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Prevalence of *Eimeria* species in local breed chickens in Gombe metropolis, Gombe State, Nigeria

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ABSTRACT

Eimeria species are protozoan parasites causing coccidiosis in exotic and local breeds of chickens. Coccidiosis is the most important protozoan disease to the world poultry industry and domestic chickens are considered susceptible to seven species of *Eimeria*. A survey was carried out between March and May 2010 in order to determine the species of *Eimeria* causing coccidiosis in local breed chickens in Gombe metropolis, Gombe State, Nigeria. The Wisconsin's faecal flotation technique was employed to analyze faecal samples obtained from 150 local breed chickens within the metropolis. The samples were examined for the presence of *Emeria* oocysts and 64 (42.7%) of the samples examined were positive for *Eimeria* oocyts. Four species of *Eimeria* were identified and the prevalence of infection were *E. tenella* 25 (39.1%), *E. acervulina* 18 (28.1%), *E. necatrix,* 12 (18.8%) and *E. maxima* 9 (14.1%). Higher prevalence were observed in males 29 (46.2%), young birds 34 (56.7%) and birds from the free range management system 44 (57.8%), than in females 35 (40.2%), adults 30 (32.3%) and birds from the semi intensive management system 20 (30.8%) respectively. Chi square test revealed no statistically significant differences in infections with sex, age and between the free range and semi intensive management systems. Recommendations were made based on the results obtained as to the effective control of coccidiosis in local breed chickens in Gombe metropolis.

Keywords: Survey, Coccidia, Coccidiosis, poultry, production.

INTRODUCTION

The poultry industry in Nigeria has witnessed expansion in recent times and the estimated poultry population in Nigeria was over 150 million in 2006 (FAO, 2006).

In Nigeria, local breed chickens constitute about 124 million of the poultry population and are considered the most important poultry species in terms of number and rate of investment in poultry production (FAO, 2006; Zahraddeen et al., 2010). Local breed chickens are found in all parts of Nigeria and their meat and eggs have continued to be the major source of animal protein for the rapidly growing Nigerian population. Local breed chicken production in Nigeria has the potential to provide relatively cheap animal protein to the rural populace and improve their nutritional status, to create both rural and urban employment and to generate

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income in times of difficulty. The rearing of local breed chickens for meat and egg production appear to be increasing at a fast rate and provides a form of employment to the local women in Gombe metropolis.

Annual losses in local breed chicken production due to infectious and parasitic diseases are uncountable and large sums of money are continuously being expended on preventive medication. Poultry coccidiosis has been reported as a major constraint to the successful backyard poultry farming, due to its significant high mortality rates and huge economic losses (Bera et al., 2010). Poultry coccodiosis which is a disease of almost universal importance in poultry production remains one of the most important protozoan parasitic diseases that are threatening local breed chicken production in Nigeria (Jatau et al., 2012; Lawal et al., 2016). About nine species of *Eimeria* have been identified and recognized in domesticated chickens which are *E. brunette, E. maxima, E. necatrix, E. tenella* considered to be the most pathogenic, *E. acervulina, E. mitis, E. mivati* considered to be less pathogenic and *E. praecox and E. hagani* which are less or non pathogenic species (Haug et al., 2008; Amer et al., 2010). The occurrence of different *Eimeria* species combinations and intensity of infection vary considerably both locally and globally. The species differ in their localization in the gut and in their ability to induce morbidity and mortality. Coccidiosis increases the consumption index, decreases growth, generates heterogenous groups, causes weight loss, lowers feed conversion rate, delays sexual maturity and decreases egg production (Lobago et al., 2005). Lesions of the intestinal mucosa and loss of pigmentation may also become apparent during the later stages of infection (Walden, 2004).

In Nigeria, most households practice the extensive management system of poultry production, which is characterized by family ownership of chickens. The chickens are left to scavenge outside for food and other nutritional needs. There is no attention given to feeding and shelter. There is high mortality from diseases, predators and theft. However, some households in Nigeria practice the semi intensive management system of poultry production. Most of the chickens reared under this system, scavenge for most of their food and other nutritional needs. There is however, some form of attention given to the provision of feed supplements, vaccination and other disease preventive measures and provision of shelter (Lawal et al., 2016).

