ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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International Journal of Poultry Science 5 (12): 1128-1132, 2006
ISSN 1682-8356

Endoparasites and Associated Worm Burden of Captive and Free-Living Ostriches (*Struthio camelus*) in the Semi-Arid Region of North Eastern Nigeria

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Abstract: Endoparasites and associated worm burden of captive and free-living wild ostriches (*Struthio camelus*) in the semi arid, north-eastern part of Nigeria was investigated by random faecal sampling. The study involved a total of 100 ostriches consisting of 50 free-living in their natural habitat found at various sectors (Kwada, Jeltare, and Bulanjibia) of Chad Basin National Park and 50 others in captivity at the Sanda Kyarimi Park and from private owners within the metropolis. The ostriches belonging to the two groups were found to harbour a variety of helminth parasites such as *Strongyloides*, *Strongyle*, *Capillaria*, *Ascaridia spp.* and protozoan parasites such as *Eimeria spp.* Mean eggs per gram (epg) of faeces was 150±0.23 to 773±0.48 and oocyst counts per gram (opg) of faeces was 310 ± 0.34 to 393.33 ± 0.34 and were significantly ($P<0.05$) higher among captive ostriches as compared to the epg (150 ± 0.21 to 400 ± 0.38) and opg (225 ± 0.29 to 300 ± 0.23) among the free living ostriches found in their natural habitat. Similarly, 44 (88%) of the captive ostriches were infected with various parasites while 36 (72%) of the free living ostriches were equally infected. There was a 100% larval recovery with *Strongyloides* and *Libyostrongylus douglassii* . The effect of age on the prevalence of infection with various endoparasites revealed that the chicks (<12 months) had significantly ($P<0.05$) higher infection rates as compared to those of the adult ostriches (>12 months). Sex did not show any effect on the prevalence of infection. The significance of infection as well as control measures is discussed.

Key words: Captivity, free-living, semi-arid region, worm burden, ostriches, Nigeria

Introduction

Ostrich (*Struthio camelus*) is the largest and heaviest living bird and is the only bird with just two toes and sole representatives of the order *struthioniformes* (Alden *et al*., 1996). Ostriches produce red meat that is very similar in taste and texture to veal and beef (Du Preez, 1991; Anonymous, 1994). The meat has been reported to be of high protein, and low cholesterol than any other protein of animal origin (Shanawany, 1996). With increasing incidences of human heart associated problems in developing countries such as Nigeria, ostrich farming would be of importance not only in supplementing protein requirements of the growing population in the country, but also in providing abundant and cheaper supply of meat for people with specific nutritional requirements such as low cholesterol and low fat.

The economic importance of ostrich could not be overemphasized. The skin is considered as one of the most luxurious leathers, and even ranked at far with crocodile and snake skins (Anonymous, 1994; Mellet *et al*., 1996). The feathers are thick, durable and extremely soft; a variety of products such as shoes, bags, belts, purses, and jackets are manufactured from the feathers.

In Nigeria, ostriches are restricted mainly to Chingurmi Duguma sector of Chad Basin National Park, Sambisa Game Reserve and parts of Biu, Damboa, Gujba and Bursari local government areas of Borno and Yobe States (Mamza, 1996). Present population in the wild is largely reduced due to loss of habitats, hunting, and collections of eggs for souvenirs and through attempts at domestication (Mamza, 1996).

With increasing interest in ostrich farming in Nigeria and elsewhere in the world, it is important in every ostrich farmer's interest to acquire as much knowledge as possible on the needs of the birds and to meet these needs so that the risk of diseases is minimized (Mustapha, 2003). Most health problems in ostriches occur during the first three months of life with mortality ranging between 30-40% which is commonly accepted by many as normal (Deeming, 1999). Although there are several other factors that can affect ostrich farming and production, infectious and non-infectious diseases, and nutritional deficiencies are some of the major constraints to a viable ostrich farming (Hallam, 1992). Veterinary problems of ostrich farming and production such as endoparasitism which can negatively affect production need to be investigated especially in the arid north-eastern Nigeria, the natural habitat of the bird in the country.

