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COCCIDIOSIS IN POULTRY – A REVIEW

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ABSTRACT
Coccidiosis is the most common and most vital disease of poultry resulting in immense economic loss worldwide. It is found to be a most complex disease of poultry which is caused by different species of intracellular protozoa parasite of *Eimeria*. It inflicts the birds in both clinical and sub-clinical forms. The disease is endemic in most of the tropical and subtropical regions. Clinical signs are associated with tissue destruction. Diagnosis is by postmortem examination of representative number of birds. The type and locations of lesions in the gut indicates the particular species of *Eimeria*. Prevention of poultry coccidiosis is mainly by the combination of superior management and the use of anticoccidial compounds in the feed or water. Coccidiosis is recognized as the parasitic disease that has the greatest economic impact on poultry production. It causes great economic loss to the poultry particularly in young birds, in all production systems. This review presents information on coccidiosis in poultry and its impact in poultry industry.

KEYWORDS: *Poultry, Coccidiosis.*

INTRODUCTION
Parasitic diseases have major impact and found to a major threat in limiting the expansion and profitability of the budding agricultural countries[33]. Ingestion of feed or water contaminated with sporulated oocysts of *Eimeria* were found to be a root cause of this disease[4]. Clinical symptoms of coccidiosis is directly associated with the number of oocysts ingested by the bird at one time, pathogenicity of the particular species of *Eimeria*, age of the infected bird and system of management in particular farm[4]. Yellow diarrhoea is the first and foremost symptoms followed by depression, ruffled feathers, droopy wings and huddling[25]. High frequency of coccidiosis is commonly observed in poultry which are reared under intensive system of management mainly deep litter because oocysts can easily mount up in the litters[35]. High density of flocks can also be a reason for high incidence of coccidiosis as it causes higher rate of infection by transmitting the coccidian oocysts from affected flocks to unaffected flocks [29]. The traditional control of coccidiosis relies mainly on chemoprophylaxis, which appeared to be successful. However, the increased occurrence of resistance against several anti-coccidial drugs has left the poultry industry with a challenge for coccidiosis prevention and control. It propelled the exploration for alternative strategies among which vaccination is of major value[34].

MORPHOLOGY
Eimeria oocysts have a characteristic ovoid shape. It can also be identified by their habitat, nature of macroscopic lesions, sporulation time, prepatent period, size of the schizonts, location of the parasite in the epithelial cells and cross-immunity trails[41].

ETIOLOGY
Coccidiosis is the major parasitic disease among the infectious diseases of poultry which can cause a serious impact in the poultry sector. It is an economically noticeable disease in chicken. It is a self-limiting disease and severity depends on the number of oocysts ingested by the bird and its immunity level[31]. It is mainly caused by an intracellular parasite of *Eimeria* species in the genus *Eimeria* family *Eimeridae* order *Eucoccidiorida* and phylum *Apicomplexa*[46]. About nine species of *Eimeria* have been recognized in chickens which are domesticated. They are *Eimeria brunette*, *Eimeria maxima*, *Eimeria necatrix*, *Eimeria tenella*, *Eimeria acervulina*, *Eimeria mitis*, *Eimeria mivati*, *Eimeria praecox* and *Eimeria hagani*. Of these, *Eimeria brunette*, *Eimeria maxima*, *Eimeria necatrix*, *Eimeria tenella* are the most pathogenic. *Eimeria acervulina*, *Eimeria mitis*, *Eimeria mivati* are the less pathogenic and *Eimeria praecox* and *Eimeria hagani* are the lesser pathogenic[20].

