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Prevalence of Coccidia Infection and Preponderance *Eimeria* Species in Free Range Indigenous and Intensively Managed Exotic Chickens during Hot-wet Season, in Zaria, Nigeria

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ABSTRACT

This study is aimed to report the prevalence of coccidia infection and preponderance *Eimeria* species of free range indigenous and intensively managed exotic chickens in Zaria, Nigeria. Seventy whole intestines each from slaughtered market age broilers, layers and indigenous chickens were collected from live bird market in Zaria from March through July, 2011. Contents of each intestinal tract were examined microscopically in the laboratory for the presence of coccidia oocysts using simple floatation technique and graded based on number of oocysts per field as, in apparent infection, low grade infection, severe infection for oocysts counts of 1-10, 11-20 and >20 per field, respectively. To identify the likely *Eimeria* species contained in each sample, oocysts shape index of twenty randomly selected oocysts were determined by measuring their lengths and widths using a calibrated ocular micrometer at 400x magnification. The 33.3% of all the collected samples had coccidia infection, with specific prevalence rates of 44.3% in layers, 37.1% in broilers and 18.6% in indigenous chickens. The 80.7% of the infected layers had unapparent coccidia infection, while 12.9 and 6.5% had low and severe grades infections, respectively. Similarly, 69.2% of the infected broilers were unapparently infected while 26.9 and 3.9% were moderately and severely infected with coccidia, respectively. More so, 84.6% of the infected indigenous chickens had in apparent infection, while only 7.69% each had low grade and severe infections. All the seven *Eimeria* species of chickens were identified with overall prevalences of: *E. maxima* (58.6%), *E. acervulina* (47.1%), *E. mitis* (30.0%), *E. brunetti* (28.6%), *E. tenella* (22.9%) and *E. praecox* (8.6%). Mixed *Eimeria* species infections were common among the sampled chickens with overall prevalence 61.4%.

Key words: Preponderance, *Eimeria* species, infection rates, chickens, coccidia infection

INTRODUCTION

Avian coccidiosis is an enteric parasitic disease caused by multiple species of the protozoan parasite of the genus *Eimeria* and is one of the commonest and economically most important diseases of poultry world-wide; causing production losses, high morbidity (due to acute, bloody enteritis) and mortality rates (Shirley *et al*., 2005). Seven species of *Eimeria* are widely recognized as the causative agents of coccidiosis in chickens, of which *E. tenella, E. necatrix, E. maxima* and

E. brunetti are highly pathogenic, *E. acervulina* and *E. mitis* are less pathogenic, whilst *E. praecox* is regarded as the least pathogenic (McDougald, 2003; Shirley *et al*., 2005; Conway and McKenzie, 2007; Taylor *et al*., 2007). In Nigeria, Majaro (1981) reported and described the seven *Eimeria* species in exotic commercial broiler chickens. Six *Eimeria* species were also identified by Majaro (1993) in indigenous domestic fowls and these included: *E. acervulina*, *E. tenella*, *E. brunetti*, *E. maxima*, *E. necatrix* and *E. mitis*.

Epidemiological studies in Nigeria have established the economic importance of coccidiosis as a major parasitic disease of poultry (Majaro, 1980, 1983, 2001; Adene and Oluleye, 2004; Abdu, 2007). The disease occurs throughout the year in Northern Nigeria but with higher prevalence rates from May to September (Etuk *et al*., 2004; Abdu, 2007). Outbreaks of up to 50% mortality were reported in commercial poultry in Zaria, Nigeria (Abdu *et al*., 2008; Musa *et al*., 2010).

Coccidiosis has been shown to be common to intensively managed commercial poultry farms especially where management or hygienic standards are compromised (Adene and Oluleye, 2004). The increasing interest in commercial poultry production in Nigeria evidenced by the proliferation of poultry farms; suggests increased risk of outbreaks of coccidiosis.

Epidemiological data on avian coccidiosis in North-western Nigeria are scarce and not up to date. Such information are very important for proper diagnosis and control of the disease and for the selection of appropriate anticoccidial drugs and vaccines (Tsuji *et al*., 1997; Woods *et al*., 2000; Morris and Gasser, 2006; Sun *et al*., 2009; Lee *et al*., 2010).

The present study is therefore aimed to report the prevalence of coccidia infection and preponderance of the *Eimeria* species affecting free range local and intensively managed commercial exotic chickens in Zaria, North-western Nigeria.

