Management and control of Escherichia coli infections in laying hens

Escherichia coli compose the initial microflora in human beings, most mammals and poultry. However, E. coli also has considerable pathogenic potential through the expression of different combinations of virulence factors.

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E. coli causing extraintestinal diseases (extraintestinal pathogenic E. coli, ExPEC) is one of the major sources of sepsis/bacteraemia in humans and many animals. Avian pathogenic E. coli (APEC) represent a subgroup of ExPEC and cause colibacillosis.

Colibacillosis in poultry

Colibacillosis was first described in chickens in 1894. Birds are continuously exposed to the bacteria through contaminated faeces, water, dust, and environment.

Poultry colibacillosis has many clinical signs; colisepticaemia, coligranulomatosis (Hjarre's disease), omphalitis and yolk sac infection, airsacculitis, swollen-head syndrome (SHS), panophthalmitis, conjunctivitis, pericarditis, pneumonia, perihepatitis, splenitis, salpingitis, egg peritonitis (in layers, breeders), cellulitis, osteomyelitis/arthritis/tenosynovitis, femoral head necrosis (FHN), foot pad dermatitis (FPD), enteritis etc.

However, lesions alone do not confirm E. coli infection, because other opportunistic bacteria (salmonella, staphylococcus, streptococcus, clostridia, ORT, MG, MS, pasteurella, etc) can behave similarly to E. coli, as secondary infections.

Economic impacts in broilers result from reduced growth, increased feed conversion rates, respiratory disease, mortality, treatment cost and condemnations, while in layers, losses are associated with decreased growth rates, mortality and egg production.

Among the conditions, predisposing to the development of E. coli infection in poultry there are numerous external and internal factors, such as bad biosecurity and poor hygiene; improper incubation; management disturbances; psychological factors (hierarchy, competition, fear, aggression, feather pecking, cannibalism); environmental issues (temperature fluctuation, humidity, draught, dust, light, noise, CO_2, NH_3, CO); water quality, subclinical intestinal/respiratory infections (coccidiosis, dysbacteriosis, helminthes, MG/MS, ORT); parasite infestations (red mites); post vaccinal reactions; immunosuppressive viruses (IBDV, MDV, CAV); respiratory viruses (LPAIV, NDV, ILTV, IBV, aMPV); hormonal responses to stress.

Outbreaks in laying hens

Outbreaks of acute mortality in laying hens are the most common clinical manifestations of E. coli infection.

Colisepticaemia is usually a disease of young birds, but occasional outbreaks of acute E. coli infection resembling fowl typhoid or fowl cholera occur in mature chickens. Acute colibacillosis in layers is being seen with increasing frequency. These commonly happen with onset of egg production and also occur at an older age less frequently. The disease may reoccur in the same flock or subsequent flocks placed on farms or in a house where affected flocks had been previously.

In a recent trial, death usually occurred suddenly without premonitory signs, although depression and/or dirty vents were observed in some affected hens in approximately half of the flocks. Weekly mortality was significantly higher in affected flocks than age-matched control flocks (9.26%-1.71% vs. 0.0%-0.03%).

Cumulative mortality ranged up to 10% and mortality remained elevated for 3-10 weeks. Polyserositis (perihepatitis, pericarditis) and peritonitis associated with free yolk in the peritoneal cavity were present in most birds at necropsy.

Oophoritis and salpingitis occurred less frequently.

The pathogenesis of the disease is unknown, but stress associated with onset of egg production is believed to be an important contributing factor. Ascending infections via the oviduct have been suggested as a means by which E. coli gain access to systemic tissues, but in a recent study, higher colonisation rates of the trachea, but not the oviduct, in affected flocks suggests layer colisepticaemia may be aerogenous.

Lack of recognised stressors or indications of diseases known to predispose chickens to colisepticaemia suggest layer colisepticaemia results from a primary E. coli infection. Risk factors for developing layer colisepticaemia include close proximity to other poultry farms and higher stocking density.

Management procedure

Biosecurity is essential to the control of colibacillosis. Keeping E. coli out of the flock is not practical because intestinal colonisation is universal. However, reducing the numbers of E. coli through water, feed, environmental sanitation, and good air quality, and protecting the flock from factors, especially viral infections, reduce the likelihood of colibacillosis.

