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Dry season prevalence of avian *Coccidia* infection in domesticated chickens (*Gallus domesticus*) in Jere Council, Borno State, Nigeria

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ABSTRACT: The present study was carried out between the months of October, 2014 to April, 2015 and aimed at determining the dry season prevalence of avian *coccidia* infection and their degree of severity among domesticated chickens (*Gallus domesticus*) in Jere Council, Borno State, Nigeria. A total of 430 fresh faecal and gut samples were collected from chickens of both exotic and local breeds. The samples were examined using floatation and intestinal impulsion smear techniques. The study was conducted among breeds (exotic vs. local), sexes (male vs. female), ages (young vs. adult), management systems (intensive vs. extensive) and housing (cage vs. deep litter). Out of the 430 faecal samples examined, 54 (12.60%) were positive for various *Eimeria* species. Infection was more in the exotic (7.90%) than the local breed (4.70%). Coccidia infection found in young (10.0%) was higher (*P*= 0.0001) than in adult chickens (2.60%), while female ones had higher (*P*= 0.03) number of *coccidia* than the males. Chickens reared under poor management system showed higher infection (10.20%) compared to the good management one (2.30%). Chickens reared under intensive deep litter housing has higher coccidial load (9.30%) than those reared under extensive system (3.30%). *Eimeria necatrix* had the highest degree (42.60%) of severity score (+4), followed by *Eimeria acervulina* (27.80%), *Eimeria tenella* (24.10%) and *E. maxima* (5.60%) with degrees of severity scores +3, +4 and (+3) respectively. In conclusion, there was presence of coccidia infection in Jere area of Borno State, Nigeria.

Key words: Avian *coccidia*, domesticated chickens, dry season, infection.

INTRODUCTION

In developing countries poultry production offers an opportunity to feed the fast growing human population and to provide income for farmers. Moreover, poultry in many parts of the world is considered the chief source of not only cheaper protein of animal origin but also of high quality human food (EARO, 2000). Coccidiosis is an important parasitic disease that induces great economic loss particularly in poultry industry (Nematollahi et al., 2009; Bera et al., 2010), and is considered as the most prevalent intestinal parasitic disease of poultry all over

the world (Oljira et al., 2012; Lawal et al., 2016). The disease is caused by different species of the genus, *Eimeria* family *Eimeridae* order Cucoccidioria and phylum Spicomplera (Taylor et al., 2007a, b). In domesticated chickens, at least nine species of *Eimeria* have been recognized (Gari et al., 2008; Bowman, 2009; Morgan et al., 2009). *Eimeria tenella* and *E. necatrix* are the most pathogenic species. *Eimeria acervulina*, *E. maxima* and *E. mivati* are common and moderately pathogenic; *E. brunetti* is uncommon but pathogenic when it does occur. *E. mitis, E. praecox* and *E. hagani* are relatively non-pathogenic species (Soulsby, 1982; Methusela, 2001; Nematollahi et al., 2008; Jadhav et al., 2011). The infection occurs when susceptible birds ingest feed or water contaminated with sporulated oocysts (Allen and Fetterer, 2002). Clinical signs of the disease is characterized by dysentery, enteritis, emaciation, droopy wings, poor growth, drop in egg production (Rehman et al., 2010; Awais et al., 2012) with high morbidity and mortality rates (Shirzad et al., 2011). Sometimes, due to higher stocking densities of birds and poor management in intensive deep litter systems, its incidence is being increased in poultry (Nnadi and George, 2010; Naphade, 2013). *Eimeria spp*. is omnipresent and can survive in infected birds and the environment for long times (McDougald, 2003). It causes high mortality in young chicks because most of the *Eimeria* species affect birds between the age of 3 and 18 weeks (Toulah, 2007; Nematollahi et al., 2008*;* 2009). Coccidiosis can be controlled by good management including good ventilation, dry and clean litter, cleaning and decontamination of drinkers and feeders, and proper stocking density in poultry farms (Al-Natour et al*.*, 2002; McDougald, 2003; Ashenafi et al., 2004; Al-Quraishy et al., 2009). Recently, there was influx of people into Jere Council of Borno State and the population is in the increase. There is urgent need to increase the supply of animal protein, which could be achieved through the improvement of livestock production especially poultry, in order to meet the immediate human nutritional requirements. However, commercial poultry production reared intensively for meat (broilers) and table eggs (layers) is a growing enterprise in Borno State. Knowledge about the prevalence and importance of avian coccidiosis among commercially reared and backyard poultry system is essential in Borno State. Rainy season had been implicated to aggravate the outbreak of coccidiosis in poultry due to the increase in humidity which favours *Eimeria* oocyts sporulation (Awais et al., 2012; Ali et al., 2014). However, researches have shown that the disease can occur throughout the year, especially where strict biosecurity measures and good hygiene in deep litter poultry houses are not well maintained. The current study was aimed at determining the dry season prevalence and the degree of infection of avian coccidia among domesticated chickens in Jere Council of Borno State.