Materials and Methods

Study area: The Sanda Kyarimi Park, located within Maiduguri metropolis and Sambisa Game Reserve; a

Table 1: Endoparasites and associated worm burden of captive ostriches (*Struthio camelus*) in Maiduguri Metropolis, Borno State, Nigeria

Location	Number examined	Parasites encountered	Number (%)	Mean (epg/opg) ± SD	Parasites Larvae recovered(%)
Sanda Kyarimi.	15	I) *Strongyloides spp.*	2 (13.33)	300 ± 0.33	*Strongyloides* (100)
Park Maiduguri		ii) *Ascaridia spp.*	2 (13.33)	150 ± 0.23	-
		iii) *Strongyle spp.*	3 (16.67)	275 ± 0.32	*Libyostrongylus douglassii* (100)
		iv) *Capillaria spp.*	2 (13.33)	460 ± 0.41	-
		v) *Eimeria spp.*	2 (13.33)	310 ± 0.34	-
		vi) None	6 (40.0)	None	-
G. R. A residents	16	I) *Strongyloides spp.*	2 (12.5)	775 ± 0.48	*Strongyloides* (100)
		ii) *Ascaridia spp.*	2 (12.5)	575 ± 0.41 -	
		iii) *Strongyle spp.*	3 (18.75)	633.3 ± 0.43	*Libyostrongylus douglassii* (100)
		iv) *Eimeria spp.*	3 (18.75)	393.33 ± 0.34	-
		v) None	9 (56.25)	None	-
Private individuals	19	I) *Strongyloides spp.*	4 (21.05)	525 ± 0.30 -	
		ii) *Eimeria spp.*	3 (15.79)	366.7 ± 0.25	*Strongyloides* (100)
		iii) None	14 (73.68)	None	
Total	50		44 (88)	433 ± 3.84	

sector of the Chad Basin National Park where this study was conducted are located in Maiduguri and Konduga Local Government Areas of Borno State respectively. Maiduguri is the capital and largest urban centre in Borno State. The Sanda Kyarimi Park has 36 different species representing over 300 animals and birds while the National park has 13 different species of animals. The state lies between latitude 11° 32' north and 11° 40' north and latitude 13° 20' East and 13° 25' East; and located between the Sudan savannah and sahel savannah vegetational zones, characterized by short rainy season of 3-4 months (June- September) followed by a prolonged dry season of more than 8 months duration where environmental conditions are not favourable for the development and survival of pre-parasitic stages of parasitic helminths (Udoh, 1981; Nwosu, 1995; Mbaya *et al*., 2006).

Sample collection and examination: The study involved a total of 100 ostriches, with 50 under captive conditions and 50 under free-range conditions. The study was conducted during several visits to the Sanda Kyarimi Park, private ostrich farms and the National Park between February and August 2005. Freshly passed faecal samples were randomly collected early in the morning during routine cleaning of the ostrich's enclosures in Sanda Kyarimi Park and the private farms. Faecal samples from the free living ostriches were also randomly collected but opportunistically as they were dropped. Samples were appropriately labelled according to sex and age. Plumage colour was used to identify the different sexes. Samples were subjected to the direct smear and floatation method. Egg and oocyst counts were determined by the modified McMaster technique using saturated sodium chloride as floating medium (Anonymous, 1977). Species identification was done by larval culture and recovery using the modified Baerman's technique (Anonymous, 1977). Identification of helminth ova, oocyst and infective larvae was done by standard parasitological techniques (Muller, 1973; Anonymous, 1977; Soulsby, 1982; Sloss *et al*., 1994).

Results

Parasites encountered and their ova, mean egg count per gram of faeces (epg) or mean oocyst count per gram of faeces (opg) and parasite larvae recovered in both captive and free-living ostriches are presented in Tables 1-2. The comparative representation in the prevalence of the various parasites encountered among the male and female ostriches and in different age groups (<12 months and >12 months) respectively are presented in Tables 3-4.

The mean faecal egg counts range from 150 ± 0.23 to 775 ± 0.48 and oocyst 310 ± 0.34 to 393.33 ± 0.34 were significantly ($p<0.005$) higher among the captive ostriches examined at the Sanda Kyarimi Park and private ostrich owners as compared to those found in the various sectors (Kwada, Jeltare and Bulanjibia) of the Chad Basin National Park. In these sectors, the mean faecal egg counts range from 150 ± 0.21 to 400 ± 0.38 while oocyst counts ranged from 225 ± 0.29 to 300 ± 0.23.

Strongyloides, Strongyle, Capillaria, Ascaridia and *Eimeria* species were the most common parasites encountered in both captive and free-living ostriches. There was a 100% larvae recovery rate with *Strongyloides* larvae and *Libystrongylus douglassi* larvae in samples positive for *Strongyloides* and *Strongyle* ova respectively.

