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Article Review

Some common bacterial diseases of poultry with focus on enteric form

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ABSTRACT

One of the fastest-growing meat supply and largest animal population in the world is the poultry industry. and considered the common demand of proteins and important source of income.
Protecting bird flocks against pathogenic microorganisms is an important part of commercial poultry production. Bacterial diseases of poultry cause important losses to the poultry industry worldwide every year. Therefore this study is intended to gathering information about these infectious diseases with focusing on the preventive measures to minimize the risk of infection and its economic losses

INTRODUCTION

The non-outbreak-related mortality rate among commercial layers and broiler breeders is approximately 50% due to bacterial illnesses., which result in significant financial losses for the poultry industry. Bacterial infections may be the cause of almost 50% of all deaths in the first week of life. **(Ida and Jens 2021).**

The danger of bacterial diseases may be due to their rapid occurrence, enteric or respiratory complication and difficult control of the disease

Enteric disease are the most important diseases affecting poultry , they are still causing significant financial losses in numerous regions across the globe as a result of rising mortality rates. poor feed efficiency, weight gain disorder, decreased feed conversion rates and higher drug usage and production costs **(Porter 1998).** Several causes are considered as potential causes of intestinal illnesses, either single or in combination with different organisms (bacteria, viruses, and parasites) (multi- causal), or in conjunction with non-infectious causes like factors connected to feed and/or management. **(Hafez 2011)**

In case of infectious coryza in chickens and fowl cholera in chickens and turkeys bacteria is the primary stimulating cause of the disease, but in other cases like E.coli infection , the bacterial agent colonises the respiratory system after a primary viral cause as in case of Infectious bronchitis or environmental cause. **(JOHN 1998)**

Colibacillosis

Agent, infection and disease

One of the most prevalent infectious bacterial infections affecting poultry is colibacillo-

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sis, this can impact commercial layers, broilers, breeders, and birds of all ages, the main cause is avian pathogenic E. coli (APEC) **(Koutsianos et al. 2021),** which is considered as the main agent causes of high financial losses as a result of mortality and less productivity of affected birds, mainly around the highest egg production period and during the late lay period **(Linden 2015).** Following Newcastle disease, mycoplasmosis, coccidiosis, infectious bronchitis, or infectious bursal disease (IBD), as well as nutritional deficits, colibacillosis can develop as a secondary pathogen, also due to environmental caues like temperature, humidity, ammonia and dust on farms that lower immunity of the bird and increase the risk of infection. Although there are many serotypes associated with colibacillosis but O1, O2 and O78 serotypes are the primary causes of poultry colibacilosis **(Kabir 2010)**

Colibacillosis of poultry includes a wide range of diseases manifestation that may be localized or systemic infection like infection of yolk sac, omphalitis, respiratory tract disorder, swollen head syndrome, septicemia, coligranuloma (Hjarre's disease), and cellulitis. Mortality due to septicaemia in its acute form, perihepatitis, airsacculitis and peri-carditis in subacute form. Also there are exudations in the peritoneal (abdominal) cavity including serum, fibrin and inflammatory cells (pus), **(Yuvraj 2019).**

Source and route of infection

The main source to the environment is the chicken feces as *E. coli* is a normal inhabitant of the digestive tracts, it can also be found in rodent droppings, litter, dust and **(Barnes et al. 2008),** so infection occur horizontally via faecal oral route **(Dho-Moulin and Fairbrother 1999)**. Faecal contamination of egg shell may occur after laying during the moving of the egg out of the cloaca **(Barnes and Gross Gross 1997)** can allow E. coli to enter through the shell, infect the yolk sac, or spread to the chicks, leading to high mortality. Vertically neonatal chick infection can occur. Oophoritis or salpingitis due to E.coli infection of laying hen may infect the inside of the egg before the shell forms (**Kabir 2010).** APEC results in embryo mortality and yolk sac infections before to hatching. Additionally, the chick may get contaminated during or soon after hatching, which could result in omphalitis, septicaemia, retained infectious yolk, and young chick mortality up to three weeks of age. **(Barnes and Gross 1997).**

Prevention and control

Preventive measures depend on: maintaining a good health status against risk of predisposing factors to infections, maintaining optimal environmental conditions inside poultry house (good air quality and reducing exposure to strong air current that caused respiratory system impairment, good ventilation decrease damage of the respiratory tract caused by ammonia, proper care of temperature, litter, stocking density, rodent control and sanitation) as well as the application of vaccination programmes **(Barnes et al. 2008).** As an alternate method of controlling colibacillosis, vaccination is the most crucial tool. Vaccines against E. coli infection in chicken have been studied using live, subunit, and inactivated forms. **(Ghunaim et al. 2014).**

