EFFECT OF *Plasmodium* SPECIES INFECTIONS ON PACKED CELL VOLUME OF DOMESTIC CHICKENS AND HELMETED GUINEA FOWLS IN NORTH EASTERN NIGERIA

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ABSTRACT

Populations of exotic and indigenous domestic chickens and guinea fowls in northeastern Nigeria were surveyed for Plasmodium sp by examining their stained blood samples. The packed cell volumes of all blood samples were estimated. During the period of study (March to September 2006), rainfall data were collected. The prevalence of Plasmodium infection in 575 domestic poultry examined was 9.4 % and the prevalence among the difference poultry types (exotic broilers and layers, indigenous chickens and guinea fowls) did not differ significantly (P > 0.05).There was a significant (P < 0.05) positive correlation between the monthly prevalence and rainfall, with mean prevalence higher (P < 0.05) in the rainy than dry months. Packed cell volume (PCV) of uninfected and infected domestic chickens did not differ significantly (P > 0.05), but the infected guinea fowls had lower (P < 0.05) mean PCV than the uninfected ones. In conclusion, Plasmodium sp infection was prevalent among the domestic poultry; and whereas the infection did not cause anaemia in chickens, mild anaemia was observed in infected guinea fowls.

Keywords: Chickens, Guinea fowls, Packed cell volume, Anaemia, *Plasmodium*

INTRODUCTION

Malaria is endemic in Africa, Central and South America, certain Caribbean islands and parts of Asia, where braithophillic mosquitoes transmit it. Over 65 species of *Plasmodium* have been isolated from birds and only three species (*P. gallinaceum, P. juxtanucleare and P. durae*) are the most pathogenic (Springer, 1991). The parasite infects domestic chickens, penguins, ducks, canaries, falcons, pigeons and several marine avifauna (Brossy, 1992; Biu *et al*., 2005; William, 2005; Schultz and Whittington, 2005). In the infected birds, the clinical disease is associated with fever, depression, anorexia, loss of body weight, dyspnea, hepatomegaly, splenomegaly, ocular haemorrhage, haemolytic anaemia, haemoglobinuria, leukocytosis, lymphocytosis, hypoalbuminaemia, nephritis, fatty liver, oedema of the lungs, hydropericardium and occlusion of capillaries of the brain (Jordan and Pattison, 1998; Aiello, 1998; William, 2005). Mortality in bird due the disease may be up to 90 % (Jordan and Pattison, 1998).

The prevalence rates of *Plasmodium* sp infections of domestic chickens were 27 % in Ghana (Poulsen *et al*., 2000), 15 % in Zimbabwe (Permin *et al*., 2002) and 29.5 % in Malawi (Njunga, 2003). The incidence rate of avian malaria infections of seabirds was 87.3 % in Cape Receife, South Africa (Schultz and Whittington, 2005). There was no available report of *Plasmodium* sp infection or avian malaria in domestic chickens in northeastern Nigeria. Biu *et al*. (2005) recently reported 3.0 % infection rate of pigeons with *Plasmodium* sp in Maiduguri, Nigeria.

This paper reports the prevalence of *Plasmodium* sp infections in exotic and indigenous domestic chickens and helmeted guinea fowls in the northeastern Nigeria and the effect of the infection on the packed cell volume of the birds.

MATERIALS AND METHODS

Poultry Population: Exotic commercial chickens (n = 250) in farms located in Maiduguri, Borno State, Northeastern Nigeria were sampled. The layers (n = 160) were Isa Brown (n = 80) and Black Harco (n = 80) breeds and broilers (n = 90) were white feathered breed. The layers and broilers were 25 – 77 and 8 – 12 weeks, respectively. They were raised on deep litter and were fed the appropriate commercial mash rations by the farmers. Feeding and water supply were *ad libitum*. Indigenous domestic chickens (n = 175) and helmeted guinea fowls (n = 150) presented for slaughter at abattoirs located in Maiduguri and Potiskum (300 Km from Maiduguri), respectively, were sampled. The birds were usually brought from the nearby villages where they were raised by the free-range scavenger system.

Blood Sample Collection and Analysis: The blood samples, anticoagulated in EDTA, were collected from the brachial veins of the exotic chickens by venipuncture and from the exanguinating cervical veins of indigenous chickens and guinea fowls during slaughter. Packed cell volume (PCV) was determined by the microhaematocrit method, and thin blood films stained with Giemsa stain were examined for *Plasmodium* sp. (Adams *et el.*, 1977)

Rainfall Data: The monthly rainfall volume within the period of study (March-September 2006) was collected from the Federal Meteorological Station, Maiduguri, Borno State.

