate, carbamate, cyfluthrin, and borax compounds. Manure removal management is important and most operations are careful not to stockpile beetle-infested litter close to the brooder building, which may allow the insects to migrate back into the building.

Prophylactic medication in feed and water is used in many operations based on disease history, antibiotic sensitivity testing, and clinical efficacy. Growth-promoting antibiotics are commonly added to the feed and may help in reducing stress and improving resistance to early poult enteritis. Treatment to prevent early mortality and clinical disease is usually based on sensitivity testing and historical clinical efficacy. Competitive exclusion products, both defined and nondefined, are being approved for use. An example is Aviguard,⁵ which has been adopted recently into the routine production plan of some breeder operations.

Growing and Finishing

Growing and finishing buildings are usually not completely cleaned and disinfected between flocks except on an annual or as-need basis depending on disease history. Most operations do not feel complete depopulation and C&D is warranted. Physical cleaning with blowers and wash-down and disinfection is done in most operations to improve sanitation and to maintain safe and efficient ventilation and feeding equipment. Usually partial cleanout of litter is done to remove the heavier wet manure under the fountains and feeders. Rototilling is helpful to mix and compost the manure pack, which

³Ammonia Hold, Inc., Little Rock, AR 72201.

⁴Jones-Hamilton Co., Walbridge, OH 43465.

⁵Bayer Corp., Watkinsville, GA 30677.

stimulates heating and helps to pasteurize the litter pack. Later digging is important to dry and cool out the litter in order to reduce ammonia levels before the next flock is brought in. Skimming and rototilling at the same time with a "little keeper" is used successfully in some operations. Finally, a thin layer of new fresh litter is also recommended and may be spread on top or mixed in to provide a cleaner environment for the new flock.

Ammonia control may be enhanced with litter additives. Litter types used vary widely but are primarily wood shavings and hulls of rice or sunflowers. Pinewood shavings are preferred and carry the least risk of microbiological contamination. Peanut hulls, chopped straw, or hay are less popular due to the risk of contamination with *Aspergillus* spp.

Dust in confinement buildings can cause foreign body pneumonia and secondary airsacculitis from *Aspergillus fumigatus*. The dust is primarily generated from dry feces and carries high levels of fecal organisms that expose the respiratory system to endotoxins. The dust particles dry to a very light weight, along with some feather and skin dander, and are easily air borne. Farms with tom turkeys experience a marked change in litter conditions after the birds are 12 to 14 wk of age. Typically, the litter goes from being damp or wet and difficult to keep dry, to a very dry condition that is difficult to keep from being dusty. Dusty conditions are particularly evident in colder climates where very dry, cool outside air ventilates the buildings and removes an excessive amount of water. In warm climate areas during summer heat, turkeys experience an excessive intake of dust into their lungs and airsacs due to hyperventilation of moderately dusty air. Both conditions lead to respiratory disease and clinical signs of respiratory distress (gaspings). Birds with excessive exudate in their lungs and air sacs usually die, either on the farm or during transport. Survivors will contribute to airsacculitis condemnation and salvage procedures to trim affected air sacs in the processing plant. Sprinkling or fogging with water in turkey houses is a common practice and is used to cool birds in summer and control dust in northern areas in the winter.

Growers in cooler climates have found that lowering the building temperature, particularly after toms are 12 wk of age or so, reduces dust levels. The relative humidity rises as temperature drops and the dust particles become heavier and settle out of the air. Even though birds eat more for maintenance in colder temperature, these birds are healthier with lower mortality, faster gain per day and improved feed conversion and cost of production. It is not unusual for poultry workers to see their breath (water vapor) and the breath of the turkeys, in older tom flocks in northern areas during winter growout.

EMERGING AND RE-EMERGING DISEASES

Bluecomb disease caused by a turkey corona virus (TCV) was an endemic problem with high economic loss

in the Midwest during the 1960s. Treatment was primarily supportive and involved the use of milk powder, potassium chloride, and broad-spectrum antibiotics in the drinking water and a higher level of husbandry to make the birds comfortable and encourage feed intake. It was eradicated with a cooperative industry biosecurity and depopulation plan in 1975. The plan utilized voluntary monitoring, quarantine and orderly marketing. Recently, TCV has reappeared in several parts of the country.

Poult Enteritis Mortality Syndrome (PEMS) started in North Carolina during 1991 and has been causing severe losses. Depopulation has been a stop gap measure. Turkey corona virus has been implicated in many cases of PEMS, but the cause has not been determined.

Ornithobacterium rhinotracheale infection and the identification of pneumovirus in many areas of the country during the past 2 yr have created some alarm in the industry. These two disease entities were unknown to the turkey industry previously. Diagnostic reagents were not available early in the outbreaks and control procedures have not been fully developed. Mortality and economic losses have been substantial.

