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CURRENT EPIDEMIOLOGICAL AND DIAGNOSTIC STUDIES OF AVIAN COCCIDIOSIS IN NIGERIA: REVIEW STUDY

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ABSTRACT
Diagnosis of *Eimeria* infections and differentiation between species is usually attempted by consideration of clinical signs, post mortem lesions and biological features of the parasite. Analysis of these characteristics is labour intensive and does not provide accurate data for identification of *Eimeria* species. Diagnostic laboratories are increasingly utilizing DNA based technologies for the specific identification of the parasite. Polymerase Chain Reaction (PCR) based assays have proved to be effective for the identification of all seven species of *Eimeria* in chickens. A number of approaches have also proved to be both specific and highly sensitive for analysis. An attractive genomic DNA target for PCR analysis is the Internal Transcribed Spacer 1 (ITS-1) and Internal Transcribed Spacer 2 (ITS-2) gene of ribosomal DNA. Epidemiological studies in Nigeria have established the importance of avian coccidiosis though in north western Nigeria, data are scarce and not up to date. The disease occurs throughout the year in northern Nigeria but with higher prevalence rates from May to September. The prevalence of coccidial infection among adult birds has been put at 36.7% while that of the younger birds is 52.9%. It has been deduced that reliance on imported day old chicks could introduce different *Eimeria* species and strains into these environments. Also the usage of imported vaccines to prevent this disease though effective is expensive and targeted at specific strains and species thus making its application difficult for the poultry farmer. It is recommended that the molecular characterization of our local avian strains and species with view of vaccine formulations will go a long way in providing adequate information on the disease as well as addressing its control.

Key words: coccidiosis, avian, epidemiology, diagnosis, Nigeria

INTRODUCTION
Avian coccidiosis is a lethal management disease and is ranked second after poultry viral diseases (Dakpogan and Salifou, 2013). The disease 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). Economic losses due to coccidiosis are significant being estimated at more than 3 billion US dollars annually in the world (Gyorke*et al*., 2013). Haug *et al*. (2008) reports that the economic impact of subclinical infection is considerable as this form of the disease shows negative effects on the performance of the infected birds and accounts for 70% of the total coccidiosis disease control cost (Gerhold Jr, 2014). With an annual growth rate of 2.1%, poultry is one of the fastest growing livestock sectors, providing an additional source of income and accessible source of protein to many poor households (Fornace *et al*., 2013). Small scale intensive livestock industries have emerged in peri-urban areas of many

developing countries and disease challenges faced by these farms are poorly characterized and have important implication for households' poverty (Fornace *et al*., 2013). The poultry industry is facing problems which include drug resistance and consumer demanding decrease in the use of drugs in animal feeds (Hamidinejat *et al*., 2010). The extensive use of prophylactic anticoccidial drugs has led to the development of drug resistant strains of *Eimeria* against all products introduced (Hamidinejat *et al*., 2010). Live vaccines can restore drug sensitivity and has proved to be efficient in controlling the disease but they are expensive and have adverse effects on early chick growth (Usman *et al*., 2011). 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 though they live in an infected environment (Usman *et al.*, 2011). 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 is written to update the knowledge of the poultry farmers and those concerned in animal health on the epidemiology as well as current diagnostic techniques involved in diagnosing the coccidiosis with a view of controlling the disease.

BRIEF DESCRIPTION OF THE DISEASE

Aetiology: Coccidiosis is caused by *Eimeria* species which belong to the Phylum Apicomplexa, Family Eimeridae and genus *Eimeria* (Hamidinejat *et al*., 2010). They are intracellular protozoan parasites (Dakpogan and Salifou, 2013). Nearly 1800 *Eimeria* species have been reported affecting the intestinal mucosa of different animals and birds (Hamidinejat *et al*., 2010). Among these, nine *Eimeria* species have been reported to affect the domestic fowls (Bachaya *et al*, 2012). These include the highly pathogenic species identified as *Eimeria tenella, Eimeria maxima*, *Eimeria brunette* and *Eimeria necatrix* (Hamidinejat *et al*., 2010). *Eimeria acervulina, Eimeria mivati* and *Eimeria mitis* are reported as less pathogenic and *Eimeria hagani* and *Eimeria praecox* reported as mild (Hamidinejat *et al*., 2010). Coccidia are almost universally present in poultry raising operations, but clinical disease occurs only after ingestion of relatively large numbers of sporulated oocysts by susceptible birds (Gerhold Jr, 2014). Both clinically infected and recovered birds shed oocysts in their droppings which contaminate feed, dust, water, litter and soil (Gerhold Jr, 2014). The infective form of the parasite is the oocyst which sporulates two days after following excretion through the faeces in the natural environment and can be ingested by a susceptible host (Dakpogan and Salifou, 2013).

