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Salahaddin University-Erbil

Coccidiosis in poultry

Research Project
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﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا
الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

صدق الله العظيم

SUPERVISOR CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the degree of BSc. in Biology with my approval as a supervisor.

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DEDICATION

I dedicate this work to:

- My dear parent who always prayed for me and supported me in everything, and my sisters and brothers who are beside me.
- My supervisor Dr. Sarwat Ekram Al-Qassab
- My best friend who help me .

Esra

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ABSTRACT

The poultry industry is one of the main providers of protein for the world's population, but it faces great challenges including coccidiosis, one of the diseases with the most impact on productive performance. Apicomplexan parasites of the genus *Eimeria* are organisms which invade the intestinal tract, causing coccidiosis, an enteric disease of major economic importance worldwide. The disease causes high morbidity ranging from an acute, bloody enteritis with high mortality, to subclinical disease. The most important poultry *Eimeria* species are: *E. tenella, E. necatrix, E. acervulina, E. maxima, E. brunetti,* and *E. mitis*. *Eimeria* alters the function of the intestinal tract, generating deficiencies in the absorption of nutrients and lowering productive performance, leading to economic losses. The objective of this manuscript is to review basic concepts of coccidiosis, the different *Eimeria* species that infect chickens, their life cycle, and the most sustainable and holistic methods available to control the disease.

Keywords: Coccidiosis, *Eimeria*, Diagnosis, Pathogenicity.

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1. Introduction

Coccidiosis is recognized as the major parasitic disease of poultry and is caused by protozoan parasites of genus *Eimeria*. Infection by coccidia in sufficient number to produce clinical manifestations of disease is called clinical coccidiosis. The disease seriously impairs the growth and feed utilization of infected birds resulting in loss of productivity. It is one of a serious poultry parasitic disease that infects the epithelial lining of the intestine of poultry throughout the world (Conway and McKenzie, 2007).

The name poultry refers to all domestic birds such as chickens (domestic fowl), turkeys, ducks, geese, guinea fowls, ostriches and others, which are mainly kept for the production of meat and egg for human consumption. Among these, chickens are the most important species, adapted globally to various climatic conditions where human being lives and play a significant role in supplying animal origin protein to improve the nutrition of human being (Chauhan, 2016).

Worldwide, the poultry industry spends a significant amount of money in the prevention and treatment of several diseases. This parasite invades epithelial tissues of the intestine, causing severe damage in birds and as a result, significant economic losses. The main problem with *Eimeria* infections is that they are caused by more than one species that attack different regions of the intestine. The use of several drugs, alone or in combination, has proven to be an effective alternative in the struggle against avian coccidiosis. However, the emergence of drug resistant strains, especially after a prolonged use of a drug, is a real problem (Bogosavljevic-Boskovic et al., 2010).

Coccidiosis is endemic in most of the tropical and subtropical regions where ecological and management conditions favor an all year-round development and propagation of the causal agent (Obasi et al., 2006). It remains the most economically significant parasitic infection of the poultry worldwide (McDougal, & Fitz-Coy, 2003).

The aim of this review is to give an overview about *Eimeria* parasite and coccidiosis.

2. *Eimeria* species

Among the infectious diseases of poultry, coccidiosis is the major parasitic disease. Poultry coccidiosis is an economically important disease in chicken caused by the intracellular protozoa parasite species in the genus *Eimeria* family *Eimeridae* order *Eucoccidiorida* and phylum (Tylor et al., 2007). The genus *Eimeria* is included **seven pathogenic species**, which are (***E. acervulina, E. mivati, E. brunetti, E. maxima, E. mitis, E. necatrix*** and ***E. tenella***).

2.1 *Eimeria acervulina* (Figure 1)

Eimeria acervulina commonly invades the duodenal loop of the intestine and in heavy infections may extend to infect lower levels of the jejunum and even the ileum or lower intestine (Conway and McKenzie, 2007).

