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Current Anticoccidials Used in Nigeria; Benefits and Challenges: Review

M.O. Otu[1], I.A. Lawal[2], B.D. George[2], M.S. Abubakar[3], I.A. Adeyinka[1], A.A. Sekoni[1], B.I. Nwagu[1], F.O. Abeke[1]
E.O. Adejoh-Ubani[1], I. Abdullahi[1], A.K. Oluntunmogun[1], A.U. Umar[1], M.A. Ibrahim[1] and H.M. Haruna[1]
[1]National Animal Production Research Institute, Ahmadu Bello University, Zaria
[2]Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, A.B.U., Zaria
[3]Department of Pharmacognosy and Drug Formulation, Faculty of Pharmaceutical Sciences, A.B.U., Zaria
Corresponding author: M.O. Otu; E-mail: marthaotu@gmail.com; Tel: +2348028565087

Abstract
The use of anticoccidial drugs has become the treatment of choice in the poultry industry in Nigeria. Currently, several types of anticoccidial drugs are available including synthetic compounds, quinolones and certain ionophore antibiotics. In recent years however, few new drugs have been introduced and very few drugs are equally efficacious against all *Eimeria* species. The poultry industry in Nigeria is facing problems which include drug resistance, lack of new anticoccidial products and consumer demanding decrease in the use of drugs in animal feeds. Specific anticoccidial drugs in use include Amprolium, Diaclazuril and Toltrazuril**,** Folic acid and Polyether ionophores. The urgent need to seek alternative strategies to control coccidiosis has made the use of vaccines more attractive. New generations of safe, live attenuated vaccines are now commercially available such as Coccivac® and Immucox® and new live vaccines such as Paracox® are safe though live. Alternative control of coccidiosis include nutritional (Fat diet and vitamin A supplement and probiotics (immune modulators) or natural feed additives and herbs. The following challenges encountered in the management of coccidiosis include poor response to drug therapy due to the development of resistant strains and increased costs of drugs. Although vaccines played a role in coccidiosis control for a long time the developed countries, in developing countries such as Nigeria their applications still remain very limited with consideration for the safety, costs and demands for high techniques by the farmers or veterinarian. In conclusion, though great exploits have been achieved in the control of the disease using drugs and vaccines, challenges with their use as well as the emphasis in the society for chemical free products, it is recommended that more work could be done using natural alternatives such as plants and other products.

Keywords: Coccidiosis, *eimeria* species, vaccines, drugs

Introduction

Coccidiosis has remained the most important poultry disease in Nigeria (Obasi *et al.,* 2006). Lawal *et al.* (2008) showed that the infection can occur in both local chickens and exotic birds with the former serving mainly as reservoir hosts. The disease causes substantial economic losses due to malabsorption, bad feed conversion rate, reduced weight gain and mortality (Fornace *et al*., 2013). It is responsible for 6-10% of all broiler mortalities and incidence of the disease in commercial poultry ranges from 5-70% (Usman *et al.,* 2011). The use of anticoccidial drugs became the treatment of choice in the poultry industry as large volumes of manufacturing methods and market competition reduced the cost of treatment (Price and Barta, 2010).

The use of anticoccidial drugs allowed for more birds to be reared in a single house, however, these products also prevented treated birds from building up any natural immunity and was not effective enough to kill all Coccidia in a bird (Hafez, 2008). The result was that the surviving Coccidia quickly became resistant to the products resulting in severe outbreaks of the disease (Hafez, 2008). The poultry industry is facing problems which include drug resistance, lack of new anticoccidial products and consumer demanding decrease in the use of drugs in animal feeds (Hafez, 2008).

Legislation demands that most anticoccidial drugs must be removed from the medicated feed approximately a week before marketing and for effectiveness (Price and Barta, 2010). However, the withdrawal of drugs could increase the susceptibility of birds to infection because they may not have acquired protective immunity while on treatment with anticoccidial drugs (Price and Barta, 2010). This suggests that coccidiosis is likely to have a greater impact on the profitability of broiler meat and egg productions in future (Sunhwa *et al.,* 2014). There is therefore, an urgent need to seek alternative strategies to control coccidiosis.