MATERIALS AND METHODS

Study area

Jere Councils is located in Maiduguri, Borno State Northeastern Nigeria. Maiduguri is the capital and largest city of Borno State, located within the Sahel savannah zone of the Northeastern Nigeria. It lies approximately between11° 5’ and 11.83° N latitude and 13° 09’ and 13.50° E longitude at about 350 m (1161 ft) above sea level with ambient temperatures of 40 to 45°C (http://www.unimaid.edu.ng/About_Maid.aspx). The climate is hot and dry for a greater part of the year with a rainy season from June to September in the Northern part and May to October in the Southern part with a mean annual rainfall and temperature of about 650 mm and 32°C, respectively. The mean relative humidity ranges from 30 to 50% with the minimum usually experienced in the months of February and March, when it drops to as low as 10% and reaches maximum in August, as high as 90%.

Study Design

A cross sectional study was designed to estimate the prevalence and degree of severity of avian *coccidia* infection in chickens of exotic and local breeds of both sexes and various ages. A total of 430 feacal and gut samples were randomly collected from both exotic and local breed chickens from backyard poultry farms located within Mairi area, the University of Maiduguri staff quarters and poultry dressing slab of Custom markets. Samples were collected between the months of October, 2014 to April, 2015.

Sample Size Determination

The desired sample size for the study was calculated using the equation described by Thrusfield (2005) with 95% confidence interval, 5% absolute precision and 50% expected prevalence as shown below:

$$n = \frac{1.96^2 \times pq\,(1 - \_p\,exp)}{I^2}$$

Where: n = the required sample size, p = expected prevalence, q = 1 – p; l = absolute precession.

As a result, 430 study populations were selected.

Sample Collection and Analysis

Fresh faecal samples were collected from birds. To collect faeces from the gut, birds were slaughtered, the abdomen cut open using a sharp scalpel blade and the

Table 1. Overall Prevalence of avian coccidia infection.

Total Number of feacal Sample Examined	Number of Positive samples	Number of negative samples
430	54	376
Overall prevalence (%)	12.60	87.40

Table 2. Prevalence of coccidia infection in breeds, ages and sexes of chickens

Risk Factors	Information	No. examined	No. positive	Prevalence (%)	L – U (95% CI)	*p-value*
Breed	Local	190	20	4.70	0.8568 – 0.9409	0.3934
	Exotic	240	34	7.90	0.8310 – 0.9126	
Age	Young	130	43	10.0	0.6806 – 0.8137	< 0.0001
	Adult	300	11	2.60	0.9377 – 0.9822	
Sex	Male	245	22	5.10	0.8780 – 0.9477	0.0343
	Female	185	32	7.40	0.7981 – 0.8969	

intestine gently removed. Intact faeces samples were then squeezed out into sterile sample bottles. All samples were properly labeled and transported immediately after collection to the laboratory. Factors that were noted during sampling included age, sex, breed of birds and management practice on farms.

Samples were processed and analyzed in the Parasitology unit, Department of Veterinary Medicine Research Laboratory, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria. In the laboratory each faecal sample was gently macerated in potassium dichromate solution at 37 ^{0}C using mortar and pestle. The suspension was filtered through a muslin cloth and allowed to sediment. The supernatant was discarded and the oocysts in the sediment were separated by floatation method in saturated sodium chloride solution. They were examined microscopically and the different *Eimeria* species were identified on the basis of shape and size of sporocysts and sporozoites as described by Bowman and Georgis (2003).

Data analysis

The data generated from this study were analyzed using SPSS version-17 statistical software. Pearson's Chi square test was used to measure statistical significance of results. Results were considered to be statistically significant at 95% Confidence Interval and *p*-value < 0.05.

RESULTS

Out of the 430 faecal and gut samples collected and examined microscopically for the presence of coccidial parasites during the dry season period, 54 (12.60%) was positive for coccidian infection (Table 1).

Considering the prevalence among the breed of chickens examined, infection was found to be more in the exotic chickens (7.90%) compared to the local chickens (4.70%). Athough, association among the breeds of chickens was not significant (*P*= 0.3934). Infection was found to occur significantly (*P*<0.0001) more in the young chickens (10.0%) than in the adult chickens (2.60%). Also, significant (*P*= 0.03) infection was found to occur more in female chickens (7.40%) compared to the male ones (5.10%) as shown in Table 2.