Fig. 1. *E. acervulina*

2.2 *Eimeria mivati* (Figure 2)

Eimeria mivati is the most recently described species of chicken coccidia, and its validity as a species has been questioned over the years. *E. mivati* moves down the intestine more than *E. acervulina* as the infection progresses, and lesions may appear further down the intestinal tract (Conway and McKenzie, 2007).

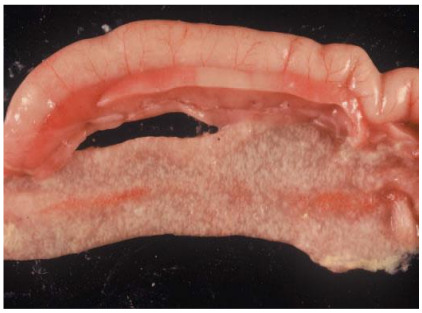

Fig. 2. *E. mivati*

2.3 *Eimeria maxima* (Figure 3)

Eimeria maxima infections are located in the mid-intestinal area on either side of the small knob (rudimentary diverticulum) left by the yolk sac. In severe infections, lesions may extend up into the duodenum and down as far as the ileo-cecal junction (Conway and McKenzie, 2007).

Fig. 3. *E. maxima*

2.4 *Eimeria necatrix* (Figure 4)

Eimeria necatrix also becomes established in the mid-intestinal area. However, later development of oocysts occurs only in the ceca (Conway and McKenzie, 2007).

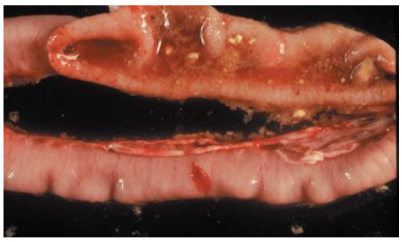

Fig. 4. *E. necatrix*

2.5 *Eimeria brunetti* (Figure 5)

Eimeria brunetti parasitizes the lower intestine extending down into the large intestine (between the ceca and rectum) (Conway and McKenzie, 2007).

Fig. 5. *E. brunetti*

2.6 *Eimeria tenella* (Figure 6)

Eimeria tenella, the well-known cause of cecal or "bloody" coccidiosis, invades the two ceca and in severe cases may also parasitize the intestine above and below the cecal junction (Conway and McKenzie, 2007).

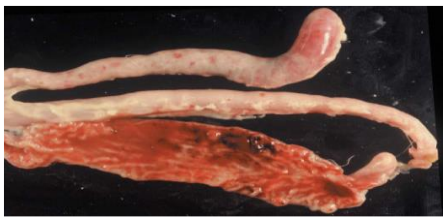

Fig. 6. *E. tenella*

2.7 *Eimeria mitis* (Figure 7)

No discrete lesions are produced, but infections with this species will adversely affect bird performance and skin pigmentation (Conway and McKenzie, 2007).

Fig. 7. *E. mitis*

3. Lifecycle

Eimeria species follow a typical coccidian life cycle with both exogenous and endogenous developmental stages (Barta, 2001) (Figure 8). The life cycle of all *Eimeria* species involves two or more generation of an asexual development known as shizogony, then merogony and followed by sexual phase gametogony which results in the formation of oocysts.

The sporulated oocyst possesses four sporocysts that each sporocyst contains two infective sporozoites (the infective agent) within them (Barta, 2001). The sporulated

oocyst which is the infective stage of this enteric protozoan parasite is ingested and the action of mechanical and chemical factors in the gut (bile salt and trypsin) leads to the release of sporocysts and then sporozoites in the duodenal lumen of chickens (Abebe et al., 2018).

Excystation results in the opening of the anterior cap of sporocysts to release infective sporozoites. Within these host cells, the sporozoite develops into a trophozoite (a growing stage that absorbs nutrients from the host) that grows larger and divides asexually to form numerous merozoites (known as merogony) (Allen and Fetterer, 2002). These merozoites invade cells and develop into either macrogametes or microgametes.