MATERIALS AND METHODS

Study area: Zaria is a very large, heterogeneous city whose 1.490,000 population comes from different parts of Nigeria. It is second in size only to Kaduna, the Kaduna state capital of the North-western region of Nigeria. Zaria is located between latitude 11°07'N and longitude 7°44'E within the Northern guinea savanna zone. It possesses a tropical continental climate with a pronounced dry season, lasting up to six months (November-April). The rainy season lasts from late April to October. The average rainfall ranges from 1000-1250 mm and the average daily temperature ranges from 19-33°C (Sawa and Buhari, 2011).

Sampling: A total of 210, whole intestinal tracts of slaughtered market age exotic and indigenous chickens were collected from poultry slaughter sites located at live bird markets in Zaria within the months of March through July, 2011. One hundred and forty of the intestinal tracts samples were collected from exotic chickens consisting of 70 each from broilers and layers, while the remaining 70 samples were obtained from the indigenous chickens. At each time of sampling, the samples were put in clean polythene bags and transported in cool box to the Protozoology laboratory, Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria for isolation and identification of coccidian oocysts.

Sample processing and analysis: Each intestinal tract was examined macroscopically for lesions consistent with coccidiosis and its entire contents were transferred into a sterile plastic tube and examined for the presence of coccidia oocysts using the simple floatation technique (Soulsby, 1986).

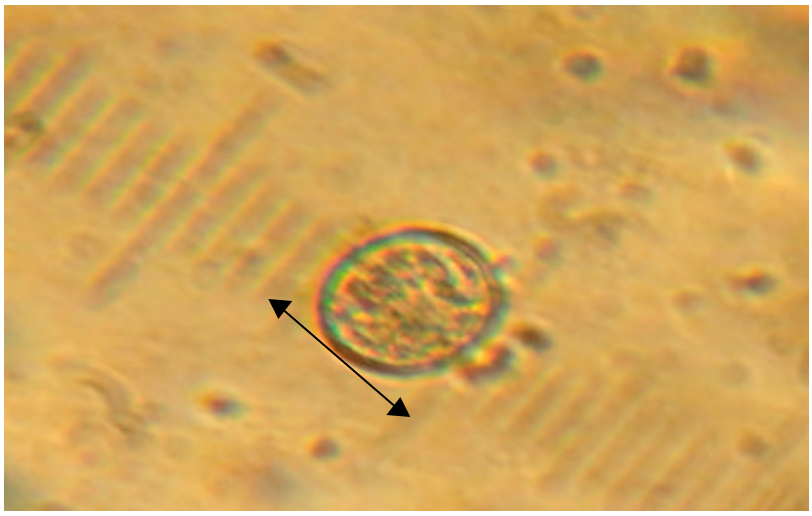

Fig. 1: Measurement of width (arrow) of *Eimeria* oocyst using ocular micrometer (x400)

For each coccidia oocysts positive sample, the intensities of the infection were categorized as described by Lawal *et al*. (2008) as follows: 1-10 oocysts per field = +1 (inapparent infection), 11-20 oocysts per field = +2 (low grade infection), >20 oocysts per field = +3 (severe infection).

Furthermore, for each of the positive samples, the oocyst shape index (length/width) of each 20 randomly selected oocysts was determined by measuring its length and width using a calibrated ocular micrometer at x40 magnification (Fig. 1) and calculating the ratio of the length and width. The likely *Eimeria* species contained in each sample were then determined by comparing the calculated oocysts shape index value of each oocyst with the guides provided by Long and Reid (1982) for the diagnosis of coccidiosis in chickens.

Data analysis: Data generated from the study were analyzed using descriptive statistical methods (Percentages and tabulation).

RESULTS

Table 1 showed that, of the 210 (70 samples each from layers, broilers and local chickens) Gastrointestinal Tracts (GIT) samples collected from the chickens at slaughter 70 (33.3%) had varying degree of coccidia infection. The result further shows that of the 70 sampled GIT obtained from each of the three types of the chickens; 31 (44.3%) samples from layers and 26 (37.1%) from broilers were infected with coccidia oocysts. However, oocysts were only detected in 13 (18.6%) of the 70 GIT samples collected from the local chickens.