Avian influenza is re-introduced annually by migratory waterfowl in some areas of the country, particularly in Minnesota. Introductions are usually as mildly pathogenic strains, which often cause serious losses due to the immunosuppressive effects of the virus and mortality from secondary bacterial infections. Control is through routine monitoring of market flocks to identify infection, followed by voluntary quarantine and orderly marketing through a cooperative industry disease alert and eradication program. This program has been successful in Minnesota and is used in other high incidence areas. Some geographic areas have a cooperative plan, with or without financial indemnity, and conduct eradication by forced depopulation. A major concern and reason for rapid control is the risk of emergence of highly pathogenic viruses from mildly pathogenic H5 and H7 AI viruses. International quarantine and eradication programs can and have resulted in the past.

BIOSECURITY

The industry continues to expand and the higher concentration of production facilities increases the risk of disease spread between flocks. Biosecurity encompasses management practices needed to prevent the spread of pathogens between farms and between buildings with a farm. The level of biosecurity should be high, but it is difficult and expensive to maintain a high level of biosecurity at all times. It is important to maintain a very high level of biosecurity in breeders in which shower-in-and-shower-out facilities are used in many operations. A written biosecurity program is developed and is used in most operations for training employees. People who travel from farm-to-farm and

building-to-building move from youngest to oldest flocks. Travel from a grower flock to a brooder is high risk for transmitting poult enteritis pathogens. All personnel wear clean outer clothing and footwear and are restricted to one farm a day in many operations. Controlling personnel travel is important. Hairnets are required in some operations. A sanitation station or entryway in each turkey building is in standard use in most parts of the country. A heated entryway is used in colder climates where water freezes in the winter. It provides a clean floor area with water and disinfecting cleaner to clean footwear before going in and upon coming out of the building. It prevents tracking disease agents from the ground outside the building, into the flock area, and prevents tracking disease causing agents into vehicles and off the farm to other operations. Biosecurity practices apply to all farm workers, maintenance persons, and all interfarm personnel and visitors as well. Plastic boots are used in most operations as a suitable replacement for washable footwear for visitors but are not durable enough for farm personnel.

Equipment that is brought into the building should be cleaned and disinfected. However, many operations do not allow vehicles in and out of a building when birds are present. This practice reduces the risk of disease. The disease transmission risk is high when birds are moved from brooder to grower. However, some operations have customized equipment to facilitate a clean and safe move.

Biosecurity also includes elimination of all animals from turkey buildings. This includes livestock, pets, wild animals, rodents, and other bird species. It also includes elimination of insects that may travel from building-to-building, such as flies, and those that migrate in and out of individual buildings, such as darkling beetles. All of these vectors can expose the turkey flock to pathogens.

RODENT CONTROL

The control of rodents carries great importance in disease control strategies. Rodents can be mechanical vectors for many of the pathogens affecting turkeys. Integrated pest management includes proper site selection for farms to minimize rodent exposure, rodent-proof construction, rodent barriers, elimination of nesting areas and food supplies, and proper baiting and monitoring to assess the efficacy of the program. Baiting is a continual, usually weekly, requirement. Alternating bait types and brands is recommended to minimize bait refusal and to prevent development of resistance.

FEED AND NUTRITION

Feed and nutrition play an important part in controlling disease in turkeys. Balanced diets with

adequate nutrition are essential to maintain disease resistance. Starter feeds containing 40,000 to 60,000 IU of vitamin E/ton are commonly used to improve resistance to early bacterial infections, particularly to *E. coli*. Vitamin C is also recommended to enhance response to disease. Feed form is important to maintain feed intake, particularly in the young poult with enteritis. Mash feed particle size should be uniform enough to prevent ingredients from separating out in the automatic feed system, thus preventing nutritional stress. Dressing the feed with fat is helpful to increase palatability. Pelleting and crumbling feed helps provide for a more uniform intake of required nutrients. Feed with excess fines is difficult for the bird to swallow and may reduce feed intake. Additionally, feed fines stick to mouthparts and are washed off in the fountains, providing nutrients for bacterial growth in the fountain. The pelleting process also reduces bacterial contaminants in feed. Formaldehyde has been approved as a feed additive for use in controlling feedborne pathogens such as *Salmonella*, and is being utilized in some operations.

VACCINATION

Vaccination has become an important tool in disease control. The Lasota and B1 strains of ND virus have been used for many years to vaccinate young turkey poults. Recently, a vectored vaccine was approved and is being used successfully for day-old poult injection in the hatchery. A modified live *Bordetella avium* vaccine is used to control turkey coryza. Garavax-T,⁶ is a live *E. coli* vaccine that is being used in some operations. Coccidia vaccine such as Coccivac®-T,⁷ is used to establish early immunity to coccidiosis. The Marble Spleen adenovirus of pheasants is used as a vaccine to protect against Hemorrhagic Enteritis in turkeys.

An AI vaccine is available as autogenous oil emulsion bacterin in states having a high incidence of mildly pathogenic infections.

