
INTESTINAL PATHOLOGY ASSOCIATED WITH NATURAL INFECTION OF COCCIDIOSIS IN DOMESTIC PIGEONS IN MAKURDI, BENUE STATE, NIGERIA

¹TERFA, Ashever Jocelyn, ¹RABO, Jude, ¹ABENGA, Jerry, ²ORAKPOGHENOR, Ochuko and ¹DZONGOR, Joel

¹Department of Veterinary Pathology, College of Veterinary Medicine, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria.

²Department of Veterinary Pathology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Corresponding Author: Terfa, A. J. Department of Veterinary Pathology, College of Veterinary Medicine, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria. **Email:** asheverterfa@gmail.com **Phone:** +234 813 190 3601

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ABSTRACT

This study was conducted to determine the prevalence of Eimeria species in domestic pigeons and study the gross as well as the microscopic pathology they cause in the intestinal tract of the birds in Makurdi, Benue State. A total of 310 healthy pigeons comprising 171(55.2%) males and 139(44.8%) females; 133(42.9%) were sampled during the dry season and 177(57.1%) were sampled during the wet season from local farmers in Makurdi, Benue State. Faeces from the rectum of each bird were analyzed using the simple flotation method for the detection of Eimeria oocyst. Intestinal gross lesions were noted and intestinal segments were obtained for Histopathological studies. The prevalence of Eimeria species in pigeons of Makurdi was 170/310(54.8%). The infection was significantly higher ($p < 0.05$) in the male Pigeons as compared to the female ($p > 0.05$). There was no significant difference ($p > 0.05$) between the number of pigeons infected in the wet season as compared with the dry season. Gross lesions revealed hemorrhagic enteritis and from the histopathological sections of the intestine, developmental stages of Eimeria species were seen in the mucosa, submucosa, and muscularis mucosa respectively with necrosis of villi and inflammatory cell infiltration. It was concluded that Since Eimeria species are highly prevalent in domestic pigeons and cause severe intestinal lesions, constant Veterinary surveillance is required to prevent economic losses in the pigeon industry.

Keywords: Coccidiosis, Domestic pigeons, Intestinal pathology, Makurdi, Prevalence

INTRODUCTION

The domestic pigeons - *Columba livia domestica* Gmelin, 1789 (Columbiformes: Columbidae) are birds that are ubiquitous and can be found in virtually every town and city around the world (Marques *et al.*, 2007). They are usually reared for meat production, gaming, showy purposes, hobbies, and recently as laboratory animals (Radfar *et al.*, 2011; Sood *et al.*, 2018).

Coccidiosis in pigeons is caused by an apicomplexan protozoan parasite of the genus *Eimeria*. It is considered an important parasitic disease of pigeons because it causes high economic losses in the pigeon industry (Balicka-Ramisz and Pilarczyk, 2014; Mohammed *et al.*, 2017) due to mortality rate and high cost of treatment. It may be seen in young squabs aged from 4 weeks to 4 months especially when they are reared intensively with poor hygienic measures, while older ones serve as carriers and

remain healthy (Soulsby, 1982; Abadi Amare *et al.*, 2012; Ali *et al.*, 2015). It affects the intestinal tissue resulting in mucoid watery diarrhea which may become bloody in severe cases and dehydration. Other signs such as rough feathers, anorexia, loss of body weight, and sometimes mortality have been reported (Saif, 2008; Latif *et al.*, 2016; Mohammed *et al.*, 2017).

Most intestinal *Coccidia* have a complex but direct life cycle in which the infective form of the parasite invades a single host animal for development to sexual maturity; the life cycle is complete in 1 – 2 weeks. Although little is known about the conditions that may lead to the development of clinical disease in wild birds, birds may become diseased more frequently during periods of stress (Mahdii and Al-Rubaie, 2013).