The most significant way that E. coli is spread throughout flocks is by faecal contamination of hatching eggs., so strict hygienic measures in the hatchery very important to lowers the chance of omphalitis in newly hatched birds . Transmission can be decreased by regularly gathering eggs, maintaining clean nest, avoid taking floor eggs, throwing away cracked or clearly fecal-contaminated eggs, and fumigating or disinfecting eggs within two hours of being deposited. Sanitisers can minimise or eradicate E. coli on the shell surface. **(Shane and A. Faust. 1996)** Additionally, it was discovered that employing UV light reduced the chance of chicks infected with E. coli . **(Coufal et al. 2003).**

Nutritional management also important through food additives that keep immune system healthy, proper protein ratios, more selenium, high levels of vitamins A and E and probiotics which important for competitive exclusion **(Linden 2015).**

Treatment strategies must be as soon as possible and include actions for rapid control of risk factors for infection or environmental

aspects with the early application of antibacterials as suggested by susceptibility testing to ascertain the bacterial isolate's vulnerability to an antimicrobial agent to avoid antimicrobial resistance is to wide range of antibiotics as the result of repeated use and insufficient dose of antibiotics. Alternative measures to antimicrobial agents are very important due to ineffective medication or lowering the use of antimicrobial agents in poultry production. Although the use of prebiotics, probiotics, enzymes, digestive acidifiers, vitamins, immune stimulants, and anti-inflammatory agents has been proposed, it has not been carried out in an interesting manner. Probiotics such as Lactobacillus and Bacillus species have been used to prevent E. coli from colonising the intestinal tract **(Yuvraj Panth 2019).**

Salmonellosis

Agent, infection and disease

Salmonella infection is a big problem that threatens the economy of poultry sector as a result of mortality and reduced production mainly in two weeks aged chickens can cause disease and high mortality **(Haider et al 2004).** Even though mature fowl have bacteria in their blood, illness is rarely observed in them.

The Salmonella typhoid group is thought to be one among the most significant worldwide zoonotic bacterial agent which incriminated in food poisoning.

Numerous bacteria species can produce a salmonella illness. *Salmonella gallinarium* (fowl Typhoid) and *Salmonella pullorum* (pullorum disease) are the most virulent serovars in avian species are that cause systemic infection and more financial losses in the poultry section **(Sania et al. 2022).** There are other serotypes like S. *Enteritidis* have the ability to contaminate eggs in the hen's fallopian tube and infect internal organs in addition to the gastrointestinal tract.

Low hatchability caused by infected hatching eggs may result in higher embryo mortality and higher death rates among freshly fledged chicks **(Sania et al 2022).**

Source and route of infection

Poultry usually become infected through contaminated feed, contact with contaminated environment and infected animals or eggs

Pullorum disease (bacillary white diarrhea)

It caused by *salmonella pullorum* generally affects chickens who are extremely young, usually between two and three weeks old. resulting in fatal diarrhea. The symptoms may vary, include overall weakness, decreased appetite, retarded growth, the birds move toward the heat source and whitish pasting diarrhea and around the vent. In some cases, When the lungs are extensively involved, gasping may be seen., blindness, joint affection which can produce lameness and swollen joints. Because to acute septicaemia and mortality, there might not be any lesions. Yolk sacs that are not absorbed and typical grey nodules in the liver, spleen, lungs, heart, gizzard, and intestine are among the most common lesions in young birds. **(Sherrill 2022)**

Contact with respiratory or faecal infections in birds, or exposure to infected feed, water, or litter by Direct or indirect way is considered the horizontal route of the infection transmission or also by vertical (transovarian) via egg. Most often, infections spread by egg or hatchery contamination cause death in the first few days of life up to two or three weeks of age. **(Berchieri et al. 2001).**

Treatment is never recommended as the survivors are little and often develop into asymptomatic carriers of ovarian infections that are localized, so the control measures are based on freedom from infection of breeding stock by routine serologic testing beside biosecurity measures to minimize the spread of S. enterica pullorum among humans, rodents, insects, wild birds, feed, and water.(**Sherrill 2022).**

Fowl typhoid

Most often affecting adult chickens, fowl typhoid is a peracute, acute, or chronic disease caused by *salmonella gallinarum*, whereas pullorum disease affects the very young chick-

ens. It usually manifests as chronic in adults. **(Christensen 1996; Shivaprashad 1997).** Whereas fowl typhoid exhibits indications of septicaemic sickness, pullorum disease primarily presents as an intestinal disease in chickens. **(Shivaprashad 1997).** Both biovars can cause acute or chronic septicaemic infections, although S. gallinarum can induce haemolytic anaemia and peracute infections in both adults and children, unlike S. pullorum. **Christensen 1996).**