Considering the prevalence of avian coccidia according to management systems, it was found that chickens reared under poor management system (10.20%) significantly (*P*<0.0001) showed high infection compared to those reared under a good management system (2.30%). However, considering the prevalence of avian coccidia according to type of housing in which chickens examined were reared, showed that chickens reared in cages under intensive housing have significantly (*P*= 0.02) higher percentage of infection (9.30%) compared to those reared under extensive housing or no house (3.30%) (Table 3).

Out of 54 infected chickens, infection by *Eimeria necatrix* (42.60%) which was found in the *jejunum* had degree of severity score (+4), followed by *E. acervulina* (27.80%) in the *duodenum* and *E. tenella* (24.10%) in the *caecum* which had degree of severity scores of +3 and +4 respectively. *Eimeria maxima* (5.60%) which was found in the *ileum* had degree of severity score (+3) (Table 4).

DISCUSSION

Coccidiosis is considered the most prevalent intestinal parasitic disease in commercial chicken production system worldwide. The results of this present study shows that in dry season chickens could be infected by

Table 3. Effect of management system on prevalence of avian coccidia infection.

Parameters	Type	No. of samples examined	No. of positive	Prevalence %	L - U (95% CI)	p-value
*Management System	Poor	105	44	10.20	0.6246 – 0.7764	<0.0001
	Good	325	10	2.30	0.9459 – 0.9856	
Housing type	Intensive	240	40	9.30	0.8102 – 0.8957	0.0157
	Extensive	190	14	3.30	0.8875 – 0.9620	

*Management system: Poor (Inappropriate; wet and damp litter/ inadequate ventilation); Good (appropriate; dry litter/adequate ventilation).

Table 4. *Eimeria* species found in gut of chickens.

Coccidia species	No. of samples examined	No. positive (%)	Region of Intestine Affected	Severity scores of infection
Eimeria tenella	54	13 (24.10)	*Caecum*	4+
Eimeria necatrix	54	23 (42.60)	*Jejunum*	4+
Eimeria acervulina	54	15 (27.80)	*duodenum*	3+
Eimeria maxima	54	3 (5.60)	*Ileum*	3+
Overall		54 (100)		

Eimeria species. The finding of this study is similar to those reported by Awais et al. (2012) and Bachaya et al. (2015) who also recorded peak coccidiosis infection in chickens between the months of November and January in Pakistan. This can be attributed to the harsh dry cold harmattan weather which can be implicating in immunosuppression and predisposition of avian species to wide range of infectious diseases including coccidiosis. Adamu et al. (2009) and Abalaka et al. (2013) have reported high incidence of poultry diseases with high recorded cases of coccidiosis in poultry during the dry season in Sokoto State, Nigeria. Bachaya et al. (2012) reported that coccidiosis in domesticated chickens occurred all around the year, but the intensity was higher in the rainy season. The 12.60% overall prevalence recorded in this study was lower than the prevalence of 31.80% in Maiduguri by Lawal et al. (2016). The occurrence was attributed to poor management systems especially allowing rampart water spillages on litter. There have been varying reports of prevalence of coccidiosis among chickens from some parts of Nigeria, Grema et al. (2014) recorded (11.40%) in Gombe; 31.80% was reported by Lawal et al. (2016) in Maiduguri, Muazu et al. (2008) recorded 89.50% in Vom, Plateau State, 34.10% was recorded by Barde et al. (2012) in Kaduna, 36.60% in Benin by Dakpogan and Salifou (2013), Adamu et al. (2009) and Jatau et al. (2012) recorded the overall prevalence of coccidiosis of 14.0% and 33.30% in Zaria and Sokoto respectively.

Higher incidence of coccidiosis in exotic chickens compared to local ones observed could be linked to the fact that the exotic chickens were reared in confinement and were likely to be most exposed to the infective stages of the organism in litters and feeds while the local breeds of chickens were usually found roaming and scavenging around the surroundings. They may not come into contact with the infection or may not ingest the infective stages of the organism. This agrees with the findings of Jatau et al. (2012); Oljira et al. (2012) and Garbi et al. (2015) who also reported high prevalence of coccidian infection in exotic breed chickens as compared to the free range local chickens. However, the findings of this current study did not corroborates previous reports by Benisheikh et al. (2013) who reported higher coccidiosis rate in local chickens (38.8%) than in exotic breeds (22.8%). Moreso, Ashenafi et al. (2004) in Ethiopia and Hadipour et al. (2013) in Iran have reported high incidence of avian coccidiosis in indigenous scavenging chickens.