The macrogametocyte gives rise to a single female macrogamete whereas the male gametocyte (= microgametocyte) matures and ruptures, releasing a large number of minute biflagellate microgametes. The life cycle is quite rapid with prepatent period of about 4-5 days but there may be variation within species. The degree varies with species but optimally may result in hundreds of thousands or even millions of oocysts produced from one ingested oocyst (Alexander, 2002).

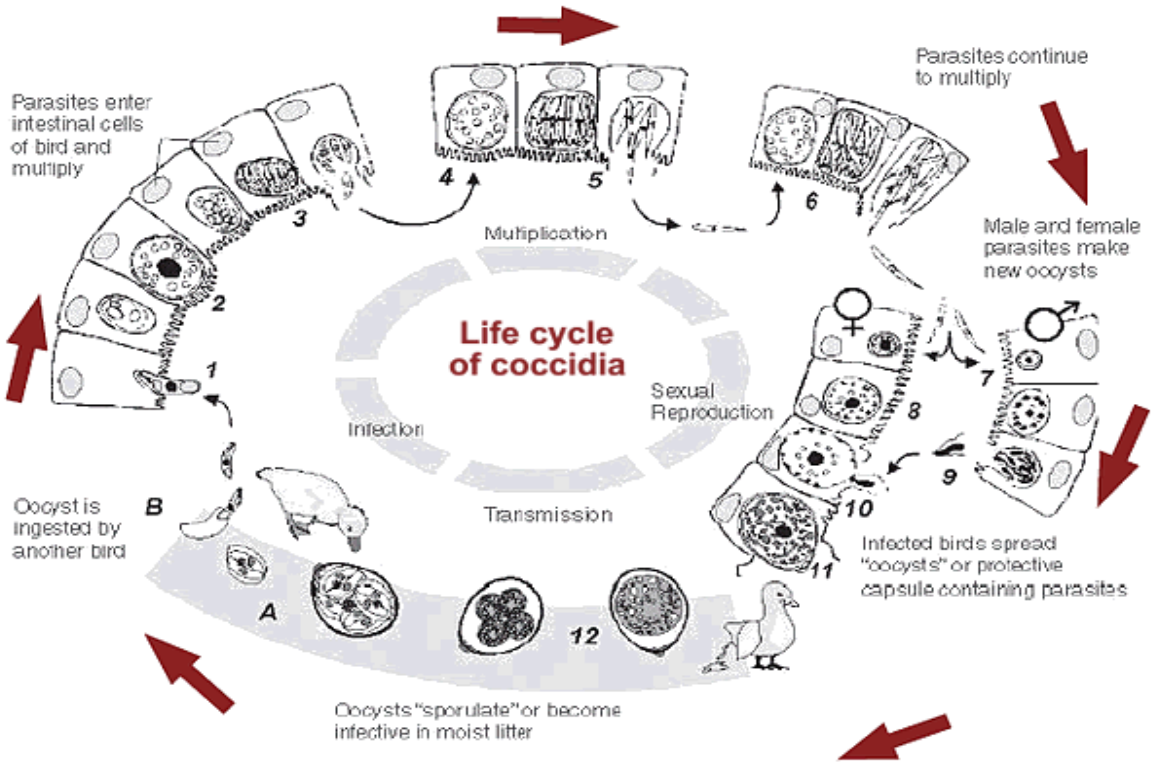

Fig. 8 The different stages of *Eimeria* in and outside intestinal cells (Fanatico, 2006).

4. Pathogenesis

Infection by *coccidia* in sufficient number to produce clinical manifestations of disease is called coccidiosis (Abdisa et al., 2019). Though nine species of *Eimeria* have been identified as causative agents of poultry coccidiosis, only seven of them have been reported to be pathogenic (Kahn and Line, 2010). *Emeria tenella* and *E. necatrix* are the most pathogenic species. *Emeria acervulina, E. maxima and E. mivati* are common and slightly too moderately pathogenic while *E. brunetti* and *E. mitis* is uncommon but pathogenic when it does occur. *Emeria praecox* and *E. hagani* are relatively non-pathogenic species (Soulsby, 1982).