The younger ostriches less than 12 months of age had significantly ($p<0.05$) higher infection rates ranging from 2 (12.5%) to 8 (50%) as compared to those of the adult ostriches with infection rates ranging from 1 (2.94%) to 3 (8.82%) with various parasites in the Chad Basin National Park. Reverse was however the case among

Table 2: Endoparasites and associated worm burden of free-living wild ostriches *(Struthio camelus)* in various sectors of Chad Basin National Park, Maiduguri, Borno State, Nigeria

Location	Number examined	Parasites encountered	Number (%)	Mean (epg/opg) ± SD	Parasites larvae recovered (%)
Sector I (Kwada)	16	i) *Strongyloides spp.*	2 (12.5)	150 ± 0.21	*Strongyloides* (100)
		ii) *Strongyle spp.*	4 (25.0)	150 ± 0.21	*Libyostrongylus douglassii* (100)
		iii) None	10 (62.5)	None	None
Sector II (Jeltare)	19	i) *Strongyloides spp.*	4 (21.05)	237.5 ± 0.20	*Strongyloides* (100)
		ii) *Eimeria spp.*	2 (10.53)	300 ± 0.23	-
		iii) *Ascaridia spp.*	2 (10.53)	275 ± 0.21	-
		iv) None	11 (57.89)	None	None
Sector III (Bulanjibia)	15	i) *Ascaridia spp.*	2 (13.33)	275 ± 0.32	-
		ii) *Capillaria spp.*	2 (13.33)	400 ± 0.38	-
		iii) *Strongyle spp.*	2 (13.33)	275 ± 0.32	*Libyostrongylus douglassii* (100)
		iv) *Eimeria spp.*	2 (13.33)	225 ± 0.29	-
		v) *Strongloides spp.*	2 (13.33)	200 ± 0.27	*Strongyloides* (100)
		vi) None	11 (73.33)	None	
Total	50		36 (72)	248.75 ± 2.64	

the captive ostriches. The effect of sex on the prevalence of endoparasitism in both captive and free-living ostriches did not show a significant ($p>0.05$) pattern or effect.

Discussion

All the parasites recovered from the captive and free-living ostriches (*Struthio camelus)* with the exception of *Libystrongylus douglassi* are common in domestic fowls in Nigeria (Fabiyi, 1980; Natiti, 1988).

This study has shown that the captive ostriches kept in the Sanda Kyarimi Park, those belonging to private individuals and those living in their natural habitat in Chad Basin National Park harbour infections with a variety of helminth and protozoan parasites. These parasites, though recorded for the first time in the arid north-eastern Nigeria have been recorded elsewhere (Brunning and Dolensek, 1990; Foggin, 1992). The occurrence of the pathogenic 'wire worm' *Libyo strongylus douglassi* for the first time in both captive and free-living ostriches examined during the study might be of serious concern to ostrich farmers in Nigeria. This nematode has been reported to cause severe lesions in the stomach of ostriches leading to high mortality rates among ostrich chicks (Foggin, 1992; Mushi *et al.,* 2003; Mustapha, 2003; Lordman and Bronneberg, 2004). The nematode might likely be the major cause of the high mortality rate among ostrich chicks as experienced by most ostrich farmers in Nigeria.

Eggs and oocyst counts were generally low among the free-living ostriches than those found among the captive ostriches. This is consistent with earlier reports among captive and free-living wild animals in Borno State, Nigeria (Mbaya *et al.,* 2006). This pattern of infection was attributed to the fact that the semi and arid region of Borno State where the Chad Basin National Park is located with its sparse vegetation of mainly *Accacia albida* with ambient temperature over 45^{0}C is characterized by short rainy season of 3-4 months followed by a prolonged dry period of over 8 months (Udoh, 1981; Nwosu, 1995; Mbaya *et al.,* 2006). During the extended dry season, the development, survival and translocation of pre-parasitic stages of nematodes do not pertain in the environment (Nwosu, 1995; Mbaya *et al.,* 1999).

Results from the present study have shown that captive ostriches kept by private individuals had higher worm burden as compared to those kept under similar conditions of captivity at the Sanda Kyarimi Park. Contact with other species of birds is common among ostriches kept by private individuals. Most of the ostriches were not completely confined as other species of birds and domestic poultry had been observed in and around the ostrich enclosures. Other possible reasons could be due to the lack of reliable history of strategic anthelmintic medication in the ostriches as well as poor sanitary conditions and faulty management practices in the private farms, whereas the reverse was the case in the Institutional Sanda Kyarimi Park which is owned and managed by the State Government. The Park has a team of veterinarians who provide veterinary care.

Among the free-living ostriches examined in various sectors of the Chad Basin National Park, sector III (Bulan Jibia) had more variety of endoparasites with higher epg as compared to the other sectors (Kwada and Jaltere). This might be due to the fact that sector III, located on the Eastern border of the Park is closer to the village (Bulan Jibia) from which the sector derived its name. During the study period, village chickens belonging to the villagers were often noticed roaming in search for food. Hence, it is possible for ostriches in the sector to pick up infections from the village chickens or *vice versa*. Mode of transmission could therefore be established to have been occurring between free-living wild animals and domestic stock around the borders of the Chad Basin National Park (Mbaya *et al.,* 2006).