The disease manifested by bad general condition, retarded growth, increased mortality, diarrhoea, reduced feed intake, impaired hatchability, and decreased egg production **(Shivaprasad 2000).** A reduced hatchability because the hen is transferring the bacteria to the egg before it is placed, consequently death of the embryos in the egg before hatching **(Kabir 2010).** The clinical manifestation due to the transovarian transmission, the diseases linked to young chicks and poults are quite similar. Dead birds may be found in the incubator or soon after hatching if they were get out of eggs contaminated with S. pullorum or S. gallinarum **(Kabir 2010).**

Infection-free chicks and a clean, sanitised environment along with stringent biosecurity controls, should be the main management practices. **(Pomery and Nagaraja 1991)**

Prevention and control of salmonellosis Biosecurity

Prevent cross infection between houses by keeping people out of the shed and avoid infections from mechanical carriers like footwear, human clothing, equipment, litters, crates and trucks. Salmonella should not be present in the feed or water, and the dead birds should be disposed of properly. **(Christensen et al. 1994)** Equipment in the shed should always be cleaned and disinfected. The shed ought to be rodent-proof. Shed should be carefully cleaned from fecal debris and moist litter. Prevent cross infection between houses through no one enter in the shed Overcrowding should be avoided. poultry must kept out of contact with wild birds **(Sania et al. 2022)**

Vaccination and competitive exclusion

Live or inactivated vaccines used against *salmonella,* These vaccination lower the danger of mortality and decrease avian infection. **(Sania et al. 2022).**

The exclusion of competition (CE) is the safest and most efficient way to manage digestive problems in chickens. It is entirely biological, leaves no trace, and typically only requires one treatment on the day of hatching. It only works for a very short time (until only two weeks after hatching) depending on Salmonella minimization in growing chickens. It applied either by spraying in the hatchery or on the farm or via the first drinking water . In order to restore the gut microbiota, the medication has also been administered to elderly birds with success following therapeutic dosages of antibiotics field studies have demonstrated that CE treatment improves feed conversion, increases bird development, and lowers bird mortality in addition to controlling pathogens. **(Carita 2005).**

Currently, AviFree, Aviguard, Broilact, MSC (mucosal starting culture), and Preempt or CF-3 are the CE products that are sold commercially . They are all mixed cultures that originated from the walls and/or caecal contents of domestic poultry**.(Carita 2005)**

AviFree is an unrefined mixed culture of whole caecal contents from an adult chicken it was moderately protective against *Salmonella typhimurium* 29E according to **(Newman and Spring 1996).** Aviguard is a lyophilised mixed culture of caecal contents from an adult SPF chicken, effective against *S. enteritidis* (**Guillot et al. 1997).** Broilact is the first CE product sold commerciall, in the field, it was also protect against Salmonella (**Bolder et al. 1992)**

Dietary intervention

Phytogenic feed additives, feed acidifiers, antimicrobial peptides, bacteriophages, antibodies, prebiotics, and probiotics are some suggested substitutes for antibiotics in poultry feed**. (Redondo et al. 2014; Suresh et al. 2018)**

Lactobacillus salivarius used as probiotic, due to their capacity to prevent Salmonella enteritidis and E. coli from growing on poultry

feed, their strong intestine mucosal adhesion efficiency and resilience to acidic (pH 3.0, for example) and bile salts **(Nemcova et al., 1997).**

Prescence of carvacrol and thymol , phenols of oregano essential oil (OEO) in avian drinking water has antimicrobial influences on the disease suppression without drug-residues and drug-resistance **(Ziheng et al. 2022)**

Clostredial infection

Agent, infection and disease

Clostredial infection is enteric disease of poultry caused by *clostridium perfringens*. It is a Gram-positive, rod-shaped, anaerobic, spore-forming bacterium normaly found in the intestinal tract of poultry. Under certain conditions, the bacterium can multiply, causing necrotic enteritis and cholangiohepatitis, they are responsible for worldwide critical losses in the broiler and turkey industry **(Kaldhusdal et al 2016).** Both the acute necrotic enteritis (NE), which has a high mortality rate in chicks aged 2 to 5 weeks, and the subclinical condition with focal necrosis in the intestine or C. perfringens-associated hepatitis, with cholangio hepatitis, are types of clostrediosis. **(Engström et al. 2003).**