Fowl Cholera vaccines are used in some areas when the disease risk and history in the area indicate the need. Commercial modified live strains of *Pasteurella multocida* are administered in the drinking water. However, some integrators make their own. An oil emulsion bacterin is used in place of the live where there is risk of concurrent AI because the vaccine strains of *P. multocida* cause clinical FC losses when the flock is co-infected with an AI virus. The control of rodents and other vectors has been a very effective management tool in most operations.

TREATMENT

Resistance to antibiotics has reduced the effectiveness of many of the antibiotics approved for turkeys. Passage of the Animal Medicinal Drug Use Clarification Act (AMDUCA) by congress allows veterinarian to prescribe approved drugs off-label under specified conditions.

⁶Schering-Plough Animal Health, Kenilworth, NJ 07033.

⁷Sterwin Laboratories, Millsboro, DE 19966.

This has increased the choices and dosages available to treat and reduce disease losses. Additionally, flouroquinolones have been approved for prescription use in turkeys and have been very effective in treating a number of difficult disease problems.

PROCESSING

Processing plant losses due to airsacculitis have been increasing and are considered by many operations to be the number one cause of condemnation losses, particularly in tom turkeys. Septicemia-toxemia is the largest category of whole bird condemnation and airsacculitis is the second largest. However, the Food Safety Inspective Service (FSIS) allows the processing plant to salvage some of the birds with airsacculitis and add the nonsalvaged portion of the carcass to the condemned parts.

The FSIS inspector has three choices for disposition when a bird is presented with airsacculitis. First, the whole bird is condemned if it shows extensive airsacculitis to the extent that the carcass can not be inspected adequately or shows signs of septicemia-toxemia. Secondly, the carcass can be passed for vacuum cleanout on-line if the inspector feels that the plant will adequately remove the kidneys, all the exudate, and affected airsacs and the bird is otherwise wholesome. Third, if the carcass has interclavicular airsacculitis or if the inspector does not feel the plant will do an adequate job of on-line cleanout and the carcass is otherwise wholesome, the bird can be sent off-line to be knife-salvaged instead of whole-bird condemned. The knife salvage procedure allows salvage of approximately 55% of the carcass and the rest of the carcass is put into the condemned parts. The latter category is very high in some operations. In general, the poundage of condemned parts has been increasing each year, and has become greater than the pounds of whole bird condemned. A greater emphasis has been placed on the control of airsacculitis in live production to prevent these losses.

VENTILATION

Ventilation is essential in preventing and controlling disease in turkeys. Ventilation equipment and management of ventilation varies widely in the industry. A tour of operations will reveal a dozen different types of ventilation systems and ventilation management and control systems. Sidewall curtains are the standard in most parts of the country for grower-finisher buildings and are used to brood poults in warmer climates. Buildings with solid walls are standard in brooder buildings and are used in northern colder climates for grower-finisher buildings as well. Combinations of building are also used. There are four fairly distinct basic systems.

The most common system is "natural ventilation", which refers to a nonpowered system that depends primarily on wind and convection. The most common

configuration is a curtain-sided building with sliding end doors that is oriented east-west to catch the southerly winds in summer and solar heat in the winter. The building usually has stir fans to equalize temperatures, improve litter drying, and cool birds in summer. Slow speed, ceiling-mounted fans are used in some operations. However, the most common stir fans are vertically mounted in the center of the building blowing horizontally all in one direction, so that air moves from one fan to the other. The air is pushed from one end of the building to the other and a portion of the air moves back down the sidewalls creating a circular, end-to-end pattern. This results in good mixing and good air movement over the litter. Horizontal stir fans may also be mounted on the side walls or support poles. Fans are usually controlled by timer and by thermostat. Automatic curtain minders are standard to control temperature. Sophisticated computer controlled systems are available and utilized in some operations. Ridge openings with manual or computer control systems are used in some operations in cooler parts of the country. Ridge ventilation depends primarily on the power of convection.

The second type of ventilation system and generally the standard in the industry for solid wall buildings, is "negative pressure ventilation". This system utilizes exhaust fans to exchange air in the building. Control of the fans and intake openings varies from manual control using thermostats or times or stage operators on the fans, to fully computerized controllers. Static pressure control is important for mixing of the air. Tunnel ventilation, which is used in broilers, is an extreme application of negative pressure. It is used with foggers in hot climate areas and variations of the system are used in turkey breeders; tunnel ventilation is not used much for market birds.

The third type of ventilation system is positive pressure ventilation using "make up" air fans and heater units. This system has lost popularity due to high cost of operation and maintenance.

The fourth type of ventilation system is a combination of positive pressure and natural ventilation. This "positive air" system utilizes a pulsing positive pressure make up air heater in the center of the house with horizontal circulating stir fans and end wall exhaust openings. The system is computer operated and is used in curtain houses as well as solid wall buildings in some parts of the country.

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