Acta Scientific Veterinary Sciences (ISSN: 2582-3183)

Volume 6 Issue 1 January 2024

Review Article

Coccidiosis Management: A Comprehensive Overview and Strategies for Control

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Received: August 02, 2023

Published: December 02, 2023

Abstract

Coccidiosis is an infectious disease of the intestinal tract of wild and domestic animals caused by different protozoa. It is one of the most expensive and common diseases of poultry in spite of the advances in treatment, management, nutrition, and genetics and is considered as a key factor that causes an enormous loss to poultry producers worldwide. The aim of this paper is to deal with the overview of the disease and effective use of anticoccidial drugs for its prevention and control.

Keywords: Coccidiosis; Ionophore; Chemical; Anticoccidial Programs

Introduction

In recent times poultry industry is focused towards improving the performance of commercially reared poultry birds by concentrating on gut health using different approaches i.e., AGP, probiotics, acidifiers etc. in feed. But without having successful coccidiosis management it seems difficult to achieve optimum performance in commercial poultry farming. Coccidiosis still persists to be one of the most expensive and common diseases of poultry in spite of the advances in treatment, management, nutrition and genetics and is considered as one of the key factors that causes an enormous loss to poultry producers worldwide. Objective of this paper is to deal with the overview of coccidiosis in poultry and effective use of anticoccidial drugs for its prevention and control.

What is coccidiosis?

Coccidiosis is an infectious disease of the intestinal tract of wild and domestic animals caused by different protozoa. Seven Eimeria species that parasitize various intestinal parts in chickens have been identified [18]., namely: *Eimeria tenella, E. brunetti, E. acervulina, E. mitis, E. necatrix, E. maxima* and *E. praecox.* Co-infection with multiple species is common and can complicate diagnosis [20]. *Eimeria necatrix* has been recognised as the most pathogenic *Eimeria* species which infects chickens, but *E. tenella* is more common and exerts a greater impact on poultry production [4,13]. *Eimeria acervulina, Eimeria maxima,* and *Eimeria mivati* are also common and slightly to moderately pathogenic. *Eimeria brunetti* is uncommon but pathogenic when found, and *Eimeria mitis* and *Eimeria praecox* can be considered non-pathogenic [19].

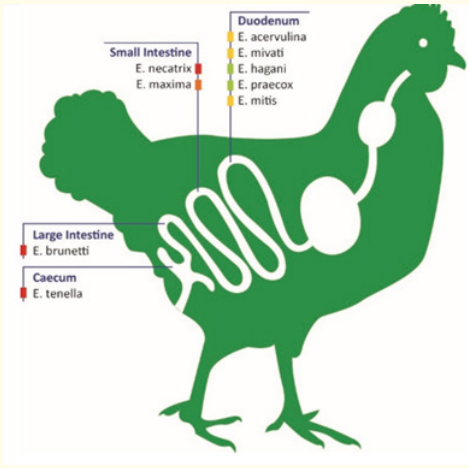

Figure 1: Different species of Eimeria in chicken. Source: The poultry site.

Global Scenario of coccidiosis

It costs chicken growers globally at least 9.2 and 15.6 billion, or approximately USD 0.2 per chicken [5]. This figure incorporates not just the expense of prophylactics and treatments, but also the accompanying performance and mortality losses. Additional losses owing to secondary coccidiosis concerns may also enhance the overall economic effect.

Indian Scenario of coccidiosis

Total loss due to coccidiosis in poultry in India was estimated to be Rs. 1.14 billion in 2003-04 [3]. Among the seven species of Eimeria, *E. acervulina, E. brunetti, E. necatrix, E. mitis* and *E. maxima* are most prevalent in India [1,17]. The three most widespread Eimeria species that cause intestinal coccidiosis in North India are *E. acervulina, E. necatrix,* and *E. maxima* [16]. Rectal coccidiosis is caused by the highly pathogenic but uncommon *E. brunetti* [16]. E. necatrix, a highly pathogenic strain, was more prevalent in South Indian farms than E. acervulina, a moderately pathogenic strain [16].

Life Cycle of Eimeria spp.