This review was done to see the benefits and challenges of contemporary drugs used to control coccidiosis.

Benefits of Prophylactic Treatment

Prophylactic treatment with the anticoccidial drug has led to the emergence of drug-resistant strains due to prolonged use in the field (Price and Barta, 2010). To combat this, management programmes such as drug rotation or shuttle programme are of a great value (Hafez, 2008). Lee *et al*. (2009) discovered that careful use of the shuttle rotation programme did not fully prevent drug resistance but increased the useful longevity of the drug. Most anticoccidials currently used in poultry production are coccidiocidal (Gerhold, Jr, 2014) and may be used in feed as preventive doses (Chauhan and Roy 2007). Coccidiostats are currently been regulated under the Feed Additives Regulation No 1831/2003 IEC (EC, 2003; 2007). As such they have not been subject to veterinary prescription status since they are required routinely in the feed of commercial broilers and turkeys (Hafez, 2008). In recent years however, few new drugs have been introduced and very few drugs are efficacious against all *Eimeria* species. Some specific anticoccidial drugs include:

Types of Anticoccidial Drugs

Amprolium: This is an antagonist of thiamine (vitamin B1) (Gerhold Jr, 2014), rapidly dividing coccidia have a high requirement for this vitamin. The primary use of Amprolium today is for water treatment during clinical outbreaks of coccidiosis (Gerhold Jr, 2014).

Diaclazuril and Toltrazuril: These are recent anticoccidial drugs (Gerhold, Jr, 2014) and it was reported that Toltrazuril is active against all intracellular developmental stages including those of schizogony and gametogony and does not interfere with the development of natural immunity (Kitandu and Juranova, 2006). Diaclazuril is used mainly for prevention used in the feed while Toltrazuril is used primarily for treatment in the water (Gerhold, Jr, 2014).

Clopidol and Quinolones (Decoquinate, Methylbenzoquate): They are coccidiostatic against early development of *Eimeria* species by inhibiting mitochondrial energy production (Gerhold Jr, 2014).

Folic acid antagonists: These include the sulphonamides, 2, 4- diamino pyrimidines and ethopabate (Gerhold, Jr, 2014). These compounds are structural antagonists of folic acid or of paramino benzoic acid (PABA) which is a precursor of folic acid. Diaveridine, Ormetoprim and pyrimethamine are active against the protozoan enzyme dihydrofolate reductase. They have synergistic activity with sulfonamides and are often used in mixtures with these compounds (Gerhold Jr, 2014).

Polyether ionophores: Since 1971, the preferred drugs for coccidiosis prevention have been ionophore antibiotics (Kitandu and Juranova, 2006). The ionophores (Monensin, Salinomycin, Lasalocid, Narasin, Maduramicin and Semduramicin) form complexes with various ions, principally sodium, potassium and calcium and transport these into and through biologic membranes (Gerhold Jr, 2014). The ionophores affect both extra and intracellular stages of the parasite, especially during early asexual stages of parasite development (Gerhold, Jr, 2014) and as such remain useful agents to activate sufficient control despite resistance being common (Kitandu and Juranova, 2006). It has also been demonstrated that some ionophores can be used in combination with live virulent vaccines. The advantage of such ionophores is that they prevent infection during the first 3-4 weeks of age when immunity is not developed (Kitandu and Juranova, 2006). Some ionophores may depress feed consumption when the dosage is above recommended levels but these products remain the most important class of anticoccidials (Gerhold, Jr, 2014).

Vaccination Against AvianCoccidia

There is an urgent need to seek alternative strategies to control coccidiosis which has made the use of vaccines more attractive (Hafez 2008). Avian coccidia are highly immunogenic and primary infections can stimulate solid immunity to homologous challenges (Price and Barta, 2010). Sporozoites are the preferred parasitic forms and cell surface antigens as logical components of vaccines because of their direct role in host-parasite relationship (Min *et al*., 2004). Some virulent coccidial oocyst vaccines now available are Coccivac® and Immucox® (Chauhan and Roy, 2007). New live vaccines such as Paracox® are safe though live because they have genetically low reproductive index, hence they cannot produce pathogenic numbers required to produce disease. Live vaccines have been used mostly in breeder stocks and to a lesser extent in commercial broilers and replacement hens.