Clinical signs: Coccidiosis is characterized by dysentery, enteritis, emaciation, poor growth, low production (Awais *et al*., 2012) with high rate of mortality and morbidity (Bachaya *et al*., 2012). *Eimeria tenella* causes moderate to severe clinical caecal lesions, sometimes death. Mortality may go as high as 50% (Chauhan and Roy, 2007). Flock mortality up to 20% has occurred within a period of 2-3 days (Jordan, 1990). Coccidiosis is a self limiting disease; most birds recover following survival past day 8. Birds with gangrenous or ruptured caecal pouches may linger for long periods but never fully recover (Hofstad *et al*., 1972).

Diagnosis: Coccidiosis is often extremely difficult to diagnose (Hamidinejat *et al*., 2010). Diagnosis of *Eimeria* infections and differentiation between species is usually attempted by consideration of clinical signs in the host and the biological features of the parasite (Hamidinejat *et al*., 2010). The latter include prepatent period, site of development within the intestine and the morphological appearance of the oocysts in the faeces and endogenous stages in the intestinal or caecal mucosa as well as sporulation time (Gyorke*et al*., 2013). Analysis of these characteristics is labour intensive for diagnosis and does not provide accurate data for identification of *Eimeria* species (Hamidinejat *et al*., 2010). Diagnostic laboratories are increasingly utilizing DNA based technologies for the specific

identification of the parasite (Gyorke *et al*., 2013). The presence of the parasites may be confirmed by post mortem examination of the host or faecal examination (Gerhold Jr, 2014). *Eimeria tenella* and *Eimeria necatrix* have unmistakable lesions and are pathognomonic (Gerhold Jr, 2014). Mixed infections are commonly found in field conditions which pose a problem for precise discrimination of species using classical methods (Gyorke *et al*., 2013). A diagnosis of clinical coccidiosis is warranted if oocysts, merozoites or schizonts are seen microscopically and if the lesions are severe (Gerhold Jr, 2014). Although some clinical eimerial infections may be unimportant, they can cause considerable depression in feed efficiency and egg production, which accounts for 70% of the total coccidiosis diseases control cost (Haug *et al*., 2008).Polymerase Chain Reaction (PCR) based assays have proved to be effective for the identification of all seven species of *Eimeria* in chickens (Gyorke *et al*., 2013). A number of approaches have also proved to be both specific and highly sensitive for analysis, either of parasites grown *invitro* or present in tissue samples and clinical materials (Gyorke *et al*., 2013). An attractive genomic DNA target for PCR analysis is the Internal Transcribed Spacer 1 (ITS-1) and Internal Transcribed Spacer 2 (ITS-2) gene of ribosomal DNA (rDNA) (Gyorke*et al*., 2013). This spacer separates the 3 ends of the 16S-like ribosomal RNA gene from the 5 end of the 5.8 S rRNA gene within individual rDNA transcription units (Patra *et al*., 2010). Due to its heterogenecity in both sequence length and base composition, the ITS-1 lends itself perfectly for the design of specific primers and as part of the rDNA transcription unit. It is also a member of a multiple copy gene family and thus provides large numbers of potential PCR targets (Patra *et al*., 2010).