The life cycle of Eimeria is relatively short, at 4-6 days, and it consists of two developmental stages -

- Exogenous stage (in faecal matter) - Sporogony
- Endogenous stage (in host digestive tract) - includes: Asexual multiplication - Schizogony (1st and 2nd Sz) and Sexual reproduction - Gametogony

The exogenous stage starts after the release of unsporulated (non-infective) oocysts in the faeces. Sporulation of the oocyst occurs in the faeces and is favoured by the right temperature, humidity and aeration (access to oxygen). In the sporulated oocyst the so called sporozoites are formed and from that point on the oocysts are considered infectious. Sporulated oocysts are remarkably hard and protect the parasite from desiccation and chemical disinfectants, ensuring long-term survival in the poultry house environment.

The endogenous stage starts after ingestion of the infective oocysts by the chicken. In the microenvironment of the gizzard sporozoites are released from the oocyst. Further in the digestive tract the sporozoites invade and destroy epithelial cells and start the highly efficient reproduction cycle. This involves several rounds of asexual reproduction followed by sexual differentiation, fertilization and shedding of unsporulated oocysts.

The highly efficient copious reproduction of Eimeria species in the digestive tract and perfect survival strategy (sporulation) in faecal matter, increase the chances of infection in avian flocks.

Species	Site of development	Pathogenicity	Gross lesions	Ref.
Eimeria praecox	Duodenum, jejunum	Least pathogenic	Watery intestinal contents Mucus and mucoid casts	15
E. acervuline	Duodenum, ileum	Less pathogenic	Limited enteritis causing fluid loss. Malabsorption of nutrients	10
E. mitis	Ileum	Less pathogenic	Limited enteritis causing fluid loss. Malabsorption of nutrients	10
E. maxima	Jejunum, ileum	Moderately-Highly pathogenic	Inflammation of the intestinal wall with pinpointed haemorrhages Sloughing of epithelia	10
E. brunetti	Caeca, rectum	Highly Pathogenic	Inflammation of the intestinal wall with pinpointed haemorrhages Sloughing of epithelia	10
E. tenella	Caeca	Highly Pathogenic	Thickened caecal wall and bloody contents at the proximal end Distension of caecum Villi destruction causing extensive haemorrhage and death.	10
E. necatrix	Jejunum, ileum, caeca	Highly Pathogenic	Intestine may be ballooned Mucosa thickened and the lumen filled with fluid, blood and tissue debris Lesions in dead birds are observable as black and white plaques (salt and pepper appearance)	10

Table 1: Characteristics of Eimeria spp. found in poultry.

Coccidiosis can affect poultry birds in many ways [14] as follows.

- Poor growth
- Impaired feed conversion
- Interruption in digestive processes and nutrient absorption
- Dehydration
- Blood loss
- Skin pigmentation loss
- Increased susceptibility to other pathogenic agents

Forms of the disease

- **Clinical coccidiosis-** Clinical outbreaks are common between 3-6 weeks of age and rarely in flocks below 3 weeks and characterized by bloody diarrhoea and high mortality.
- **Sub-clinical coccidiosis** (economically important)- Subclinical infection mainly causes defective feed conversion.

Factors pre-disposing coccidiosis in poultry

- High stocking density
- Bad quality litter and lighting schedule
- Antinutritional factors (ANF's) in the feed
- Faulty brooder and grower management
- Number of oocysts ingested by the bird and strain of coccidia.
- Environmental factors affecting the survival of the oocysts
- Site of development within the host
- Nutritional status and age of the host

Different approaches used against treatment and prevention of coccidiosis

There are different drugs like sulfatrimethoprim, toltrazuril or sulfachloropyrazine sodium monohydrate, amprolium with vitamin K, sulfadimethoxine or sulfamethazine (sulfadimidine) are generally used for treatment of the coccidiosis outbreaks. Treatment is very expensive in case of coccidiosis outbreaks experts often suggest to go for the control of coccidiosis primarily through routine chemoprophylaxis and vaccination. These control measures have proven to be highly effective in managing Eimeria in commercial chicken production out of which chemoprophylaxis, is widely used in commercial poultry production. However, using vaccines to control coccidia is not as common. There are two types of coccidiosis vaccines: virulent and attenuated, are mainly used in layer and breeder chickens. But overall, using vaccines to control coccidia is not as popular as giving drugs to the chickens.

