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Poultry Coccidiosis: - Clean Coops, Healthy Flocks

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Abstract

Poultry coccidiosis, a destructive parasitic disorder of poultry industry on a world scale, is conditioned by intestinal tract protozoan parasites of the genus Eimeria. This disease causes disturbance in poultry production with symptoms as diarrhoea, low feed efficiency and high mortality rate in young birds. Environmental conditions are favourable to the survival and spread of the parasite in tropical and subtropical regions. Currently, chemoprophylaxis is the conventional precautionary strategy, however, overuse of anticoccidial drugs has resulted in the development of strain resistance to these agents and necessitated alternate prevention methods such as vaccination using attenuated Eimeria strains and increased farm management initiatives. The strategies stress the need to control hygiene, to manage litter moisture and stocking density to reduce risk of infection.

Coccidiosis remains an important problem in developing countries including Somalia and Pakistan, particularly in extensive or poorly managed farming systems in which biosecurity or effective drug access is poor. There remain persistent challenges, including poor litter management and inadequate efficacy of anticoccidial drugs, that require a more integrated disease control. The review calls for integrated strategies for poultry management underscoring elements of hygiene, judicious use of drugs and vaccination that will enhance health status and productivity and thus alleviate the substantial economic losses from this disease.

Keywords: Coccidiosis; Chickens; Diagnosis; Eimeria; Prevention

Introduction

Parasitic diseases continue to be a significant challenge in limiting the growth and profitability of agriculture in developing countries. In these regions, the expansion and intensification of poultry production have often outpaced the availability of skilled husbandry practices. Among these diseases, poultry coccidiosis stands out as one of the most widespread and economically impactful diseases affecting poultry globally [1]. Coccidiosis is caused by a protozoan parasite belonging to various Eimeria species within the genus Eimeria, family Eimeriidae, order Eucoccidiorida, and phylum Apicomplexa [2]. These Eimeria species infect the intestinal tracts of multiple animal species and birds. Transmission usually occurs when animals ingest contaminated feed or water containing sporulated oocysts [3]. In chickens, nine Eimeria species are known, with Eimeria brunetti, Eimeria maxima, Eimeria necatrix, and Eimeria tenella being the most harmful. Other species, such as Eimeria acervulina, Eimeria mitis, Eimeria mivati, Eimeria praecox, and Eimeria hagani, are less pathogenic [4].

Coccidian parasite infections have significantly impacted the commercial broiler industry economically over recent decades. These infections are widespread in tropical and subtropical regions, where environmental and management conditions allow the parasite to thrive and spread throughout the year [5]. Poultry coccidiosis is one of poultry infectious diseases causing significant poultry losses in Somalia [6]. Coccidiosis caused by pathogenic Eimeria species typically presents symptoms such as dysentery,

enteritis, and diarrhoea, sometimes blood-stained depending on the species involved. It can also lead to emaciation, reduced feed efficiency, delayed sexual maturity, drooping wings, stunted growth, decreased production, and often high rates of illness and death [7]. Eimeria tenella is identified as the most prevalent and serious species to affect the global poultry industry, as it affects 100% morbidity and high mortality with severe damage to the digestive tracts of chickens [8]. Eimeria species also cause high mortality rates, particularly in young chicks, since birds aged three to 18 weeks are most commonly affected [9]. Several factors influence development of clinical coccidiosis including the number of oocysts ingested by poultry, the virulence of the Eimeria species, age of the chicken, and management practices in place [10].

Many protective drugs have been internationally accredited to control coccidiosis in chickens. However, reduced drug efficacy and increasing resistance are important problems now, since no new anticoccidial agent is being developed [11]. In fact, with chemoprophylaxis, coccidiosis has been the primary method used to control the disease, and over the years chemoprophylaxis has worked. However, resistance to the traditional anticoccidial drugs has been becoming an increasing challenge to the poultry industry. The acceleration of efforts to explore alternative preventive measure has a lot to do with vaccination, which is now considered as one of the most important strategies in the prevention of these species [12]. Therefore, this paper is intended to review comprehensively poultry coccidiosis and its management strategies.

Review of literature

Etiology

Table 1: Eimeria Species with their Predilection Site in Intestine of Poultry.