Several studies have established the prevalence and economic importance of coccidiosis in both local and exotic breeds of chickens in Nigeria (Etuk et al., 2004; Musa et al., 2010; Nnadi and George, 2010; Jatau et al., 2012; Olanrewaju and Agbor, 2014; Grema et al., 2014; Lawal et al., 2016; Agishi et al., 2016). However, there are currently very few studies on the prevalence and occurrence of poultry coccidiosis in Gombe metropolis, though a majority of the population practices backyard poultry farming for meat, egg and income (Grema et al., 2014). Published information therefore, on the coccidian parasites of local breed chickens in Gombe metropolis is scarce or unavailable, despite the economic importance of local breed chickens in the area. This study was therefore designed to determine the incidence of coccidiosis in local breed chickens and to identify the prevalent species of *Eimeria* causing coccidiosis in local breed chickens in Gombe metropolis, Gombe State, Nigeria.

MATERIALS AND METHODS

Study area

The study was carried out in Gombe metropolis, which lies between latitude 10^0 11' 36" N and 10^0 19' 26" N and longitude 11^0 7' 34" E and 11^0 11' 26" E of the Greenwich Meridian. Gombe is the capital of Gombe State in North Eastern Nigeria. The average annual temperature is about 24 ^{0}C and annual rainfall of between 850 mm and 1000 mm, relative humidity ranges from 15-80%. The area experiences two seasons, the wet season (May-October) and dry season (November-

April), with a sudano-sahelian savanna vegetation. (Grema et al., 2014). Generally, the climate provides good conditions for poultry production. The metropolis is subdivided into several areas (Figure 1).

Sample collection

Faecal samples were collected from households in five selected areas in Gombe metropolis. Samples were collected over a period of three months. (March to May 2010). The samples were collected from chickens raised under semi-intensive and free-range management systems, early in the morning as the chickens defecated in santana polytene bags. The area of collection, sex, age, and management system of the chickens were noted. A total of 150 faecal samples were collected, 30 samples from each of the five selected areas. Sixty-three samples were collected from males, 87 from females, 57 from young birds, 93 from adults, 65 from semi-intensive and 85 from free-range management systems. Young birds were those below one of age and adult birds were those above one year of age.

Laboratory analysis of samples

In the laboratory, each sample was analyzed immediately, using the Wisconsin's faecal flotation technique, described by Conway and Mckenzie (2007). Three grammes of faeces were dissolved in 5 ml of the sugar-salt flotation medium in a rubber tube, mechanically and thoroughly mixed using a stirring glass rod. The resulting feacal mixture was then transferred through a filter paper inside a funnel, into a test tube. The test tube was then filled up with flotation medium, to enable the oocyts float up to the surface.

Carefully, a cover slip was placed over the test tube and left to stand for five minutes. The oocyts that were floating, adhered to the cover slip. The cover slip was then carefully removed from the test tube, and placed immediately on a clean microscope slide. The slide was then examined using the light microscope under X40 magnification, for presence or absence of oocyts. Details on the morphology, presence or absence of micropyle, shape, length and thickness of the oocyts, if present, were noted. The number of oocysts was estimated using the McMaster egg-counting chamber at X40 objective of a light microscope. The numbers of oocysts in the left and right side wells of the counting chamber were added to give the number of oocysts per sample, without multiplying it by a factor of 200 as described by Taylor et al. (2007).

Procedure for sporulation

Faecal samples containing unsporulated oocysts were homogenized with water and filtered. The filtrate was re-suspended in 2.5 aqueous potassium dichromate solution. This was to provide enough moisture, as well as kill other microorganisms present in the faeces and competing for oxygen and nutrients with the oocysts. The samples were poured into rubber tubes and kept under room temperature to induce sporulation. The samples were left to stand for 24-48 hours to allow unsporulated oocysts to sporulate. Each sample was observed at different times by microscopic examination to find out if it contained sporulated oocysts. The morphology and size of the sporulated oocysts were microscopically determined using calibrated ocular microscope at X40 magnification as described by Conway and McKenzie (2007).

Identification of *Eimeria* species

Identification of the different species of *Eimeria* was carried out based on the shape and size of sporulated oocysts. The species of *Eimeria* were identified based on identification key given by McDougald (2003).