Table 3: Comparison of the prevalence of endoparasites of free-living and captive ostriches (*Struthio camelus)* in different sex groups in Chad Basin National Park and Maiduguri Metropolis, Borno State, Nigeria.

Location	Sex	Number examined	Parasites encountered	Number (%)
(A) Chad Basin National Park (Free-living)	(a) Male	29	i) *Ascaridia* spp.	3 (10.34)
			ii) *Strongyloides* spp.	7 (24.13)
			iii) *Eimeria* spp.	2 (6.89)
			iv) *Capillaria* spp.	1 (3.45)
			v) *Strongyle* spp.	4 (13.79)
			vi) None	21 (72.41)
	(b) Female	21	i) *Eimeria* spp.	2 (9.52)
			ii) *Strongyloides* spp.	2 (9.52)
			iii) *Strongyle* spp.	2 (9.52)
			iv) *Capillaria* spp.	1 (4.76)
			v) *Ascaridia* spp.	1 (4.76)
			vi) None	16 (76.19)
Total		50		
(B) Maiduguri Metropolis (captivity)	a) Male	25	i) *Strongyloides* spp.	5 (20)
			ii) *Capillaria* spp.	1 (4)
			iii) *Eimeria* spp.	6 (24)
			iv) *Strongyle* spp.	3 (12)
			v) *Ascaridia* spp.	2 (8)
			vi) None	10 (40)
	b) Female	25	i) *Ascaridia* spp.	2 (8)
			ii) *Eimeria* spp.	2 (8)
			iii) *Strongyloides* spp.	3 (12)
			iv) *Capillaria* spp.	1 (4)
			v) None	17 (68)
Total		50		

Table 4: Comparison of the prevalence of endoparasites of free-living and captive ostriches (*Struthio camelus)* in different age groups in Chad Basin National Park and Maiduguri Metropolis, Borno State, Nigeria

Location	Age	Number examined	Parasites encountered	Number (%)
(A) Chad Basin National Park (Free-living)	(a) Young (chicks) (<12months)	16	i) *Strongyle* spp.	3 (18.75)
			ii) *Strongyloide* spp.	6 (37.5)
			iii) *Eimeria* spp.	3 (18.75)
			iv) *Ascaridia* spp.	2 (12. 50)
			vi) None	8 (50)
	(b) Adults (>12months)	34	iI) *Ascaridia* spp.	2 (5.88)
			ii) *Capillaria* spp.	2 (5.88)
			iii) *Strongyloides* spp.	2 (5.88)
			iv) *Strongyle* spp.	3 (8.82)
			v) *Eimeria* spp.	1 (2.94)
			vi) None	29 (85.29)
Total		50		
(B) Maiduguri Metropolis (captivity)	a) Young (chicks) (<12months)	21	i) *Ascaridia* spp.	4 (19.05)
			ii) *Eimeria* spp.	6 (28.57)
			iii) *Strongyloides* spp.	4 (19.05)
			iv) None	12 (57.14)
	b) Adults (>12months)	29	i) *Strongyle* spp.	5 (17.24)
			ii) *Strongyloides* spp.	4 (13.79)
			iii) *Capillaria* spp.	3 (10.34)
			iv) *Eimeria* spp.	2 (6.89)
			v) None	17 (58.62)
Total		50		

Comparison of the prevalence of endoparasites among different sex groups in the captive or free-living ostriches did no show any significant ($p>0.05$) statistical difference. The effect of age on the prevalence of infection among captive and free-living ostriches in the Chad Basin National Park, however, showed that chicks (<12 months) had a higher ($p<0.05$) prevalence of infection as compared to the adult ostriches in the same park. This could be due to age susceptibility and lack of premunity in the young as compared to adults (Soulsby, 1982).

The importance of this study lies with the fact that it is the first to be undertaken among captive and free-living ostriches in this part of the country which is the only

natural habitat of the ostrich (*Struthio camelus*) in Nigeria.

In conclusion, results from this study highlights the need to protect ostriches under various forms of intensification procedures particularly chicks during the most susceptible period of life. Protection could be in the form of early and sustained anthelmintic prophylaxis for both chicks and adults. The maintenance of good sanitary conditions in ostrich farms, avoidance of contact with domestic species of birds and zoological gardens with balanced nutrition may supplement the above control measures.

Acknowledgement

The authors are grateful to staff of Borno State Wildlife Unit, Sanda Kyarimi Park and Chad Basin base camp for cooperation and assistance during the study.

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