Species	Predilection Site
E. tenella	Caecum
E. acervulina	Duodenal loop
E. necatrix	Mid gut
E. maxima	Mid gut
E. hagani	Anterior gut
E. mivati	Duodenal
E. praecox	Anterior gut
E. mitis	Anterior gut
E. brunette	Lower intestine

Poultry coccidiosis is amongst the most important parasitic diseases and thus represents a severe economic burden to the poultry industry. These are intracellular protozoan parasites belonging to the order Eucoccidiorida, family Eimeriidae, genus Eimeria [13]. Chickens are susceptible to infection by seven Eimeria species: (Table 1) nominates these species as E. acervulina, E. brunetti, E. maxima, E. mitis, E. necatrix, E. praecox and E. tenella. Coccidiosis, despite decades of study, remains one of the most economically impactful parasitic diseases that impact poultry production on a worldwide scale.

Morphology

An ovate structure forms the outer layer of most Eimeria oocysts. Other characteristics that can be used to distinguish between species include the extent of the intestinal area affected, gross lesion morphology, shortest time to sporulation, minimum prepatent period, size of the developmental stage of schizonts, location of the parasite within epithelial cells and results of cross-immunity tests [14].

Lifecycle

The life cycle of Eimeria involve cycles of asexual reproduction, called schizogony and sexual reproduction, commonly referred to as gametogony and finally the production of oocysts [15]. The sporulated oocyst is the infective stage and is ingested, in the gut mechanical and chemical factors such as bile salts and trypsin release the sporocysts within which the sporozoites are liberated into the duodenal lumen. (Figure 1)

Epidemiology

Coccidiosis is prevalent in tropical and subtropical areas due to ecology and management practices that promote the continuous presence of the pathogen [5]. In both local and international studies, the level and type of infections by Eimeria species differ considerably. In Ethiopia coccidiosis due to E. acervulina, E. necatrix, E. maxima and E. tenella is common and most prevalent in growing birds. In Somalia it is however noteworthy that the disease incidence is less in intensive poultry

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settings in comparison to smallholder systems. This is due to reasons such as poor managerial practices, stress, poor feed quality and nutrient digestion as well as diseases, unfavourable environmental factors, and frequent use of anticoccidial drugs by poor or extensive poultry farming systems [6]. Similarly in Pakistan, an overall coccidiosis prevalence of 28.3% in broilers was found, with clinical cases contributing 84.7% and subclinical cases 15.3% E. tenella (35.29%) was the most prevalent Eimeria species and the disease was more prevalent in broilers 22-42 days old with peak incidence during August and September, causing significant economic losses [16].