Necrotic enteritis (NE) affecting broilers with high economic consequences due to the costs of prevention **(Opengart et al. 2008),** the disease has been associated with a novel toxin, NE toxin B called (NetB), secreted by a toxin-producing *C. perfringens* type A and G isolates and suggested to be a virulence factor in NE pathogenesis **(Keyburn et al. 2008).**

Isolating C. perfringens and/or detecting its alpha toxin are not very useful for confirming disease condition due to their normally prescence in the intestine of healthy birds. **(Kerry 2013)**

NE affects the chickens at the age 3- 6 weeks as a result of maternal antibody levels in the birds are insufficient until three weeks of age. Stress may be one of the main factors causing changes in gut flora brought on by switching from a starter to a growth diet, which facilitates the environment's proliferation of C. perfringenes. **(Moore 2016).** In contrast, There have been reports of NE outbreaks in commercial layers raised in floor pen environments between the ages of two weeks and six months. (**Opengart 2008**)

Depression, decreased appetite, slowed growth rates, and diarrhoea were the most often seen symptoms in the birds under examination. (**Kaldhusdal et al. 2001)** In addition to decreased growth rate and feed conversion during production, the decline in bird performance is linked to higher broiler condemnation rates because of hepatitis. **(Opengart 2008).** The most notable postmortem abnormalities include necrotic hepatitis, which is characterised by tiny, white, pinpoint-like foci in the liver, brownish pseudomembrane development, which is a membrane covering the inner coat of the gut, and small intestinal enlargement with abrown fluid with a foul odour (**Timbermont et al 2011**).

Source and route of infection

C. perfringens infection occur through horizontal transmission **(Svobodova et al. 2007).**

C. perfringens contamination raised inside broiler barns during grow-out by eating litter or drinking from a contaminated source or from other outside source through insects, staff footwear, dirty barn entrance area, and stagnant water outside the barn. Additionally, excreta of wild birds and mammals around the barn can spread infection. **(Craven et al. 2001).**

Necrotic enteritis is frequently brought on by an infection with coccidiosis and prior intestinal epithelial injury caused by Eimeria spp. or any other factors that cause stress, reduce immunity, and disturb intestinal ecosystem such as overpopulation, a range of management and climatic conditions, high dietary amounts of specific grain, fish meal, and high protein levels, or infectious bursal disease virus and an overall imbalance of commensal microbiota **(McDevitt et al. 2006; Diego and Audrey 2014)**

The other prevalent clostridial intestinal illness in chickens is ulcerative enteritis (UE), which is also brought on by Clostridium colinum. It mainly affect game birds, hens, and other bird species in addition to bobwhite quail. include sudden death and hemorrhagic enteritis in quails are the main clinical manifestations but less sever in chickens. Typical pathological findings is the main step of diagnosis of ulcerative enteritis. The most frequent lesions in the first stages of the infection are tiny ulcers in the small, cecal, and upper large intestines that are encircled by haemorrhages. Later, small ulcers develop into bigger, occasionally perforating ulcers that cause diffuse or local peritonitis. Blood in the stomach is similar to coccidiosis. **(Kerry 2013).**

The most common lesions in the hepatic parenchyma are characteristic yellow to grey necrotic foci, all these beside isolation of *C. colinum* from the intestine of affected birds (**Raul_2002**). Ulcerative enteritis (UE) needs to be diagnosed differently from NE, UE will manifest as small intestine ulcers, which frequently rupture the wall of the intestine with adhesions and peritonitis. **(Kerry et al. 2013)**

Prevention and control

Administration of antibiotics against clostridia can lead to additional financial losses due to treatment expenses, the spread of resistance among harmful bacteria, and drug residues in the meat. Therefore, probiotics, organic acids, and essential oils are examples of antibiotic substitutes. Therefore, probiotics, organic acids, and essential oils are examples of antibiotic substitutes, prebiotics, toxoid vaccines and natural phytochemical extracts in poultry diets are becoming more crucial in the management and prevention of necrotic enteritis that could be used along with biosecurity practice **(Jerzsele et al. 2012).**

Maternal vaccination with a NetB-enhanced toxoid vaccine is a useful technique for the control of NE in chicks (**Keyburn et al. 2013).**

The blend of feed additives of (propionic, sorbic, caprylic and capric acids), direct- fed microbials (*Lactobacillus johnsonii*) have great effect on mortality due to necrotic enteritis (**Geier et al. 2010)**

Botulism

Avian botulism is a neurotoxic disease of birds as a result of ingestion of toxin of botulinum neurotoxins (BoNTs) producing clostridia. It is rare in poultry but make massive mortality in waterfowl. The disease includes flaccid paralysis leading to death by cardiac and respiratory failure (**Martine and Francisco 2019)**