Anticoccidial drugs: essential weapons in the fight against coccidiosis

The agents used for the control and prevention of coccidiosis are known as anticoccidial drugs. They may be 1. Coccidiostatic- in which growth of intracellular coccidia is arrested but development may continue after drug withdrawal, 2. Coccidiocidal- in which coccidia are killed during their development. Some anticoccidial drugs may be coccidiostatic when given short term, but coccidiocidal when given long term. Most anticoccidials currently used in poultry production are coccidiocidal. Today almost all the broiler flocks throughout the world receive anticoccidial drugs in feed as prophylaxis, and treatment is used as a last resort.

The anticoccidial drugs currently used can be classified in three categories: Polyether antibiotics (Ionophores), Synthetic and mixed [2,6,7].

- Ionophores are produced by the fermentation of Streptomyces spp. Or Actinomadura spp. Further ionophore drugs are classified into three classes:
  - **Monovalent Ionophores:** Salinomycin, Monensin and Narasin**.**
  - **Monovalent glycosides ionophores:** Maduramicin and Semduramicin.
  - **Divalent Ionophores:** Lasalocid
- Synthetic compounds are produced by chemical synthesis and often referred to as 'chemicals'. Synthetic drugs have a specific mode of action against the parasite metabolism.
- Mixed products are few drug mixtures, consisting of either a synthetic compound and ionophore i.e., Nicarbazin/Maduramicin and Nicarbazin/Monensin or two synthetic compounds are also used against coccidiosis.

Ionophores interfere with the transport of ions across the cell membrane, resulting in parasite death. They have a common method of action, and if resistance develops to one, it will be visible to the others, specifically amongst ionophores of the same class (cross resistance). Synthetic medications interact in a completely distinct manner and inhibit a wide range of biochemical pathways; if resistance develops, it will not be shared with an ionophore or synthetic drug of a different type.

This gives reasons for using synthetic medicines and ionophores in rotation schemes. Another key difference between ionophores and synthetic drugs is the manner in which parasites are destroyed. Ionophores act on sporozoites, the stage of the life cycle found in the gut lumen, before they penetrate a host cell, whereas chemical coccidiostats destroy intracellular stages after they have penetrated host cells and are developing in the intestine [9].

Managing coccidiosis: strategies for effective control and prevention on the farm

Eradication of coccidiosis has proved impossible and the parasites are found in almost all commercial broiler houses. Therefore, prophylaxis has been the preferred method for the control of coccidiosis in poultry because treatment once clinical signs become apparent, treatment is often too late to prevent the pathological consequences of infection and cause heavy economical loss [8].

Continuous use of anticoccidial drugs promotes the emergence of drug-resistant strains of coccidia. While there is little cross-

resistance to anticoccidials with different modes of action, there is widespread resistance to most drugs. Resistance: this term is used to indicate a loss of protection by a product, which may be recognised more commonly by poor weight for age and feed efficiency than clinical disease. To overcome this problem, various programmes are practised

- **Rotation Programme:** In rotation programme one anticoccidial drug is used continuously through succeeding flocks and then changed to alternative anticoccidials every 4-6 months.
- **Shuttle programme:** In shuttle programme two or more drugs are used in different feeds in the same flock. Shuttle programmes commonly involve incorporating a synthetic drug or their combination in the starterfeed followed by an ionophore in the grower.

Ionophore	Chemical	Mixed Compounds
Lasalocid	Robendine	Maruramicin + Nicarbazin
Maduramicin	Diclazuril	Monensin + Nicarbazin
Salinomicin	Clopidol	
Monensin	Decoquinate	
Narasin	Nicarbazin	
Semduramicin	Amprolium	

Table 2: Commonly used anticoccidial drugs in poultry feeds.