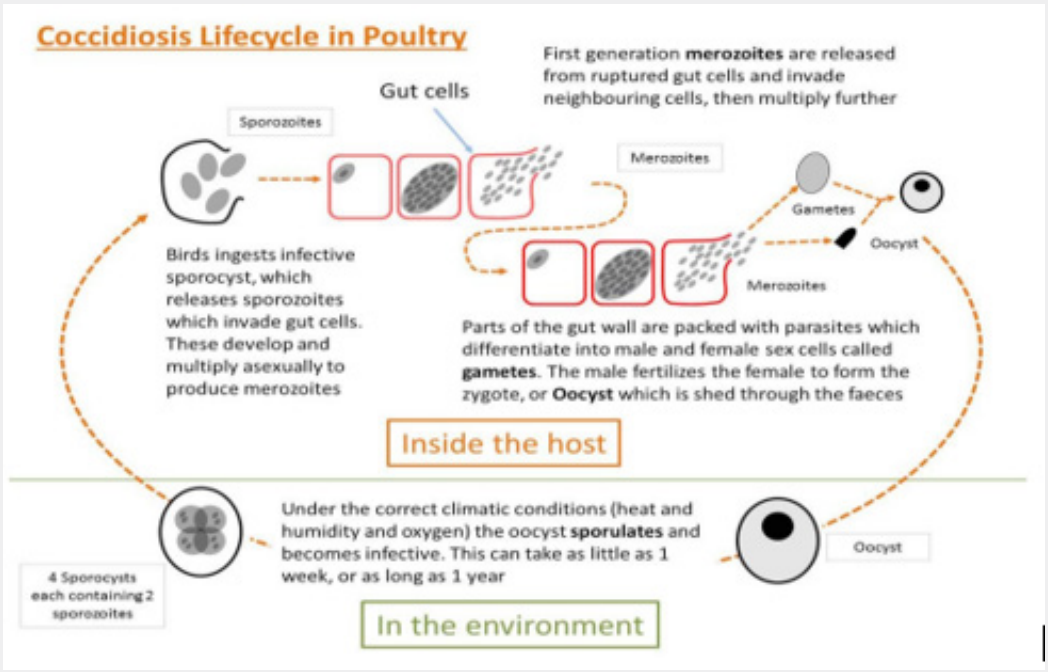

Figure 1: The different stages of Eimeria in and outside of intestinal cell.

Agent related risk factors

Coccidiosis reoccurrence in poultry depends on the Eimeria species per an infection and also the number of oocysts infective dose. The prepatent period of this parasite is short and it has a high reproductive rate that make oocyst numbers to rise sharply within litter [17]. Furthermore, enormous multiplication potential of poultry coccidia within the hosts intensifies parasite loads in susceptible birds and greater chance of environmental contamination [18].

Host related risk factors

Coccidiosis is common in young birds but older birds could also be affected if they have not had prior exposure. This increases the susceptibility to infection because the coccidia populations gradually builds up to dangerous levels. As a result, outbreaks are inclined in the young birds of ages three to eight weeks [19]. Susceptibility factors include floor stocking densities, the age of exposure to this parasite and the number of infection cycles [20].

Environmental and management related risk factors

The two main ways in which the oocysts of coccidia are spread are through contamination of feed and water and mechanically via poultry housing infrastructure. Because the parasite reproduces so rapidly, complete eradication of coccidiosis is difficult especially under today's rearing conditions [21]. Consequently, prevalence rates do not necessarily reflect flock size but tend to row with management practices. As common in poultry rearing, clinical symptoms are often compounded by poor management practices that facilitate oocyst sporulation as through wet litter, unhygienically associated feed and water troughs, inadequate ventilation and housing density [22].

Clinical Sign

In poultry, coccidiosis due to Eimeria species has been found to manifest signs characterised by decreased feed intake and poor weight gains, high mortalities, and poor feed conversion in affected chicks [23]. Eimeria tenella infection leads to moderate to severe lesions in the ceca and can sometimes be fatal. Infected birds often show signs of depression, ruffled feathers, drooping wings, diarrhoea, and a tendency to huddle together. Feed and water intake typically decline, and birds may become thin and dehydrated. In laying hens, egg production rates drop. Cecal coccidiosis can lead to symptoms such a bloody dropping and anaemia [24]. Clinical signs are related with tissue lysis due to

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efflux of the merozoites and mature forms of oocysts from the epithelial layer of mucosae during the terminal erythrocytic schizogony and during gametogenesis. As the mucosal disease progresses, most of the epithelial cells are desquamated, and the nutrient transport is severely affected [25].

Diagnosis

Coccidiosis in chickens is most easily diagnosed by autopsy of a representative sample of birds. Fecal examination alone can prove to be misleading [26]. In infections with E. tenella, pathological changes may occur to a major extent prior to oocyst release. In contrast, they do not necessarily need to contain large amounts of oocysts in feces to be very pathogenic. For example, E. acervulina infections release significantly more oocysts than E. necatrix of a lower reproductive capacity. Taxonomic differentiation of oocysts from different species of Eimeria can be a major diagnostic challenge [27].

More recently many biochemical and molecular methods have also been employed [12]. One of the factors that makes coccidiosis still an issue despite the efficiency of Eimeria as a parasite is diagnosis. Conventional parasitological diagnostic approaches are time-consuming and frequently expensive. Oocyst shedding rate expressed as oocysts per gram (OPG) of faeces or litters shows little correlation with the parasite's effect on the productivity of a flock. Discrimination of different species by morphology of oocysts is extremely difficult and calls for entomologists [11]. Detection of clinical disease caused by E. tenella is relatively easy enabling prompt treatment and long-term control strategy changes. Given this, its impact on broiler productivity is viewed as negligible, with many broiler farmers mostly linking coccidiosis to caecal infections. But this isn't true at all. In reality, E. acervulina and E. maxima are much more likely to be found in the field and are far less concerned with overt clinical disease. White lesions develop in the duodenum, sometimes more distally, interrupting the development of E. maxima and can be caused by E. acervulina [28].