EPIDEMIOLOGY
It is reported as endemic in most of the tropical and subtropical regions because ecological and management conditions favour the development and propagation of the causative agent[36]. Drastic economic impact on the commercial poultry industry occurred in the past several decades which are mainly due to the infections caused by coccidian parasites. Most common and most important diseases of poultry worldwide is poultry coccidiosis[37]. It is said that about 1800 Eimeria colonize and intestinal tract infections occurs in different animals and birds[18]. In India, overall prevalence in Jammu region was of 39.58 per cent and five *Eimeria* species have been identified in this region were *E. tenella*, *E. necatrix*, *E. maxima*, *E.*

acervulina and *E. mitis*[43]. In Tamil Nadu, *E. acervulina*, *E. brunetti* and *E. necatrix* were the most prevalent species of *Eimeria*[1]. Various *Eimeria* species including *E. acervulina*, *E. brunetti*, *E. maxima*, *E. necatrix*, *E. mitis* were isolated from different places of Coimbatore, Cuddalore, Madurai, Namakkal, Udumalpet, Tirupur in chicken[40]. *E. tenella* is the most common and pathogenic species that affects the poultry industry globally[6] and it may cause 100% morbidity and this high mortality is due to extensive damage to the digestive tracts[17]. Both locally and globally, the occurrence and intensity of infection vary considerably[18]. Other farm animals such as turkeys, rabbits, dogs, cattle, sheep, and hogs may also have coccidial infection, but the species of coccidia that infect them are different[14].

AGENT RELATED FACTORS

The occurrence is dependent on which species of *Eimeria* and the size of the infecting oocysts. The number of oocysts in the litter rises rapidly because of the short prepatent period of the parasite and its high biotic potential[22]. Poultry coccidia have high frequency of reproduction within the host and thus it leads to a high level of the parasite within the host which is susceptible[47].

HOST RELATED FACTORS

Coccidiosis is generally a disease of young birds, but it may occurs at any age. Most of the *Eimeria* spp. affects birds between 3 and 18 weeks of age group[43]. Mortality rates are usually found to be high in young chicks than the older ones. It is because most of the *Eimeria* species affects birds between the age of 3 and 18 weeks[11]. Occurence of infection also releys on high animal density, age of the bird whether it gets infection for the first time and number of passages, ability of the bird to develop proper specific immune response[19].

MANAGEMENT RELATED FACTORS

It plays a major role in the spread of coccidial infection because *Eimeria* oocysts are omnipresent and can easily spread. Also it is very complex to keep poultry coccidia free, especially under intensive rearing circumstances, due to its high rate of recurrence of reproduction potential [2]. Prevalence varied by management and not by flock size[17] while wet litter, contaminated drinkers and feeders, bad ventilation, and high stocking density will encourage oocyst sporulation and can increase the clinical signs[3].

MISCELLANEOUS FACTORS

Its pathogenicity is increased with higher crude protein levels[44] may be due to increased tryptic activity in the host which leads to more efficient excystation of oocysts in the intestine[50]. *Eimeria tenella* is more pathogenic in chickens which are usually fed with wheat-based diets than those of maize-based diets. This is because of the presence of higher amounts of soluble non-starch polysaccharides in wheat, which increases digesta viscosity[53]. Increase in susceptibility of coccidiosis may be due to immunosuppressive diseases such as MD[42] and IBD[32].

LIFE CYCLE

Two developmental stages are involved in the life cycle of *Eimeria* in the host as an exogenous stage or sporogony and an endogenous stage (schizogony and gametogony). Asexual development (shizogony) followed by a sexual phase formed by gametogony as a result oocyst is formed[26]. In the infective stage, sporulated oocyst is ingested and the action of mechanical and chemical factors in the gut *i.e.*, bile salt and trypsin leads to the release of sporocysts and sporozoites in the duodenal lumen. During the exogenous phase, the unsporulated oocyst is excreted from the chicken and undergoes sporulation in the presence of moisture, warmth, and oxygen, thus becoming a sporulated oocyst. Sporulated oocysts of *Eimeria* have four sporocysts, each containing two sporozoites. The sporozoites raid the mucosa sometimes passing down the whole length of the alimentary tract. Phases of intracellular growth and asexual multiplication with periodic release of merozoites entering in to the sexual phase of the life cycle is called as gametogenesis[21]. These merozoites invade cells and build up as either macro-gametes or micro-gametes. The former gives rise to a single macrogamete whereas the male gametocyte matures and ruptures and releases a large number of minute biflagellate micro-gametes. The micro-gametocyte grows to form a micro-gamete. A thickened wall is formed around the macro-gamete and forms a zygote when the macro gamete is fertilized by microgamete. This stage is known to be young or immature oocyst[10]. Infection occurs when the host ingests sporulated oocysts. After ingestion, the microenvironment of the host digestive tract stimulates excystation of the oocyst in the gizzards and thus helps in the release of sporozoites and that invades and destroys the cells in the intestinal mucosa and begins the reproductive cell cycle. As a corollary, infected birds exhibit symptoms of disease such as reduced feed intake, bloody diarrhoea and reduced weight gain[12,15].