Data analysis

Data was collected and analyzed initially in Microsoft Office Excel Version 2011 to obtain percentages and prevalence of *Eimeria* species. The SPSS Statistical

Software Version 22 was used for Chi square statistical analysis. The statistical significant association between sex, age, management system and infection were determined at $p<0.05$. Prevalence and intensity were calculated according to Margolis et al. (1982). The prevalence (P) in percentage (%) was calculated using the formula P = d/n, where d is the number of positive samples analyzed at that point in time and n is the total number of chickens sampled at that point in time. The specific prevalence for each *Eimeria* species was calculated as the number of chickens infected with a particular *Eimeria* species divided by the total number of chickens infected, then multiplied by hundred (100) and expressed as a percentage (%).

The intensity of infection was determined by the number of *Eimeria* oocysts in 3 g of faecal sample. This was presented as + representing 1-10 oocysts in 3 g of faecal sample, indicating very light infection, ++ representing 11-20 oocysts in 3 g of faecal sample, indicating light infection and +++ representing 21-30 oocysts in 3 g of faecal sample, indicating slightly heavy infection.

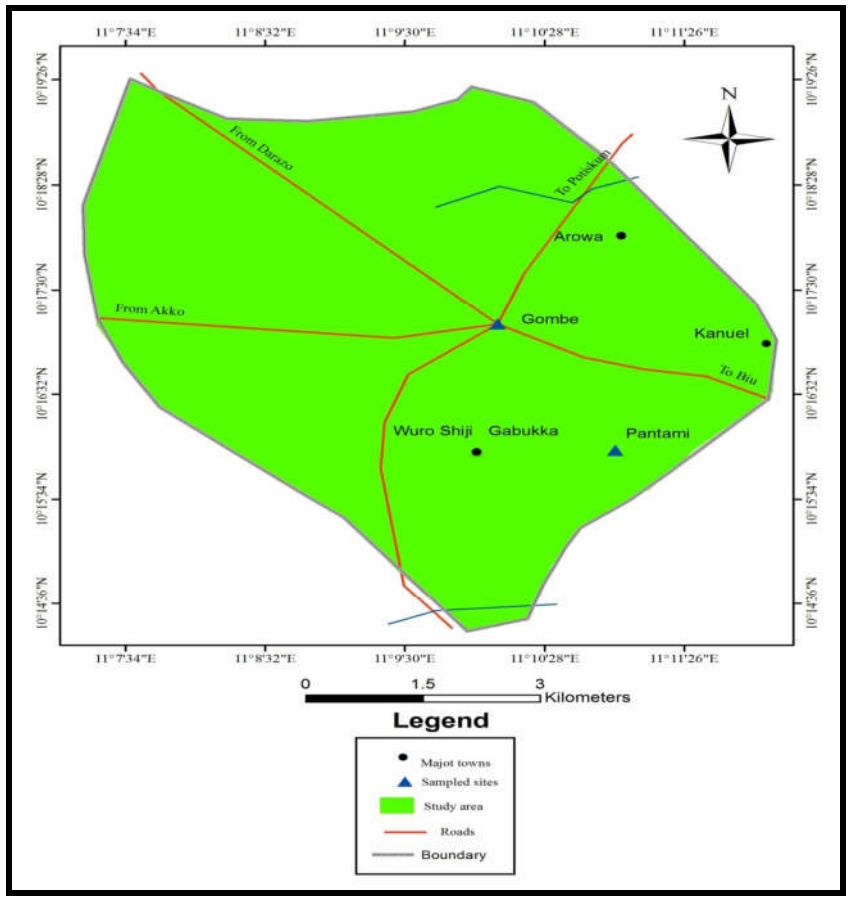

Figure 1: Map of Gombe metropolis
Source: GIS Section Department of Geography Federal University Lokoja.

RESULTS

Sixty four (42.7%) of the 150 faecal samples examined, were positive for coccidian oocysts.

Four species of *Eimeria* were identified and the prevalence of infection with the *Eimeria* were *E. tenella* 25(39.1%), *E. acervulina* 18(28.1%), *E. necatrix,* 12(18.8%) and *E. maxima* 9(14.1%). Chi square test revealed no significant differences in infection with sex, age and management system.

Male chickens 29(46.0%), young chickens 34(56.7%), and chickens reared under the free-range management system 44(51.8%) had higher prevalence compared to female chickens 35(40.2%), adult chickens 30(32.3%) and chickens reared under the semi intensive management system 20(30.8%) (Table 1). Each of the chicken positive for coccidian oocysts was found to be infected by one of the four types of *Eimeria* species identified. Thus, all the infections were single species infections. No cases of multiple species infections were recorded. The four *Eimeria* species identified were based on the morphometric of their oocysts (Table 2).