Necropsy Findings

Indications of the specific Eimeria species attacking a bird can be made by the location and characteristics of the intestinal ulcers. The damage is to the top fraction of the small intestine (duodenum) and appears as very small red marks and white lines. Furthermore, Eimeria maxima affects the entire small intestine, where changes in feces first appear watery, upon which blood and mucus are then present. The intestinal lining may become swollen or distended and 'ballooning' may be seen along with red pinpointed lesions. Alternatively, Eimeria tenella usually inhabits the ceca (blind sacs) of the gut, where the ceca may fill with blood and pus which then calcify [19]. The gut wall gets thick from a histological standpoint, representing fluid build-up (edema). Bleeding (Haemorrhage) may be evident in the gut lumen or the accumulation of blood in tissues hyperaemia may indicate inflammation. Infiltration by immune cells and other body responses are also common [29].

Treatment, Control and Prevention

Anticoccidial feed additives have been indispensable ingredients in the poultry industry and allowed for production of high-quality, cost-effective poultry products for the past five decades. Coccidiosis prevention relies primarily on two methods: chemoprophylaxis and vaccination. Chemoprophylaxis, which involves adding anticoccidial agents to feed, remains the most widely used approach [30]. Preventing coccidiosis is generally much easier than treating it. While drugs have been crucial for its control, the rise of drug-resistant Eimeria strains has reduced their effectiveness. This limitation has prompted a growing interest in alternative methods of coccidiosis management [31]. Besides drug control, control is currently achieved through hygiene, vaccination and genetic controls. But genetics is considered theoretical strategy which is not put into practice [17].

The control of avian coccidiosis constitutes proper animal husbandry practices and administration of anticoccidial agents in feed or water. It is important to keep litter dry, with an emphasis on keeping areas around water bowls or troughs dry to prevent excessive build-up of moisture, including the difference between 'dry and high-carbon' and 'dry and low-carbon' diets [32]. The drugs applied to prevent coccidiosis are coccidiostats. Essential features of a coccidiostat are that it should prevent the development of the schizogonic stage and the host should be able to develop immunological resistance to the infection. This is done because major harm is done before symptoms develop and because drugs cannot fully prevent an outbreak [33].

Management

Avian coccidiosis can be controlled by management practices and through the administration of anticoccidials in the feed or in the water. Litter must also remain dry all the time, especially where there are water dispensers or feeding troughs [2]. Therefore, the main aspects of disease prevention on chicken farms are litter, cleanliness, cleaning of feeders and drinkers, and stocking density [34]. Extra precautions have to be exercised in rainy season since moisture is present, and the temperature is ideal for sporulation of oocysts. For clinical outbreaks, the clinically affected birds must be culled because these birds defecate oocysts daily and are a threat to other birds [35].

Prophylaxis

Coccidiostats are the anti-coccidial preventatives employed to counteract coccidiosis. Coccidiostat used should preferably act at the schizogonic stage of the parasite while the bird is being exposed so that own natural defences be developed. The drugs that can be used singly or in combination are amprolium, the ionophores and sulpha quinoxaline [33]. Sulpha quinoxaline was the first drug to be marketed and administered in the feed continuously and in relatively low concentrations [36].