Pelleted feed has fewer E. coli than mash, rodent droppings are a source of pathogenic E. coli, and contaminated water can contain high numbers of the organism.

Recontamination of finished feed should not be overlooked.

Chlorination of drinking water and use of closed (nipple) watering systems have decreased the occurrence of colibacillosis and condemnation for airsacculitis.

Competitive exclusion over APEC in chick intestines with commercial products or Bacillus subtilis spores could help. Food and water deprivation increased the occurrence of spontaneous bacteraemia.

Infections with M. gallisepticum or IBV disturb the protective effect of native flora colonisation. Effective vaccination to protect against respiratory tract pathogens and immunosuppressive agents that predispose to colibacillosis reduces occurrence of the disease.

Maintaining good air and litter quality is fundamental to reducing the risk of a flock developing colibacillosis. Degree of damage to the respiratory mucosa correlates with the level of ammonia exposure. Dust also increases the risk of colibacillosis. The

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combination of dust and ammonia results in birds inhaling high numbers of bacteria and being unable to clear them from their respiratory tract.

Treatment and vaccination

Historically, antibiotics have been used to treat and control colibacillosis; however, they are no longer a favourable tool due to increasing concerns about antibiotic resistance and stricter regulation on antibiotic residues. It is important to determine susceptibility of the bacterial isolate involved when selecting an antibiotic therapy in order to avoid ineffective treatment and propagation of resistance profiles.

APEC is frequently resistant to tetracyclines, sulphonamides, ampicillin, and streptomycin. Multidrug resistance is common, may be linked to transmissible plasmids, and may occur in conjunction with virulence factors.

There are two main types of vaccines used in pullets. An autogenous inactivated vaccine provides protection against homologous E. coli strain and has no cross protection, whereas the commercial modified live vaccine – Poulvac E. coli by Zoetis offers cross protection over various APEC strains and reduced morbidity/mortality from E. coli infection. As such it enhances flock productivity successfully.

Poulvac E. coli can be administered from the first day of life onwards by coarse spray or drinking water application.

Global and Asian experience

Poulvac E. coli vaccination of broiler breeders in an integrated broiler breeder company in South Africa has been investigated since January 2011 when its broiler division experienced increased mortalities due to colisepticemia in broilers 8-18 days of age.

In broiler breeders, the period from 22-32 weeks of age is a very stressful period. During this period the body weight gain per week is high and birds go from 0% eggs to peak egg production (about 89%). Birds are transferred from the rearing farm to the laying farm and must adapt to a new environment.

A new pecking order results in fighting, pecking and injuries. Mating starts during this period and males can be very aggressive during mating and cause skin injuries to females (head, back and wings).

Birds are also stimulated into egg production with lights (intensity and duration) and feed (quantity and layer ration). Overstimulation of females can result in E. coli peritonitis and salpingitis. Skin injuries with secondary E. coli infection can be an important cause of increased mortality in broiler breeders.

Under the farming conditions the introduction of Poulvac E. coli during the rearing period has resulted in a decrease in mortality on layer farms from 13.4% to 10.7%. Mortality due to peritonitis has reduced from 28% to 15%. In broilers placed from breeders that received Poulvac E. coli vaccine, seven day mortality has reduced from 1.44% to 1.18% and seven day bodyweight has improved from 183g to 188g.

The situation of colibacillosis in laying hens in France shows up to 15% mortality during the lay. A flock vaccinated during the last months of 2012 demonstrated better results (0.75% mortality at 35 weeks old, no antibiotic use) than the previous flock which had 8% mortality before 35 weeks old. Production monitoring in a layer farm with 75,000 hens in South Korea until 30 weeks old, showed that 603 more birds had been saved and 94,500 more eggs had been produced.

The poultry industry requires inexpensive, safe and effective prevention tools that can be easily administered. The modified live E. coli vaccine fulfills these requirements. Vaccinations with Poulvac E. coli are an efficacious measure that prophylactically contributes to the control of colibacillosis and its consequences in poultry. ■