Table 1: Prevalence of *Eimeria* species in local breed chickens in Gombe metropolis, Gombe State, Nigeria.

Species of *Eimeria* Identified	**No. of samples infected**	**No. infected by sex**		**No. infected by age**		**No. infected by management system**		**Intensity**		
		Males (n=63)	Females (n=87)	Young (n=57)	Adult (n=93)	Semi-intensive (n=65)	Free-range (n=85)	+	+ +	+ + +
Eimeria tenella	25(39.1)	10(15.6)	15(23.4)	14(21.9)	11(17.2)	7(10.9)	18(28.1)	14	7	4
Eimeria acervulina	18(28.1)	8(12.5)	10(15.6)	10(15.6)	8(12.5)	5(7.8)	13(20.3)	13	5	0
Eimeria necatrix	12(18.8)	6(9.4)	6(9.4)	5(7.8)	7(10.9)	5(7.8)	7(7.8)	6	4	2
Eimeria maxima	9(14.1)	5(7.8)	4(6.3)	5(7.8)	4(6.3)	3(4.7)	6(9.4)	5	3	1
Total	64 (42.7)	29 (46.0)	35 (40.2)	34 (59.7)	30 (32.3)	20 (30.8)	44 (51.8)	38	19	7

Key: Number of coccidia oocysts per 3 g of faeces
+ = 1-10 very light infection
++=11-20 light infection
+++=21-30 slight heavy infection

Table 2: Morphometric identification of *Eimeria* species in faecal samples of local breed chickens in Gombe metropolis, Gombe State, Nigeria.

***Eimeria* species**	**oocysts (um)**	**Sporulation time (hrs)**	**Characteristic morphology of unsporulated oocysts**
Eimeria tenella	×19.0	18 hrs	Double-contoured lines, Smooth wall, micropyle, ovoid
Eimeria necatrix	×17.2	18 hrs	Double- contoured lines, smooth wall , oblong, ovoid
Eimeria acervulina	×14.6	17 hrs	Double-contoured lines, smooth wall, ovoid
Eimeria maxima	×20.7	30 hrs	Double-contoured lines, Smooth, wall, micropyle, ovoid

DISCUSSION

The prevalence of 42.7% shows that coccidiosis is prevalent in local breed chickens in Gombe and the species of *Eimeria* causing the disease in the area are *E. tenella, E. acervulina, E. necatrix* and *E. maxima*. The prevalence of the disease in the metropolis maybe attributed to poor sanitation practices and unhygienic environmental conditions which provide a conducive environment for oocyts survival.

The four species of *Eimeria* identified in the present study have been reported by Dereje (2002), Al-Natour et al. (2002), Getachew (2004) and Lobago et al. (2005), suggesting that these species of *Eimeria* cause coccidiosis in local breed chickens and are worldwide in distribution.

Razmi and Kalideri (2000) reported *E. tenella, E. acervulina* and *E. maxima*, all of which were reported in this study. They however did not report *E. necatrix* as reported in the present study.

Mohammad et al. (2002) identified nine *Eimeria* species including the four species identified in this study. They however, identified five other species (*E. mivati, E. mitis, E. brunetti, E. praecox, E. hagani*) not identified in this study.

Reperant et al. (2003) identified seven species of *Eimeria* including the four identified in this study.

Getachew et al. (2008) and Ahmed et al. (2012) reported *E. tenella, E. acervulina*, *E. necatrix, E. maxima* and *E. mitis*, four of which were identified in the present study.
Hachimi et al. (2009) reported *E. necatrix*, *E. maxima* and *E. tenella*, all of which were reported in the present study.

Eimeria tenella was the most prevalent species in the present study which supports the findings of Dink and Yacob (2012). However, Safari (2001) and Ashenafi et al. (2004) revealed *Eimeria acervulina* as the most prevalent species while Lobago et al. (2005) reported *Eimeria brunetti* as the most prevalent species. Ahmed et al. (2012) reported *Eimeria necatrix,* and *Eimeria tenella* as the most prevalent species while Haug et al. (2008) reported *Eimeria tenella* and *Eimeria maxima* as the most prevalent species.

The probable reasons for these discrepancies could be the difference in the virulence of the *Eimeria* species at different management systems and/or due to the possibility of drug resistance.