PATHOGENESIS

Coccidiosis is a parasitic infection by coccidia to produce clinical warning of disease[9]. Nine species of *Eimeria* have been recognized as causative agents of poultry coccidiosis. Of that, only seven of them have been labelled as pathogenic[24]. *Eimeria tenella* (*E. tenella*) and *Eimeria necatrix* (*E. necatrix*) are the most pathogenic species. *Eimeria acervulina* (*E.acervulina*), *Eimeria maxima* (*E. maxima*) and *Eimeria mivati* (*E. mivati*) are common and moderately pathogenic while *Eimeria brunetti* (*E. brunetti)* is uncommon but pathogenic when it occurs. *Eimeria mitis* (*E. mitis*), *Eimeria praecox* (*E. praecox*) and *Eimeria hagani* (*E. hagani*) are non-pathogenic[45]. Oocysts always require a comfortable environmental situation to sporulate. Wet, moist, temperate or cool environmental conditions only can enhance sporulation, whereas high temperatures and dryness cannot support it[39]. Outbreaks are commonly classified according to their habitat in the digestive tract based upon their affinity. The disease is often described as either cecal or intestinal coccidiosis[14]. The protozoan parasite causes tissue damage in the intestinal tract by multiplication in the intestinal tract which in turn resulting in the interruption of feed intake, process of digestion, absorption of nutrients,

dehydration, loss of blood, absence of skin pigmentation and increased susceptibility to the pathogens of other diseases[31].

CLINICAL SIGNS

Clinical signs include anorexia, reduction in weight gain, reduction in feed conversion in affected birds[28]. *E. tenella* causes moderate to rigorous lesions in caecum and may cause death. The birds will become depressed associated with ruffled feathers, the droopy wings, bloody diarrhea and often huddle. Reduction in food and water consumption, emaciation and dehydration may be noticed. Layers may show remarkable drop in their rate of egg production. Caecal coccidiosis may be characterized with bloody droppings and anaemia[49]. In case of severe infections, more number of mucosal epithelium gets vanished and nutrient absorption is lowered [55]. Mainly it is characterised by dysentery, enteritis, emaciation, drooping wings, poor growth, low production rate with high rate of mortality and morbidity[5].

DIAGNOSIS

It is clearly identified by necropsy/post mortem examination of affected birds at the earliest. Species identification is mainly through identifying morphological characteristics of specific species of *Eimeria*[52]. Diagnosis is by fecal examination and it may lead to quite fallacious interpretation[45]. Diagnosis was based mainly on the gross appearance of lesion, morphology of the oocysts, location of parasite in the intestinal epithelium of the host[10]. In some cases, it is known when oocysts are shed in the feces. On the other hand, the existence of large number of oocysts may not necessarily indicates a severe pathogenic condition. Accurate identification of the oocysts of various poultry coccidia is not easy[45]. It is based on the type and locations of lesions in which the species of *Eimeria* is localised in the gut. *E. acervulina* affects the upper parts of the small intestines and small red spots and white bands were noticed. *E. maxima* is concerned with the entire small intestine and the intestine looks too watery and in later have blood mucus and also with red pin point lesion in the intestine and it may look very thick and ballooned. *E. tenella* affects the blind sacks of the gut. The intestine may be filled with blood and turn in to a solid[16]. Diagnostic characteristics which includes the clusters of the large schizonts of *E. necatrix* and *E. tenella*, the small round oocysts of *E. mitis*, or the large gametocytes of *E. maxima* plays a major role. Presence of clusters of large schizonts in the midgut area is pathognomonic for *E. necatrix*, and a similar findings in the caeca indicates *E. tenella*. Oocysts with lesions in the duodenum are *E. acervulina, E. mivati*, or *E. praecox*, and oocysts with lesions in the lower gut are *E. mitis*, *E. mivati* or *E. brunette*[31]. Histopathologically, thickened gut wall indictes the fluid retention. Lumen of the gut may hold blood and that indicates haemorrhage and hyperaemia. There is also access with various body reaction and the progression of immune response[30]. Various biochemical and molecular methods have also been used in recent years[34]. As far as the performance of the flock is concerned, Oocyst per gram (OPG) counts in faeces or litters have a poor relation with the impact of the parasite. It is very challenging and requires expertise in identification of different species based on morphology of oocysts[13]. For detection of coccidial infections and species identification, Polymerase chain reaction was also used[18]