Gangrenous Dermatitis (GD)

GD caused by *Clostridium septicum* and *C. perfringens* type A. *Staphylococcus aureus* and *Escherichia coli* may be causative or contributing agents, it characterized by dry to weepy cutaneous lesions of the wings , leg and abdomen, and necrosis of the subcutaneous tissue and muscle **(Kenneth 2019).**

Limitation and control of the infection can be performed by frequent removal of GD-affected birds. Also improve litter condition, decrease litter moisture, acidify litter pH, reduce bacterial levels in the environment **(Pizarro et al. 2005).**

Staphylococcal infection

Staphylococcus species have been associated with yolk sac infection and omphalitis in newly hatched chicks, but in older birds make septicemia, osteomyelitis, arthritis, synovitis, and gangrenous dermatitis (**Andreasen 2008).**

To prevent and control staphylococcosis, keeping proper host defense is very important, avoiding wounds, stress, and other disease agents. Because wounds are a portal of entry for *S. aureus* into the body. Sharp objects that can cut or puncture the feet should be eliminated away from poultry area. Maintenance of good litter quality will minimize foot ulceration**. (Claire 2019)**

Recently hatched chicks with open navels can be easily infected, leading to chronic infections and death shortly after hatching. Avoid infectious bursal disease and chicken infectious anemia virus to prevent staphylococcosis (**Santivatr et al. 1981)**

Fowl cholera

Agent, infection and disease

Pasteurella multocida is the main causative agent of contagious fowl cholera, that affects a wide variety of birds causing respiratory tract infection leading to high and sudden mortality with great loss in poultry production. **(Bisgaard et al. 2003),** the disease often manifests as acute fatal septicemia in adult birds, although chronic, and asymptomatic infections also occur (**Anon. 2015).** Fowl Cholera can affect the birds of any age, but it never occurs less than 4 weeks of age in commercial poultry with high prevalence in cage rearing system (**Rimler 1994).**

The clinical indicators of fowl cholera are fever, anorexia, ruffled feathers, mucus flow from mouth and nose, fast breathing and initially watery to yellowish diarrhea and mucoid greenish at the late stage **(Rhoades and Rimler 1990)** and cellulitis of face and wattles **(Ali and Sultana 2015).** As *P. multocida* able to multiply in the bloodstream of the bird consequently bacteremia and The organism has the potential to colonise numerous organs, resulting in common purulent exudative lesions in the brain, ovaries, joints, and wattles.(**Rimler and Glisson 1997).** Commonly observed lesions are congested body, cyanotic, hard ,swollen comb, cloudy air sacs, pneumonic lungs with adhesion, and enlarged kidney, spleen, liver with friable texture and small grayish necrotic foci, fibrinous peritonitis, pericarditis with hemorrhagic coronary fat **(Sharna 2021)**

Source and route of infection

The organism can enter the body via the respiratory system or digestive tract. The primary source of *P. multocida* excreted from the nostrils, eyes and mouth of sick or chronic birds. Other sources are contaminated feed, water, equipment and shoes. Wild birds can also disseminate *P. multocida* **(Onet and Shivaprasad 1995)**. *P. multocida* also found in cloacal mucosa of asymptomatic birds which remain as the sources of outbreaks **(Muhairwa et al. 2000)**

Prevention and control

The respiratory infections spread rapidly so the primary control of the infection depends on good biosecurity and hygiene measures **(Tarek et al. 2014).** Taking dead birds out of a flock that has an active P. multocida infection is a crucial way to stop the illness from spreading because many domestic chicken species have a tendency to eat the carcasses of dead fowl cholera birds. **(JOHN 1998).**

To lower the prevalence of the disease, vaccination against fowl cholera is a preventive approach, especially for turkeys and grill breeders**. (Samina et al. 2013).**

CONCLUSION

Most of the people invest a huge amount in poultry sector as an investment, but they lack knowledge about the diseases and disease prevalence of poultry so they cannot get their desired profit. Present article might be focus the signs and pathological lesions of some common bacterial diseases by which people can easily aware of these from the beginning of poultry rearing system as well as they can diagnose the disease and take preventive measures to minimize the risk of infection and its economic losses. To control poultry diseases should perform strict hygienic measures and biosecurity related to workers, , chicken buyers who move from farm to farm which may spread these diseases without taking precautions to disinfect footwear, hands, and clothing. Similarly, trucks may be also infected. Also should avoid crowding, malnutrition, and other stressful conditions. Wild birds, mammals, and flies may be important mechanical spreaders of the organisms

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