The prevalence of coccidiosis in local breed chickens in Gombe metropolis (42.7%) appears to be higher when compared to the findings of Lunden and Thebo (2000), Ashenafi et al. (2004), Adamu et al. (2009), Kaingu et al. (2010), Lunden et al. (2010), Jatau et al. (2012), Ahmed et al. (2012),

Dakpogan and Salifou (2013), Grema et al. (2014), Agishi et al. (2016) and Lawal et al. (2016). The prevalence of 42.7% reported in the present study is however lower than that reported by Ahmed et al. (2003), Mu'azu et al. (2008), Amer et al. (2010), Dink and Yacob (2012) and Olanrewaju and Agbor (2014).

Differences in the observed prevalences might be attributed to different factors such as sampling periods, sample size, geographical area, climatic conditions, agroecological setup, breed differences, management system, possibility of drug resistance, age, sex, season and locality. Ashenafi et al. (2003) and Haug et al. (2008) confirmed that the incidence of coccidiosis is varied in relation to different selected climatic zones. Lobago et al. (2005) stated that the prevalence differences were normal due to the differences in the epidemiological situation among different countries.

High prevalences might be attributed to highly humid geographical areas which favour oocyst sporulation and poor management practices which encourage build up of oocysts, high stocking density resulting in high contamination rate of poultry houses with oocysts of *Eimeria* and lack of regular disposal of litter.

In the present study, a higher prevalence was observed in males than in females but the difference was not statistically significant ($P>0.05$). This indicates that both sexes have equal chances of acquiring and carrying *Eimeria* oocysts and coming down with coccidiosis. This is consistent with the findings of Getachew (2004), Gari et al. (2008), Oljira et al. (2012) and Alemaryehu et al. (2012). Getachew (2004) underlined the absence of difference in the natural resistance between sexes to coccidiosis. However, Lawal et al. (2016) reported higher prevalence in females than in males contrary to the results of the present study.

The higher prevalence in young birds compared to adults agrees with the findings of Omer et al. (2011) and Ahmed et al. (2012), but disagrees with the findings of Etuk et al. (2004), Amare et al. (2012) and Dakpogan and Salifou (2013), who reported higher prevalences in the adults than in the young. According to Chapman et al. (2005), this could be associated with the immature immune system in young birds leaving them susceptible to infection even with the less pathogenic strains of *Eimeria* species.

The present study reported higher prevalence in the extensive management system than in the semi intensive management system. In the semi intensive management system, there is some form of attention with regards to the provision of feed supplements, vaccination and other preventive measures, which are lacking in the extensive or free range management system. Chickens raised under the free-range management system are allowed to roam about looking for food. There is therefore a higher probability of them coming in contact with oocyts than chickens raised under the semi-intensive management system. Lawal et al. (2001) reported that free range birds which feed freely would be more prone to various infections. However, Lawal et al. (2016) reported higher prevalence in the semi intensive management system than in the extensive or free range management system. They believe that the scavenging village chickens are less likely to ingest pathogenic levels of the coccidian oocysts during feeding.

Reperant et al. (2003) reported that *E. necatrix* and *E. tenella* lead to morbidity and mortality while *E. acervulina*and *E. maxima* have diverse effects on live stock performance of birds and could sometimes cause symptoms like diarrhea, nervousness and prostration.

Hachimi et al. (2009) concluded that the most serious cases of intestinal coccidiosis are caused by *E. necatrix*. The clinical coccidiosis kills 2% of the sample and fall production by 20%.

Naciri (2000) reported *E. acervulina* to be pathogenic, *E. tenella* to be prolific and highly pathogenic and *E. necatrix* to be shortly prolific and pathogenic.

Coccidiosis can cause anorexia and malabsorption of nutrients and can also reduce the availability of Arginine and other amino acids (Allen and Fettererm, 2000)

The present study concludes that coccidiosis is a common disease in local breed chickens in Gombe metropolis and four species of *Eimeria* are implicated as causative agents, with *E. tenella* as the most prevalent.

It is therefore recommended that local breed chickens within the metropolis be given proper veterinary attention as it relates to coccidiosis.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

LKA conceived the idea and designed the study, carried out the data analysis and supervised the study. He drafted and revised the manuscript and served as corresponding author to the manuscript. ZI conducted the study as her undergraduate student project, carrying out the sampling, literature review and laboratory work.

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