Pigeon coccidiosis is usually sub-clinical, however, outbreaks of coccidiosis may occur causing mortality among nestlings and young birds (Ali *et al.*, 2015). There are four species of *Eimeria* in pigeons: *E. columbae*, *E. columbarum*, *E. labbeana*, and *E. labbeana*-like (Yang *et al.*, 2016; Balicka-Ramis *et al.*, 2021). They are characterized by varying degrees of virulence. Therefore, this study was undertaken to determine the prevalence of *Eimeria* species among domestic pigeons in Makurdi, Benue State, and study the gross as well as the microscopic Pathological changes these parasites cause in the intestinal tract of their host pigeons.

MATERIALS AND METHODS

A total of 310 Pigeons consisting of 171(55.2%) males and 139(44.8%) females sourced from local farms located in Makurdi Metropolis were used for this study. 133(42.9%) were sampled during the dry season and 177(57.1%) were sampled during the wet season from the months of January 2020 to November 2020. They were caught at night, kept in cages, and transported the following morning to the necropsy room of the Veterinary Teaching Hospital (VTH), Joseph Sarwuan Tarka University, Makurdi.

Fecal Examination: Fecal samples were collected into sterile polythene bags from each pigeon using gloved hands, labelled appropriately, and taken immediately to the

laboratory for analysis. Analysis was done within 3 hours of collection to identify coccidian oocyst using the flotation technique.

The simple flotation method: Using this method, coccidian oocyst was identified from faeces using a standard procedure (Gupta and Singla, 2012). The eggs were identified using a guide by Thienpont *et al.* (1979). The saturated salt solution was used as the flotation medium. It was prepared by dissolving 400 g of table salt in 1 liter of water. Twenty millilitre of the saturated salt solution was dispensed into a beaker and a spatula was used to scoop 1 g of faeces and emulsified into the saturated salt solution. A funnel was then used to sieve the solution into a centrifuge tube to make a convex meniscus. A cover slip was placed on the centrifuge tube so that the parasite eggs present can attach to it. The cover slip was then dropped on the microscope slide and viewed at X10 microscope objective and confirmed at X40 microscope objective.

Sacrificing of Pigeons and Necropsy: The infected pigeons were humanely euthanized according to the procedure described by Underwood *et al.* (2013). The gastrointestinal tract was harvested and examined for gross lesions. Photographs of the lesions were taken using a digital camera (Sony Alpha a6300). Sections of the intestinal segments were collected and submitted for histopathology. These tissues were processed according to the procedure described by Drury and Wallington (1980). Photomicrographs of the histological sections of the avian intestine were taken using an AmScope 3.7 digital camera fitted to a triocular Olympus light microscope.

Statistical analyses of data were carried out using Chi-square and p p-value less than ($p < 0.05$) was considered statistically significant. Results were expressed in percentages based on the presence or absence of *Eimeria* oocyst in the faeces of the pigeons based on sex and season.

RESULTS

A total of 310 pigeons were sampled, and these comprised 171(55.2%) males and 139(44.8%) females (Table 1). One hundred and thirty-three

pigeons (42.9%) were sampled during the dry season (January, February and November 2020)

Table 1: Demographic of Pigeons Sampled and Distribution of Pigeons infected with *Eimeria* Species within Makurdi metropolis, Benue State, Nigeria

Characteristics	Number of Pigeons Sampled (%)	Number of Pigeons Infected (%)
Sex		
Male	171 (55.2)*	103 (33.2)*
Female	139 (44.8)	67 (21.6)
Season		
Dry	133(42.9)	80(25.8)
Wet	177 (57.1)*	90 (29.0)*
Total	310 (100)	170 (54.8)

*significant mean at $p < 0.05$ using student pairwise comparison (t-test)

and 177(57.1%) were sampled during the wet season (July – October 2020).

Of the 310 pigeons, 170 were infected with the *Eimeria* parasite. Therefore, the prevalence of *Eimeria* species in Makurdi is 54.8% (Table 1). Based on sex, 103(33.2%) males and 67(21.6%) females were infected with the parasite, and based on the seasons of the year, 80(25.8%) pigeons were infected during the dry season while 90(29.0%) were infected in the wet season (Table 1).

Infection of *Eimeria* parasites was significantly higher ($p < 0.05$) in the male pigeons as compared to the female. There was no significant difference ($p > 0.05$) between the number of pigeons infected in the wet season compared to the infection in the dry season.