Table 2 showed the intensities of coccidia infections in the sampled chickens. Out of the 31 infected layers 25 (80.7%) had unapparent infection of the coccidia parasites, while 4 (12.9%) and 2 (6.5%) had low grade and severe infections, respectively. Similarly, 18 (69.2%) of the 26 infected broilers were unapparently infected while 7 (26.9%) and 1 (3.9%) were moderately and severely infected with coccidia, respectively. More so, 11 (84.6%) of the 13 coccidia oocysts positive indigenous chickens had unapparent infection while only 1 (7.69%) each were having low grade

Table 1: Prevalence of coccidia oocysts in different types of chickens at slaughter in Zaria

Type of chicken	No. of GIT sampled	No. of infected	Prevalence rate (%)
Layers	70	31	44.3
Broilers	70	26	37.1
Local	70	13	18.6
Total	210	70	33.3

Table 2: Intensity of coccidia infection in different types of chickens at slaughter in Zaria

	Type of chickens infected					
	Layers		Broilers		Local	
Intensities of infections	No.	%	No.	%	No.	%
Unapparent infection	25	80.6	18	69.2	11	84.6
Low grade infection	4	12.9	7	26.9	1	7.7
Severe infection	2	6.5	1	3.9	1	7.7
Total	31		26		13	

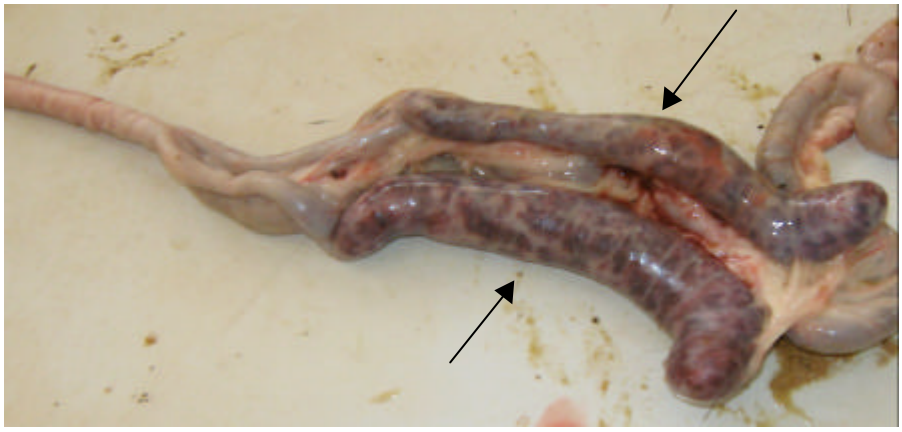

Fig. 2: Ballooning (upper arrow) and haemorrhages (lower arrow) in the caeca of a broiler with severe coccidia infection (arrows)

and severe infections, respectively. No gross lesions were observed in all birds with unapparent and low grades infections and the indigenous chicken with severe grade infection. However, ballooning, severe haemorrhages with clotted blood and caseous materials in the intestinal lumen were observed in the caecum and across the entire intestinal segments of the broilers and the layer with the severe grade of infections, respectively (Fig. 2, 3).

Table 3 shows occurrence of the seven recognized pathogenic *Eimeria* species of chickens in the 3 types of the chickens sampled. *Eimeria maxima* has the highest overall prevalence of 58.6% followed by *E. acervulina*: 47.1%, *E. mitis*: 30.0%, *E. brunetti*: 28.6%, *E. tenella*: 22.9% and *E. necatrix*: 15.7%. *E. praecox* has the least prevalence of 8.6%.

Table 4 shows the prevalence of single and mixed infections of *Eimeria* species in the sampled chickens. The result showed overall prevalence rates of 38.6 and 61.4% for single and mixed infections, respectively. However, greater numbers of birds with mixed infections were from the

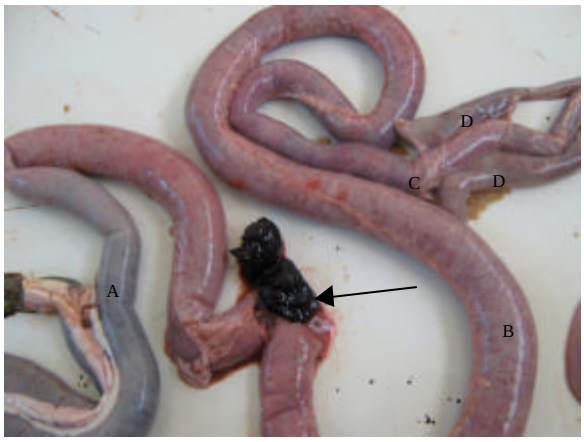

Fig. 3: Intestine of a layer with severe coccidia infection showing haemorrhages, ballooning and clotted blood in the lumen (arrow) across the A: Duodenum, B: Jejunum, C: Ileum and D: Caecum