Statistics: Poultry type-specific and overall prevalence were calculated as percentages of the infected individuals out of the total population examined within the study period. The monthly prevalence was calculated as the percentage of the infected individuals out of the total population examined in the month. Comparisons of prevalence between types of layers, all layers and broilers, exotic and indigenous chickens, all domestic chickens and guinea fowls, were done using chi-square test (Singha, 1996). The correlation (r) between the monthly prevalence and rainfall was calculated. Pooled data were summarized as means ± standard deviations and the means were compared using one-way analysis of variance with Tukey post-test (GraphPad Software, 1998).

RESULTS

The prevalence of *Plasmodium* sp infections in 575 domestic poultry comprising exotic broilers (n = 90), and layers (n = 160), indigenous chickens (n =175) and guinea fowls (n = 150) was 9.4 % within a period of 7months (March – September 2006). The prevalence among the different types of poultry examined did not differ significantly (P > 0.05), when Isa Brown (IB) and Black Harco (BH) layers, all layers and broilers, all exotic and indigenous chickens, all domestic chickens and guinea fowls were compared, but values ranged from 5.0 % in layers to 12.2 % in broilers (Table 1).

Table 1: Prevalence of *Plasmodium* species infections in different poultry populations in northeastern Nigeria

Type of poultry	Number examined	Number Infected (%)*
Isa Brown layers	80	4 (5.0)
Black Harco layers	80	6 (7.5)
All layers	160	10 (6.3)
Broilers (white feathered)	90	11 (12.2)
All exotic chickens	250	21 (8.4)
Indigenous chickens	175	20 (11.4)
All domestic chickens	425	41 (9.6)
Guinea fowls	150	13 (8.7)
All poultry	575	54 (9.4)

**No significant (P > 0.05) variation in prevalence of infection in the various types of poultry*

The monthly prevalence varied significantly (P < 0.05) (Table 2), and the mean value in the rainy months of June to September (14.9 ± 5.1 %) was significantly (P < 0.05) higher than the mean in the preceding months of March to May. There was a significant (P < 0.05) positive correlation (r = 0.79) between the monthly prevalence and rainfall.

Table 2: Monthly rainfall and prevalence of *Plasmodium* species in poultry in northeastern Nigeria

Month	Number Examined	Number Infected (%)	Rainfall (mm)
March	65	0 (0)[a]	0
April	105	3 (2.9[a]	0
May	65	1 (1.5)[a]	77.4
June	65	5 (7.7)[b]	103.8
July	65	12 (18.5)[b]	419.8
August	140	20 (14.8)[b]	590.6
September	70	13 (18.6)[b]	217.7
Total	575	54 (9.4)	

[a,b] Prevalence rates with different superscripts are significantly (P < 0.05) different

The mean PCV values of different poultry groups studied ranged from 23.7 ± 2.0 % in BH layers to 41.8 ± 6.3 % in guinea fowls (Table 3). The infected chickens did not have significantly (P > 0.05) different mean PCV from the uninfected ones among the various types of chickens. Instead, the infected BH layers had higher values than the uninfected ones.

Table 3: Packed cell volume of blood of different poultry populations examined for *Plasmodium* species

Type of poultry	Infected	Uninfected
Isa Brown layers	25.5 ± 1.9[a]	25.5 ± 3.0[a]
Black Harco layers	26.3 ± 1.4[a]	23.7 ± 2.0[b]
All layers	25.9 ± 1.6[a]	24.6 ± 2.5[a]
Broilers	27.5 ± 2.4[a]	26.6 ± 2.6[a]
All exotic chickens	26.7 ± 2.2[a]	25.4 ± 2.7[a]
Indigenous chickens	32.3 ± 2.5[b]	32.8 ± 4.5[b]
Guinea fowls	32.0 ± 5.8[b]	41.8 ± 6.3[c]

[a, b, c] Mean ± SD with different superscripts are significantly different (P < 0.05)

The infected guinea fowls had lower (P < 0.05) mean PCV than the uninfected ones. The uninfected guinea fowls had higher (P < 0.05) mean PCV than the uninfected domestic chickens, but the exotic chickens had lower (P < 0.05) values than the indigenous ones. The lowest values were 18 %, 21 % and 20 % in the exotic or indigenous chickens and guinea fowls, respectively. Among chicken types examined, 24 % and 1.7 % of exotic and indigenous chickens, respectively, had PCV of < 24 %. Only 0.7 % of the guinea fowls had PCV of < 24 %.