Oocysts passed in the feces require suitable environmental conditions to sporulate. Moist, temperate, or cool conditions favor sporulation, whereas high temperature and dryness impede it (Abdisa et al., 2019). The protozoan parasite of the genus *Eimeria* multiplies in the intestinal tract and causes tissue damage, resulting in the interruption

of feeding, digestive processes, nutrient absorption, dehydration, blood loss, loss of skin pigmentation and increased susceptibility to other disease pathogens (Shirzad et al., 2011).

5. Diagnosis

Diagnosis of coccidiosis in chicken is best accomplished by postmortem examination of representative number of birds. Diagnosis by fecal examination may lead to quite erroneous results. In some instances, the major pathology is produced before oocysts are shed in the feces (*E. tenella*) and, conversely, the presence of large number of oocysts may not necessarily indicate a serious pathogenic condition. Thus, with *E. acervulina,* which has a high biotic potential, comparatively larger numbers of oocysts are shed than, for example, with *E. necatrix.* Furthermore, the accurate identification of the oocysts of various poultry *Coccidia* is not easy (Abdisa et al., 2019).

Diagnosis of clinical disease caused by *E. tenella* is quite easy and action (therapy on the short term, change of preventive means on the long term) can be swift. These facts make its impact on the productivity of the broiler industry is relatively limited compared to the other species, although many broiler farmers associate coccidiosis only with caecal coccidiosis. This is a good example of perception not being in accordance with the facts. *Eimeria acervulina* and *E. maxima*, both much more prevalent, are less perceived to be related with clinical coccidiosis in the field. *E. acervulina* is causing white lesions in duodenum and in heavier infections also more caudal, interfering even with the ability for *E. maxima* to develop (Mathis and Broussard, 2006).

Molecular techniques have contributed to the detection of *Eimeria* spp. where PCR has a prominent position. PCR using the internal transcribed spacer-1 (ITS-1) and (ITS-2) molecular markers, and multiplex PCR using (SCAR) markers, allowing for a precise identification of the seven species through a single reaction (PCR) (Moraes et al. 2015).

6. Treatment, Control and Prevention

The effective use of anticoccidial feed additives over the past 50 years has played a major role in the growth of the poultry industry and has allowed the increased availability of high quality, affordable poultry products to the consumer. There are basically two means of prevention of coccidiosis: chemoprophylaxis and vaccination. Chemoprophylaxis using so-called anticoccidial products (ACP) or anticoccidials in the ration is by far the most popular (Chapman, 2005).

Prevention of avian coccidiosis is based on a combination of good management and the use of anticoccidial compounds in the feed or water. Litter should always be kept dry and special attention should be given to litter near water fonts or feeding troughs (Tylor et al., 2007). The prophylactic drugs used for prevention of coccidiosis are coccidiosistats.

7. Economic Importance of Poultry Coccidiosis

Coccidiosis, caused by *Eimeria* species parasites, has long been recognised as an economically significant disease of chickens. As the global chicken population continues to grow, and its contribution to food security intensifies, it is increasingly important to assess the impact of diseases that compromise chicken productivity and welfare. The global cost of coccidiosis in chickens is estimated to have been ~**£10.36 billion** in 2016, including losses during production and costs for prophylaxis and treatment. As the human population continues to expand and the challenge to achieve food security increases, improving understanding and control of economically significant pathogens of livestock remains essential (Blake et al., 2020).

8. Conclusions

Coccidiosis is an important enteric parasitic disease of poultry associated with significant economic losses to poultry farmers worldwide. It has been indicated that there are several species of *Eimeria* affect chickens with varying pathogenicity. The occurrence of coccidiosis dependent on agent, host and management as well as environment associated risk factors. The presence of lesions and part of intestine

affected in combination with histo-pathology could help in better diagnosis of coccidiosis. Anticcocidials and good management are important for control and prevention of coccidiosis in domestic chickens.

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