Higher occurrence of *coccidial* infection in younger chickens (10.0%) as compared to adults (2.6%) showed that *coccidial* infection is age related. The difference in age variation among birds could be due to the effect of age susceptibility. Adult birds could have developed acquired immunity to infection due to previous repeated contacts with several *coccidia* species in the litter, that can enable them to harbor the infection without showing clinical signs whereas young birds may not have developed full immunity and can be more vulnerable and experience great mortality where outbreak of the disease occur (Chapman et al., 2005; 2011; Györke et al., 2013).This finding is in concurrence with previous report of Muazu et al. (2008) who reported 36.7% prevalence of *coccidial* infection among adult birds and 52.9% among

the younger birds. Moreover, Oljira et al. (2012), Bachaya et al. (2012), Ali et al. (2014) and Lawal et al. (2016) have also reported the predominance of *coccidial* infection among young birds as compared to adult birds. The finding of this present study was not consistent with those of Dakpogan and Salifou (2013) who reported higher rate in adult chickens (40.70%) as compared to the young ones (28.20%). Moreover, high rate of infection in adult chickens as compared to younger ones have also been reported by Ahmed et al. (2003), Amer et al. (2010) and Bachaya et al. (2015).

In this current study, *coccidial* infection was found to occur more in females (7.40%) than in male chickens (5.10%). The association between the sexes was statistically significant (*P*= 0.03). This finding agrees with those of Oljira et al. (2012) who also reported higher frequency of avian coccidiosis in female chickens (21.43%) as compared to male ones (19.38%). Although, Olanrewaju and Agbor (2014) have recorded high prevalence of coccidiosis among male chickens (80.0%) as compared to females (70.0%). Garbi et al. (2015) have also reported higher prevalence of coccidiosis in male (20.0%) chickens as compared to the female (19.27%).

Chickens reared under poor management system (10.20%) in the study area shows high frequency of infection compared to those reared under a good management system (2.30%). The association between the management systems was statistically significant (*P*< 0.0001). Many researches have reported the implication of management systems on chickens' productivity, disease occurrence and susceptibility of intensively reared chickens (Geidam et al., 2011, Elelu et al., 2012; Hadipour et al., 2013). More so, management of poultry houses plays a significant role in the spread of coccidiosis because coccidial oocysts are ubiquitous and are easily spread in the poultry house environment. Furthermore, due to *Eimeria* species high sporulation potential, it is usually very complex to control coccidia in chickens reared on deep litter system under intensive management conditions (Adhikari et al., 2008). Poor management systems, such as allowing water spillage in poultry house to wet litter that encourages oocyst sporulation, contamination drinkers and feeders by feaces, bad ventilation, and high stocking density, can worsen the clinical manifestation of coccidiosis (Al-Quraishy et al., 2009; Sharma et al., 2013; Lawal et al., 2016).

However, it was found that chickens caged and reared under intensive deep litter housing (9.30%) in the study area shows high frequency of infection than those in extensive type or no house (3.30%). The association between the housing types was statistically significant (*P*= 0.02). This could be connected with fact that birds under intensive housing could possibly get regular infection with *coccidia* whenever they feed on litters contaminated with sporulated *Eimeria* oocytes (Methusela et al., 2002; Taylor et al., 2007a, b). This finding is also consistent with previous reports of Lunden et al. (2010) and Dakpogan and Salifou (2013) which stated that relatively higher prevalence of coccidiosis in birds could be ascribed to the confinement and deep litter-based rearing system compared to birds in cages.

Among the 54 infected chickens, *Eimeria necatrix* (42.60%) in the *jejunum* with degree of severity score (+4) was most frequent, followed by *Eimeria acervulina* (27.80%) in the *duodenum* and *Eimeria tenella* (24.10%) in the *caecum* with degrees of severity score +3 and +4 respectively. *Eimeria maxima* (5.60%) found in the *ileum* was the least frequent *Eimeria spp*. in the examined chickens with degree of severity score (+3). This present study recorded four *Eimeria* species in the infected chickens. The results agree with the type of *Eimeria* species reported by Khan et al. (2006), Hadipour et al. (2011), Awais et al. (2012), Bachaya et al. (2012) and Bachaya et al. (2015). The degree of severity of coccidiosis reported in this study supported the findings of Dalloul and Lillehoj (2006) and Benisheikh et al. (2013) who have stated that *Eimeria tenella* and *Eimeria necatrix* are the most pathogenic *Eimeria* species in infected birds but *Eimeria acervulina and Eimeria maxima* are common and slightly to moderately pathogenic. Although, it has already been reported that *Eimeria* species and their prevalence vary greatly within different geographical areas of the world (Györke et al., 2013; Zhang et al., 2013).

Conclusions

In conclusion, the present study showed that infection of different species of coccidia occurred in dry season and was found to be more in exotic, female and young birds. Poor managed and intensively reared birds accumulated more *coccidia* in their gut.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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