DISCUSSION

Mosquitoes, the vectors of *Plasmodium* sp, are endemic in the environment of the semi-arid Sahel region of northeastern Nigeria. They inflict wounds on the comb and wattles of the birds, infecting them in the process. The evidence of such infections of domestic chickens and guinea fowls, presented in this report, and the report of Bui *et al*. (2005) suggested that avian malaria was prevalent in this environment and the infection rates of the different types of poultry were similar.

The poultry in north-eastern Nigeria seemed to have less *Plasmodium* sp infections than poultry in other parts of Africa (Ghana, Malawi, Zimbabwe), where the prevalence of 15 – 29 % were reported in domestic chickens (Poulsen *et al*., 2000; Permin *et al*., 2002; Njunga, 2003) and 87.5 % in seabirds of South Africa (Schultz and Whittington, 2005). No report was available on the prevalence in guinea fowls outside Nigeria. In Malawi, indigenous scavenging chickens had higher prevalence of infection (29.5 %) than the commercial, intensively managed chickens (0 %) (Njunga, 2003). Intensive management of chickens may provide adequate screening against mosquito bites and occasional antiprotozoal drugs against infections may maintain minimal prevalence. In our study, the indigenous free-range chickens and guinea fowls had similar prevalence with the exotic intensively managed chickens, suggesting that both types of management exposed the birds to infections through mosquitoes. Poultry farms visited during the study were not adequately screened from flying insects.

In the dry period (March), the prevalence was 0 %, but increased with increasing rainfall in the later months. Similar observation was reported in the semi-arid areas with epidemics of human malaria (Thomson *et al*., 2005; Abeku, 2007), which suggested that rainfall increased the population of mosquitoes and the *Plasmodium* transmission risks (Thomson *et al*., 2005). The rainy season was invariably expected to be the period for higher prevalence of avian malaria with the accompanying lesions, one of which was anaemia.

To confirm anaemia in a bird, the PCV should be below the lower limit of the normal or reference range. In domestic chickens, malaria caused anaemia with PCV of < 24 % (William, 2005). Goodwin *et al*. (1992) reported 26 – 36 % as the lower limit of normal PCV for young broilers at various ages, but Odunsi *et al*. (2007) reported 24.5 – 29.0 % as the normal mean PCV range for broiler chickens. The PCV range in healthy domestic chickens was 22 – 35 % (Jain, 1993). In Nigeria, the mean PCV reported for domestic chickens ranged from 24.4 ± 0.3 to 36.5 ± 9.6 % (Oyewale, 1987; Oladele and Ayo, 1999; Oladele *et al*., 2000; Useh *et al*., 2005; Odunsi *et al*., 2007). The exotic and indigenous chickens had their mean values in the lower and upper limits, respectively. Oladele *et al*. (2007) reported a mean PCV of 25.5 ± 5.6 % with a lower limit of 20 % in the indigenous (backyard) chickens. Thai indigenous chickens had similar mean PCV (32.2 ± 4.5 %) with the Nigerian ones (Simarak *et al*., 2004). The exotic chickens had a PCV lower limit of 18 %, which was below the normal range, but their mean values compared with those reported by Odunsi *et al*. (2007).

The mean PCV of guinea fowls was higher than that of indigenous chickens, but recently Useh *et al*. (2005) did not report any difference between the PCV of indigenous chickens and guinea fowls. The mean PCV of the uninfected guinea fowls in this report (41.9 ± 6.3 %, n = 137) was higher ($P < 0.05$) than the mean (38.2 ± 9.6 %, n =50) reported by Useh *et al*. (2005). The infected guinea fowls had lower mean PCV (32.0 ± 5.8 %) than the uninfected ones, but the mean PCV of the infected ones was within the normal range (27 – 34 %) reported by Oke *et al*. (2003) and 28.4 ± 5.0 % to 38.2 ± 3.7 % reported by Onyeyili *et al*. (1991). Thus, a guinea fowl with low normal PCV may be harbouring *Plasmodium* sp infection, which may be responsible for an increased turnover of erythrocytes to maintain PCV at a level lower than normal for the individual.

In conclusion, *Plasmodium* sp infection was prevalent among the domestic chickens and guinea fowls in northeastern Nigeria, with infection rate increasing in the rainy periods of the year; and whereas *Plasmodium* infection of the chickens did not decrease their PCV, there was mild anaemia in infected guinea fowls.

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