Table 3: Prevalence of *Eimeria* species of chickens in Zaria

		Occurrence of *Eimeria* spp. in the infected chickens													
		E. acervulina		*E. brunetti*		*E. maxima*		*E. mitis*		*E. necatrix*		*E. praecox*		*E. tenella*	
Type of chicken	No. of infected	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Layers	31	17	54.8	11	35.5	20	64.5	9	29.0	6	19.4	0	0.0	8	25.8
Broilers	26	10	38.4	7	26.9	12	46.2	11	42.3	5	19.2	4	15.4	5	19.2
Local	13	6	46.2	2	15.4	9	69.2	1	7.6	0	0.0	2	15.4	3	23.1
Total	70	33	47.1	20	28.6	41	58.6	21	30.0	11	15.7	6	8.6	16	22.9

Table 4: Prevalence of single and mixed infections of *Eimeria* species in chickens in Zaria

		Single infection		Mixed infection	
Type of chicken	No. of infected	No.	%	No.	%
Layers	31	9	29.0	22	71.0
Broilers	26	11	42.3	15	57.7
Local	13	7	53.9	6	46.2
Total	70	27	38.6	43	61.4

intensively managed exotic chickens which reported prevalence of 71 and 57.7% for the mixed infection and 29.0% and 42.3 for the single infections in layers and broilers, respectively. However, for the free range local chickens, prevalence rates of 46.2 and 53.9% were observed for the mixed and single infections, respectively.

DISCUSSION

An overall prevalence of 33.3% of coccidia infection was recorded in the sampled chickens which further confirm the endemicity of coccidiosis in Zaria. This relatively high prevalence of the infection in the sampled chickens might be due to the period of the study which coincided with the

rainy season that is an enabling factor for coccidia infection in chickens. Higher prevalence of the coccidia infection was observed in the exotic chickens as compared to that seen in the free range local chickens. This agrees with previous reports that coccidiosis is most common to birds under intensive management especially those on deep litter due to relatively higher oocyst accumulation in the deep litter (Methusela *et al*., 2002; Taylor *et al*., 2007). Thus, the chances of the chickens to pick-up large numbers of sporulated oocyst is more likely in the intensively managed exotic chickens than the indigenous chickens under extensive management system. Among the exotic breeds of chickens, layers had higher prevalence rate of infection. This agrees with report of Etuk *et al*. (2004) who also reported higher frequency of coccidia infection in layers than in broilers. According to McDougald and Reid (1997), breeder and layer pullets are at greater risk of infection by coccidia because they are kept on litter for several weeks. The higher rate of infection in the layers might also be due to stress occasioned by egg production.

Most of the birds sampled had unapparent and low grade coccidia infections. This may call for concern, since the economic implication of coccidiosis is largely associated with the subclinical form of the disease as it has been reported to have negative effect on the performance of infected birds (Haug *et al*., 2008a). Impaired feed conversion is among the major effect of subclinical coccidiosis and since feed costs comprise some 70% of the cost of producing commercial chickens, the economic impact of subclinical infection is therefore considerable. The present report showed that all the 7 widely recognized *Eimeria* species of chickens occurred as single or multiple infections in Zaria. This agrees with the findings of Majaro (1981, 1993) in broilers and local chickens in Ibadan, Nigeria. *Eimeria maxima* and *E. acervulina* are the most prevalent species in this study. This is in agreement with the report of Frank *et al*. (2002) which stated that *E. acervulina* and *E. maxima* are the most prevalent species in chickens. The higher biotic potential of these species might be responsible for their high prevalence. Although, outbreaks of coccidiosis due to the highly pathogenic *E. tenella* and *E. necatrix* are common in Zaria (Bishu, 1982; Abdu *et al*., 2008; Musa *et al*., 2010). A relatively low frequencies of these two species observed in this study might be due to the fact that most anticoccidial drugs in general use were developed specifically because of these species (Taylor *et al*., 2007) hence, reducing their population more in relation to the less drug sensitive species. Low fecundity of these species might also be another reason for their low prevalence rates (McDougald and Reid, 1997). The finding that most of the infected sampled chickens harboured more than one species of *Eimeria* agrees with McDougald (2003) who reported multi species infections of *Eimeria* in chickens with up to 6 species occurring together. Hence, this ubiquity of chicken *Eimeria* precludes eradication as a practical option for control especially in intensively managed poultry farms. The observed frequencies of isolation of the pathogenic *Eimeria* species in this study are remarkable as it indicates potential economic impact on poultry production in the study area and in Nigeria. The high prevalence of *E. maxima* (58.6%) is of great concern due to its pathogenic potential and marked antigenic diversities of strains of this specie (Martin *et al*., 1997; Shirley, 2009). Therefore, birds that survive infection due to one strain of *E. maxima* may not be protected against subsequent challenge with some other strains of the parasite. *E. brunetti* is present in 28.6% of the sampled birds. This represents a major risk since *E. brunetti* is a markedly pathogenic species associated with severe weight lost and hemorrhagic cases in birds especially in heavy infection (Taylor *et al*., 2007). Although, *E. necatrix* and *E. tenella* appear to be the less frequent among the four most pathogenic *Eimeria* species in the sampled chickens, however, their higher pathogenic potential calls for great concern. According to Taylor *et al*. (2007) *E. necatrix* can cause severe clinical signs and mortality within 5-7 days post infection and birds that recover often