TREATMENT

Anticoccidial drugs and anticoccidial feed additives have been used in treating coccidiosis. Over the years, the effective and appropriate use of anticoccidial drugs and feed additives plays a major role in the development of the poultry industry and has cemented the way for the increased availability for better and reasonable poultry products for edible purpose.

CONTROL AND PREVENTION

Chemoprophylaxis and vaccination are the two means of control and prevention of coccidiosis. Chemoprophylaxis is by using anticoccidial products (ACP) or anticoccidials feed additived or drugs in the feed. It is most popular and it is estimated that 95% of the broilers receive anticoccidials[8]. Coccidiosis can easily be prevented than treated. Drugs may not always be relied up on to control but coccidiosis has led to other means of control[48]. Control is now based on hygiene, vaccine and genetics, apart from using drugs. But genetic way is a speculative strategy not practically established[22]. Combination of very good hygienic practices and the use of prompt anticoccidial agents in the feed or water will prevent coccidiosis. Litter should always be kept dry and special care and attention should be given to litter in which the farms located near water bodies[46,47]. Coccidiosistats are the prophylactic drugs used for prevention of coccidiosis. An effective coccidiostat will always inhibit the schizogonic stage and in turn develops immunity. Prophylactic use will be helpful because most of the damage occurs before signs become apparent and drugs cannot completely stop an outbreak[25]. It is known that when chickens are infected with low number of *Eimeria* parasites, protective immunity is induced after two or three consecutive infections[23]

ECONOMIC IMPORTANCE

The clinical form of the disease manifests through prominent signs of mortality, morbidity, diarrhoea or bloody faeces, and sub-clinical coccidiosis manifests mainly by poor weight gain and reduced efficiency of feed conversion and gives rise to highest proportion of the total economic losses[54]. Coccidiosis is recognized as the parasitic disease that has the greatest economic impact on poultry production. The annual worldwide cost is estimated at about $800 million[51]. These estimates include the costs of prophylaxis in feed medication for broilers and broiler breeders, alternative treatments, if the medications are unsuccessful, loss due to mortality, morbidity, poor feed conversions. It costs chicken producers worldwide at least 3 million US dollars yearly [12]. Coccidiosis in poultry had made a remarkable loss in Indian market and it is found to be of Rs. 1.14 billion for the year 2003-04[7].

CONCLUSSION

Coccidiosis is most important enteric parasitic disease of poultry which is allied with indicative economic losses to poultry industry and to poultry farmers worldwide. It has

been discussed that there are several species of *Eimeria* that affects poultry with varying pathogenicity. Occurrence of coccidiosis mainly depends on the agent, host and management as well as environment related risk factors. The presence of lesions and area of intestine which got affected in amalgamation with histo-pathological studies could be of assistance in healthier diagnosis of coccidiosis. Anticoccidials and very good management are important for control and prevention of coccidiosis in poultry industry. Hence, appropriate diagnostic methods and bio-security measures should be carried out to prevent and control the disease in the poultry. Further detailed studies may be taken up to have a sustainable production and cost-effective prevention and control methods.

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