The gross lesions associated with the infection of *Eimeria* species observed in this study include hemorrhagic enteritis (Figure 1) and intestinal petechiations on the mucosa (Figure 2).

The intestinal villi were completely colonized by macrogametes and microgamete of *Eimeria* (Figure 4); mononuclear inflammatory cells were also seen in the submucosa and extending into the muscularis mucosa (Figure 5). Severe necrosis of intestinal glands was seen with marked infiltration of eosinophils in the lamina propria of the intestine (Figure 6)



Figure 1: Picture of the intestine of a domestic pigeon showing hemorrhagic enteritis (A)



Figure 2: The intestine of a domestic pigeon showing petechial hemorrhages on the mucosa (B)

Histopathological study showed *Eimeria* schizonts and merozoites in the intestinal mucosa (Figure 3).

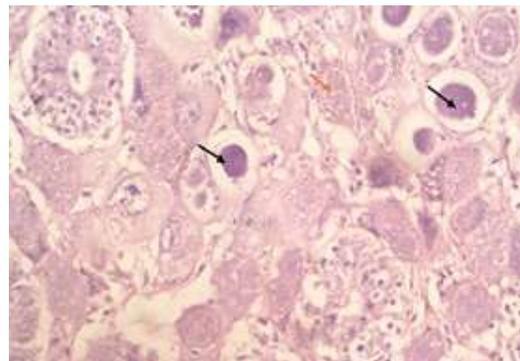


Figure 3: Photomicrograph of the intestine of a domestic pigeon showing different stages of the life cycle of *Eimeria* species in pigeons (Schizogony and gametogony) (black arrow and orange arrows (H & E stain X400))

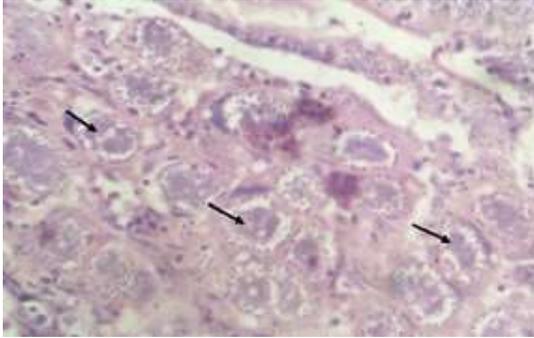


Figure 4: Photomicrograph of the intestine of a domestic pigeon showing the villi completely colonized by macro and microgametes of *Eimeria* (arrows) (H & E stain X400)

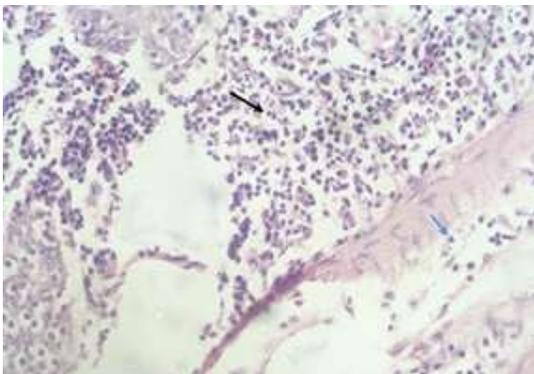


Figure 5: Photomicrograph of the intestine of a domestic pigeon showing marked presence of mononuclear inflammatory cells in the submucosa (black arrow) and extending into the muscularis mucosa (blue arrow) (H & E stain X400)

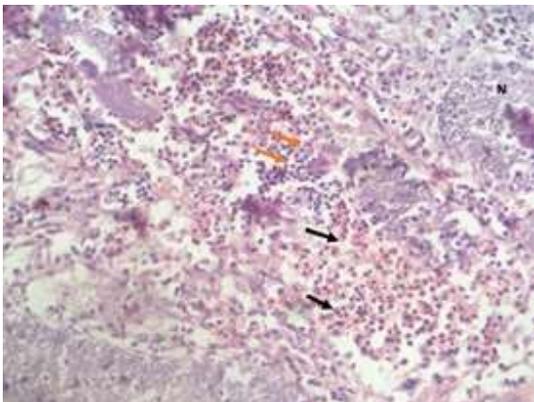


Figure 6: Photomicrograph of the intestine of a domestic pigeon showing the massive presence of inflammatory cells mainly eosinophils (Black arrows) and lymphocytes (orange arrows) in the lamina propria. There is also necrosis of intestinal glands (N) (H & E stain X400)