remain unthrifty and emaciated. *E. tenella* considered as the most pathogenic specie worldwide is a major cause of outbreaks in poultry farms because of its great potential to cause injury to birds, even with low dose of oocysts. Conway *et al.* (1993) reported that, *E. tenella* and *E. acervulina* (which has moderate pathogenicity) are able to provoke changes in birds starting from 100 oocysts and are associated with large economic losses. Less pathogenic species such as *E. mitis* and *E. praecox* are not commonly related to clinical cases but in major infections they can increase feed conversion or even cause low grade mortality in young birds (Taylor *et al.*, 2007). The Nigerian local breeds of chickens have shown resistance to *Eimeria* infection (Majaro, 1993; Saidu *et al.*, 1994; Lawal *et al.*, 2001, 2008). Our finding that these free range breeds of chicken harbour the highly pathogenic *Eimeria* species in substantial frequencies may have a lot serious implication to the commercial poultry production in Nigeria. One of the consequences will be that the local breeds will continue to serve as reservoirs of infection for the highly producing vulnerable exotic breeds. The extensively managed breeds of chickens more often than not rest in shaded and damp areas that favour sporulation of the voided oocysts. Once sporulated, oocysts can resist dry conditions and many forms of commonly used disinfectants (Guimaraes *et al.*, 2007). Oocysts have been reported to survive during winter and can stay infective for up to two years (Sainsbury, 1992). Poultry attendants or personnel often serve as disseminators of sporulated oocysts through the attachment of the infective stages to their clothes and shoes. Contaminated equipment, dust, rodents, wild birds as well as insects could also introduce the infective oocysts to poultry houses (Chapman, 1997; Majaro, 2001).

In our study the identification of *Eimeria* species was done using the oocysts morphometric technique. Discrimination of *Eimeria* species using this technique has sort of limitations to be used as a single tool for diagnosis. Meaning that results obtained with this method should be carefully interpreted (Woods *et al.*, 2000; Lopez *et al.*, 2007). This is because the measurements of the oocysts may undergo variations due to changes in metabolism of the parasites or birds and even in the value of the shape morphometric indices of the oocysts that may overlap leading to misleading conclusions regarding the species (Sun *et al.*, 2009). Despite the limitations of morphometric techniques, there are some reports that indicated that oocyst morphometry could also be a sensitive method for the discrimination of *Eimeria* species of chickens in field trials as it shows high degree of agreement with the molecular methods (Terra *et al.*, 2001; Luchese *et al.*, 2007; Haug *et al.*, 2008b; Carvalho *et al.*, 2011). The use of molecular techniques is the most specific and rapid way of diagnosing *Eimeria* infection especially when it involved several species occurring concurrently (Fernandez *et al.*, 2003; Haug *et al.*, 2007; Vrba *et al.*, 2010). However, in developing countries like Nigeria very few laboratories have the facilities and personnel to carry out these molecular techniques for routine diagnosis of coccidiosis.

In conclusion, our study showed that all the pathogenic *Eimeria* species of chicken occurred in Zaria with *E. maxima* and *E. acervulina* being the most abundant. Most of the slaughtered chickens had unapparent infection with more than one species of *Eimeria*. This may pose high economic implication to commercial poultry farming in the area due to poor performance of the affected birds that most often looked apparently healthy. Subclinical coccidiosis are most likely going to be missed by season clinicians as diagnosis of coccidiosis has often being based on history of hemorrhagic diarrhea and gross lesions consistent with the disease. Speciation of *Eimeria* based on segment of the intestine affected no longer holds water because of the very high prevalence of mixed infection recorded in the study area. Therefore, routine check up for coccidia oocysts and its morphometric identification that will help in detecting subclinical coccidiosis and the associated

Eimeria species in poultry farms is highly recommended. This will help both the farmers and the clinicians in the appropriate choice of drugs and or vaccines against coccidiosis in the study area. Proper control measures must be taken in the form of strict biosecurity measures, avoiding water spillage, overcrowding and good use of prophylactic anticoccidial programmed. Poultry houses should be disinfected in the intervals between depopulation and restocking. These measures have been established to be effective in reducing the menace of coccidiosis in many countries.

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