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Vaccination and immunization

Two primary types of vaccines are used to immunize chickens against coccidiosis: attenuated and virulent [30]. Eimeria vaccines are attenuated meaning they are derived from Eimeria that have had part of them lifecycle removed so that they have less asexual reproduction cycles. By modifying them this way, their ability to cause disease and reproduce is reduced by a tremendous amount, which is an enormous advantage over virulent vaccines. But attenuated vaccines have lower reproductive capacity and, therefore, higher production costs. Other vaccines are called virulent vaccines, with strains that can comprise anticoccidial sensitive or resistant types. One notable advantage to vaccines utilizing live anticoccidial susceptible strains is their capacity to modify the resistance level within that coccidial population [28]. Attenuated or virulent oocysts from various Eimeria species used for these live vaccines are an economical alternative to anticoccidial drugs for coccidiosis control in poultry. This is the case for several commercially available vaccines. Examples of this are manufacturing attenuated vaccines from oocysts which are passed through embryonated eggs, as done in Livacox vaccines of E. tenella, or selection of early developmental stages of other Livacox [37] and Paracox vaccines, respectively. Such live attenuated vaccines thus provide a practical substitute to coccidiostats in the control of coccidiosis in chickens

Economic Importance

Coccidiosis is the most economically significant parasitic disease of the global poultry industry [38]. This is typically quantified in the animal agriculture sector and for poultry, it is in the area of revenue losses, vaccination and prevention expense and expense for eradication, decontamination, and bird replacement [39]. One characteristic that makes the disease challenging is the subclinical nature of the disease, which leads to growth depression and reduced feed conversion efficiency. The commercial broiler sector is estimated to bear about 95.6% to 98.1% of coccidiosis losses [40]. Protozoan disease, coccidiosis imposes enormous economic burdens to the global poultry industry where annually losses exceed about 3 billion dollars [41].The broiler and breeder preventive feed-based medication expenses, medication failure and alternative treatments expenses and moreover broiler mortality, sickness and illness, stunted growth of broiler, reduced egg production of layer, and inefficient feed utilization of surviving bird are considered as the financial impact of Coccidiosis [42].

Current Status of Poultry Coccidiosis in Somalia

Coccidiosis has been reported with varying prevalence among poultry across different places of Somalia. Prevalence of Coccidiosis was reported by researchers as listed as 19 out 40 examined chickens (47.5%) by [43], (19.8%) by [6] and (15.04%) from Mogdishu, 13.36% and 12.34% from Baidao and Kismayo respectively by [44]. There are several reasons why the prevalence of coccidiosis varies, including differences in breed and management systems, as well as the potential development of drug resistance [45].

Current Status of Poultry Coccidiosis in Pakistan

Coccidiosis is a serious challenge in Pakistan's poultry sector for broilers as well as layers, particularly inflicting significant fiscal losses. Wide occurrence of the disease in Punjab is related with its low management and increasing resistance to anticoccidial drugs [46]. In Dera Ismail Khan, prevalence of 44% was reported due to in adequate husbandry and biosecurity practices [47] and the highest prevalence of 52.94% was observed in August in Quetta in young flocks of 20-26 day of ages [48]. In Pakistan, the treatment costs and reduced broiler productivity due to coccidiosis cause losses exceeding 45,000 US$ annually, with the most severe coccidiosis rates (37.91%) during the monsoon season [49, 50]. Phytochemical intervention and implementation of biosecurity protocols are promising strategies to tackle high prevalence and drug resistance, as primary methods to protect the poultry industry [51].

Conclusion and Recommendation

In conclusion, poultry coccidiosis continues to be a major and wide spread protozoal parasitic disease that seriously affects poultry production with economically important impact all over the world especially in developing countries including Somalia and Pakistan. It remains an enormous problem despite advances in both disease control and prevention. Coccidiosis is host specific, site specific, and non-cross protective protozoan parasite of the genus Eimeria. These parasites target the intestinal tract of chickens, and the target chickens are of intensive poultry production systems. The disease mainly affects young birds or those with no prior exposure. Attempts have been made to control the condition, but in recent years, the extreme reliance on anticoccidial drugs has led to increased drug resistance. It is also important consideration to include the agent, host, environmental and management related risk factors in designing the control and prevention programs for poultry coccidiosis. Proper hygiene and biosecurity measures and prophylactic administration of appropriate anticoccidial drugs at recommended doses remain the best way to manage the disease. Furthermore, in intensive production systems, the use of a cage housing system rather than deep litter housing can assist in helping to reduce Eimeria oocyst accumulation and reduce infection risk. To minimize disease risks, chickens of different age groups should be housed separately, optimum stocking densities should be maintained and an all-in, all-out production system should be used on intensive farms.

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