Epidemiology

Amare *et al*. (2012) conducted a study to evaluate the prevalence of coccidiosis, identify the prevalent species of *Eimeria* and to assess the predisposing factors in Kombolcha Poultry breeding stock in Ethiopia. He observed an overall prevalence of 25.24% of clinical coccidiosis assessed from which was recorded prevalence rates of 22.3% and 35.3% respectively for the White leghorn (WLH) grower chickens and parent stocks of the WLH and Rhode Island Red (RIR) breeds. The prevalence of clinical coccidiosis was significantly higher in adults than the growers ($P<0.05$). However, no statistically significant difference was observed between sexes and breeds. Species identified were *Eimeria tenella, Eimeria brunetti, Eimeria necatrix, Eimeria acervulina* and *Eimeria maxima*. Sun *et al*. (2009) examined the faecal samples of chicken from poultry farms located in China for *Eimeria* species. The infection rate of identified *Eimeria* in these farms were 90%, 88%, 72%, 68%, 60%, 26% and 8% for *Eimeria tenella, Eimeria praecox, Eimeria acervulina, Eimeria maxima Eimeria mitis, Eimeria necatrix* and *Eimeria brunetti* respectively. In China, the prevalence of *Eimeria tenella* is the highest with it presenting an explosive appearance of caecal coccidiosis in the acute phase and where the mortality rate can reach up to 50-80% in a few days. In recent years, the prevalence of intestinal coccidiosis is increasing especially *Eimeria necatrix* infection in South China. Awais *et al*. (2012) reported on the prevalence of coccidiosis in industrial broiler chickens in Pakistan. *Eimeria tenella* had the highest prevalence (27.04%) followed by *Eimeria. maxima* (22.42%), *Eimeria acervulina* (19.89%) and *Eimeria necatrix* (4.02%). The prevalence of the disease was significantly higher in the autumn (60.02) followed by summer (47.42), spring (36.92) and winter (29.89).In Nepal, Adhikari *et al*. (2008) reported that the highest prevalence rate month wise for coccidial infection of *Eimeria tenella* (50%) was observed in March and the lowest (10%) in the months of April and September. Season wise the highest prevalence rate (33%) was in the summer and spring followed by 14% in the autumn. In layer birds, highest prevalence rate age wise (48%) was in 31-45 days age group and the least (6%) in 0-15 days age group of layers (Adhikari *et al*., 2008).

While coccidiosis has been demonstrated to cause production losses affecting profitability of individual farms in Europe and the United State, the occurrence and economic relevance of coccidiosis

in poultry farms in Africa remain largely unknown (Fornace *et al*., 2013). Within Africa and other areas of the developing world, increasing human population and urbanization have led to an increase in livestock production often referred to as the "Livestock revolution" (Fornace *et al*., 2013). In Ethiopia, poultry coccidiosis is endemic in various parts of the country and affects mainly young growing birds (Fornace *et al*., 2013). Mersha *et al*. (2009) reported a prevalence of clinical coccidiosis from 3 commercial broiler farms in Central Ethiopia to be 37.5, 43.33 and 50% respectively and the *Eimeria* identified were *Eimeria tenella, Eimeria necatrix,* and *Eimeria acervulina*. Losses due to mortality following a severe outbreak may be devastating and incidences rate as high as 80% were observed to occur in an outbreak in Ethiopia. Fornace *et al.* (2013) reported the detection of coccidiosis in farms in Ghana, Tanzania and Zambia. Reliance on imported day old chicks can introduce different *Eimeria* species and strains into these environments as exemplified by the presence of OTU's (Operational Taxonomic Units which are three genetic variants) previously only identified in Australia (Fornace *et al*., 2013).

Epidemiology of coccidiosis in Nigeria

Epidemiological studies in Nigeria have established the economic importance of coccidiosis as a major parasitic disease of poultry (Abdu *et al*., 2008), though data on avian coccidiosis in northwestern Nigeria are scarce and not up to date (Jatau *et al*., 2012). Such information is very important for proper diagnosis and control of the disease and for the selection of appropriate anti coccidial drugs. The disease is said to occur throughout the year in Northern Nigeria but with higher prevalence rates from May to September (Abdu *et al*., 2008). Outbreaks of up to 50% mortality have been reported in commercial poultry in Zaria, Nigeria (Abdu *et al*., 2008). Majaro (2001) reported and described the seven *Eimeria* species in exotic commercial broiler chickens. Muazu *et al*. (2008) investigated the prevalence of coccidiosis and identification of species in Vom, Plateau State from nine different poultry farms during the months of April - June 2008. The prevalence of coccidial infection among adult birds was 36.7% while the younger birds were 52.9%. The species of *Eimeria* identified include *Eimeria tenella, Eimeria maxima, Eimeria necatrix* and *Eimeria acervulina*.

CONCLUSION

The endemicity of coccidiosis as a major parasitic disease in Africa and Nigeria has been established through epidemiological studies. However, lack of up to date information on the disease as well as the local strains and species involved in does not allow for adequate control measures to be put in place. Reliance on imported day old chicks can introduce different *Eimeria* species and strains into these environments and the usage of imported vaccines to prevent the disease though effective, is expensive and targeted at specific strains and species thus making its application difficult for the poultry farmer. It is recommended that molecular characterization of our local avian strains and species with view of vaccine formulations will go a long way in providing adequate information on the disease as well as addressing its control.

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