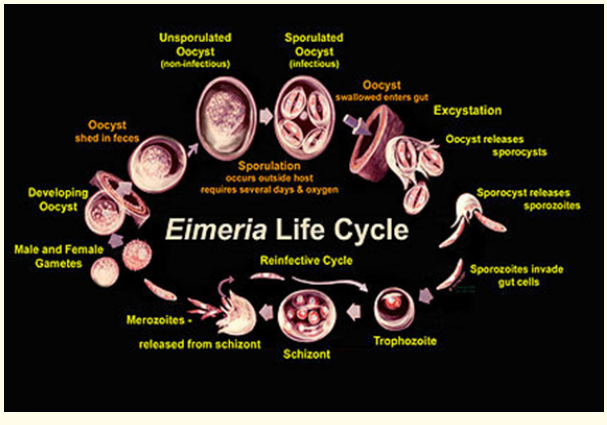

Figure 2: Eimeria life cycle.

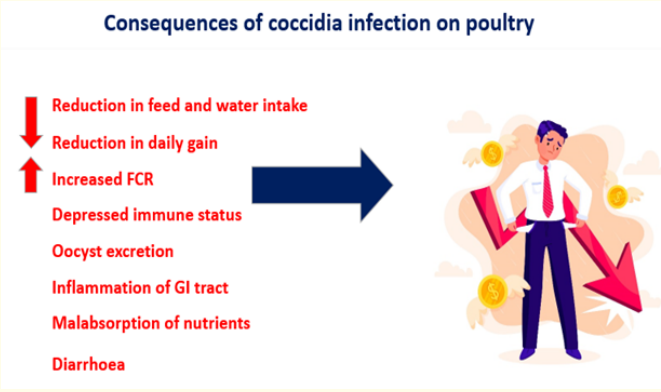

Figure 3: Consequences of coccidia infection on poultry.

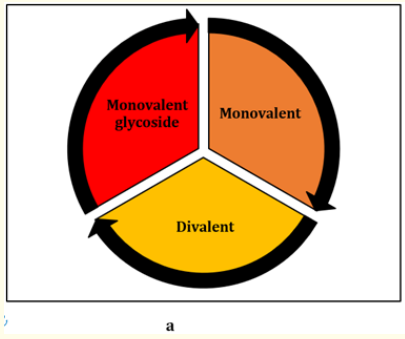

Figure 4: Suggested anticoccidial rotation programmes a and b.

Mastering anticoccidial programs: key factors to remember for optimal success

Poultry producers often use a single drug for prolonged durations until they get good results, but that also leads to the development of resistance to that drug on those farms. To overcome the challenges of drug resistance and effective management of coccidiosis in poultry production, we need to avoid long-term exposure to any drug that will result in loss of sensitivity. Therefore, we need to keep the following things in mind when we are using shuttle or rotation programmes

- Do not use single drug for prolonged duration simply because you are getting good results.
- Give appropriate resting period to every drug after use for prevention and control of coccidiosis.
- Do not rotate products. Rotate the molecules of different classes.
- Use a chemical clean up once a year, it gives a very good reduction infection pressure.
- Always follow the dose recommendations from labels.

Keeping a watchful eye on coccidiosis occurrence on farm

The clinical signs of coccidiosis may or may not be accompanied by large numbers of oocysts being shed in the faeces. Currently, the most commonly used diagnostic methods are oocyst counts and lesion scoring.

- **OPG (oocyst per gram):** The number of oocysts shed in the faeces, which is measured in oocysts per gram (OPG), can be used as an indication of the presence of infection. But this is not a diagnosis of the disease since coccidia are present in the intestine of 3-6-week-old birds in most flocks. It should be correlated with the gross intestinal lesions and associated mortality.
- **Lesion scoring:** Most commonly used diagnostic tool for examining the intestinal integrity damaged by Eimeria spp. This scoring system provides valuable information about the severity of the infection and the involved species of Eimeria.

Conclusion

Coccidiosis is a significant threat to poultry production, leading to reduced productivity and increased mortality. The use of anticoccidial drugs is a crucial management strategy to control. For superior coccidiosis control there is need to follow proper anticoccidial programs. With the use of quality products, anticoccidial programs and monitoring of coccidiosis on poultry farms, producers can improve the health, welfare, and productivity of their birds, leading to increased profitability and sustainability in the poultry industry.

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