Natural medicinal products as feed supplements have been widely used as growth and health promoters in farm animals (Kitandu and Juranova, 2006). Alternative controls of coccidiosis are described below:

Factors influencing the Outcomes of Coccidial Infections

Fat diet: Diets containing high concentration of fatty acids (n-3 FA) docosahexaenoic acid, eicosapentaenoic acid and linolenic acids such as fish oils, flax seed oil, and whole flax seed when added to starter ration and fed to chicks from 1 day of age effectively reduced lesions resulting from challenge infection with *E tenella* (Kitandu and Juranova, 2006).

Feed additives: Vitamin A known for its role in the differentiation of epithelial cells is essential for maintaining the integrity of mucosal surfaces (Kitandu and Juranova, 2006). Feed supplementation with antioxidants such as ϒ-tocopherol found plentiful in seed oils appear effective in reducing upper and mid-small intestinal infections caused by *E. acervulina* and *E maxima*.

Probiotics: Probiotic supplementation of the intestinal microflora has been shown to enhance gut defensive mechanisms in poultry. Several studies have demonstrated that a Lactobacillus-based probiotic stimulated local immune system of broiler chicken and improved resistance to *E acervulina.* Reports were that probiotic fed chickens shed fewer oocysts than did chickens without probiotics even in vitamin A deficient birds (Kitandu and Juronova, 2006).

Herbs: Artemisinin is a Chinese herb isolated from *Artemisia annua* which is a naturally occurring endoperoxide with antimalarial properties. It has been found effective in reducing oocyst output from both *E acervulina* and *E tenella* infections (Kitandu and Juranova, 2006). Otu *et al.,* (2016) in an experiment discovered that the n-butanol leaf extract of *Khaya senegalensis* had some anticoccidial activity *in vivo*.

Challenges to Effective Coccidiosis Management

The management of coccidiosis in Nigeria is encumbered with limitations which make it difficult to control the disease in our endemic environment. The following are some of the challenges confronting drugs or other alternatives used to control coccidiosis.

Drugs: Due to the poor activity of Amprolium against some *Eimeria* spp, its spectrum has been extended by using it in mixtures with the folic acid antagonists, ethopabate and sulfaquinoxaline (Gerhold Jr, 2014). Clopidol and quinolones have a broad species spectrum and are sometimes mixed together for synergism. However, resistance may develop rapidly during extended use (Gerhold Jr, 2014). Although resistance to antifolate compounds is widespread, they are commonly used for water treatment when clinical signs are already evident (Gerhold Jr, 2014) and polyether ionophores cannot be used in situations of heavy parasite challenge (Kitandu and Juranova, 2006).

Vaccines: A major disadvantage of vaccines made with virulent type of coccidia is that if the vaccine dose is not carefully controlled then severe disease may occur in those birds which do not ingest vaccinal oocyts and thus remain highly susceptible. Although vaccines played a role in coccidiosis control for a long time in the developed countries, in developing countries such as Nigeria, their applications still remain very limited with consideration for the safety, costs and demands for high techniques by the farmers or veterinarians (Xu *et al*., 2013). Also, the control of coccidiosis in replacement birds namely broiler breeders and egg producing stock is a continuing problem since most anticoccidials cannot be given to birds in egg production, yet most adult birds live in an infected environment (Usman *et al.,* 2011).

Conclusion

The endemicity of coccidiosis in Nigeria entails the careful and considerate use of anticoccidials in order to combat the disease. Though great exploits have been achieved in the control of the disease using drugs and vaccines, challenges with their use as well as the emphasis in the society for chemical free products (chickens and eggs), it is recommended that more work could be done using natural alternatives such as plants and other products.

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