DISCUSSION

Coccidiosis is an economically important disease which is caused by unicellular protozoa, *Eimeria*. It continues to be a serious threat to animal health and results in lowered productivity due to the associated morbidity, mortality, and cost of treatment and control measures. In this study, *Eimeria* spp. was found to infect pigeons of all sexes and in all seasons of the year. The prevalence of *Eimeria* species in pigeons of Makurdi may be attributed to the free-range and semi-intensive practices of rearing pigeons which expose the birds to a substantial number of sporulated oocysts. However, no clinical signs were observed as the birds all seemed healthy at the time of sampling. Mohammed (2009) suggested that after first ingesting some quantities of oocysts, the pigeons develop immunity to infection by the stimulation of endogenous defense mechanisms, without visibly succumbing to the disease. With this protection, immunity is reinforced by constant ingestion of low levels of oocysts and the birds live in a kind of equilibrium with the parasites, which also protects them against severe intestinal disease.

Higher infection rates of 58.3% were reported in Egypt (Elseify *et al.*, 2018), 67.58% reported in Van, Turkey (Gül *et al.*, 2009), and 75% reported in India (Ramesh *et al.*, 2018). Other researchers reported a lower prevalence of 27% in Egypt (Gadelhaq and Habelaty, 2019), 31% in Andhra Pradesh, India (Sivajothi and Sudhakara, 2015), 19.44% in Kano Nigeria (Mohammed *et al.*, 2017), 35% in Baghdad City (Mahdii and Al-Rubaie, 2013) and 38.81% was reported in Assam, India (Saikia *et al.*, 2017).

Differences in the geographical location, number of birds sampled, and type of laboratory tests used might be the possible reasons for the disparity in the prevalence of *Eimeria* species recorded in this study and those by other researchers.

The significantly higher ($p < 0.05$) prevalence of *Eimeria* species in the male pigeons as compared to the female was similar to the report of Ola-Fadunsin (2017) who proposed that the aggressive feeding nature of male birds makes them pick up more sporulated oocysts

from contaminated feed, water, or litters and this may be the reason for the higher prevalence seen in male. This was similar to reports of Mahdii and Al-Rubaie (2013) where the prevalence was also higher in male pigeons (38.09%) than in the females (31.57%) but varies with the report of Mohammed *et al.* (2017) in Kano State, Nigeria where the prevalence of coccidiosis was significantly higher ($p < 0.05$) in females (20.83%) than in males (18.06%). The infection of *Eimeria* spp. in the wet season though numerically higher than that of the dry season was not significant ($p > 0.05$). Mohammed *et al.* (2017) also reported that infection with *Eimeria* spp. oocysts were significantly higher ($p < 0.05$) during the wet season (8.96%) than the dry season (5.98%) in Kano, Nigeria.

The gross lesions associated with the infection of *Eimeria* species observed in this study include hemorrhagic enteritis and intestinal petechiations on the mucosa. These were consistent with previous reports (Shane, 2005; Bahrami *et al.*, 2013; Abed *et al.*, 2014; Belete *et al.*, 2016).

Histopathological study showed degeneration and necrosis of intestinal glands and villi. Also, there was marked infiltration of inflammatory cells with developmental stages of *Eimeria* species observed. These findings are similar to those of Abed *et al.* (2014), Belete *et al.* (2016), and Saikia *et al.* (2017).

Conclusion: Our findings indicate that coccidiosis is prevalent in domestic pigeons in Makurdi, Benue State, and causes severe pathology in the intestinal tract of these birds. Therefore, constant Veterinary surveillance is required to prevent economic losses in the pigeon industry. The results of this study also provide information that will contribute to the establishment of efficient control measures against coccidiosis in domestic pigeons. Continuation of parasitological studies is needed to ensure proper health assessment.

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