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Gastrointestinal Helminths of Local Chickens (*Gallus gallus domesticus* Linnaeus) and Guinea Fowls (*Numida meleagris galeata* Pallas) Slaughtered in Maiduguri, Nigeria

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ABSTRACT

Free-range birds are exposed to a diverse array of parasitic infections during scavenging. For an effective control, confirmation of their presence is important. The gastrointestinal (GI) parasites of chickens and guinea fowls slaughtered for human consumption in Maiduguri, Nigeria was surveyed. Of the 210 of chickens and guinea fowl gastrointestinal tracts (GIT) examined, there were nematode ova in 41.9%. There were ova in 84.5% of the guinea fowl tracts examined while ova were found in only 25.7% of the local chickens ($p<0.05$). Guinea fowls were 15.8 times more likely to be infected than local chickens. Nematode ova identified were *Ascaridia galli* (84.1%), *Subuluru brumpti* (21.6%), *Heterakis gallinarum* (15.9%) and *Strongyloides avium* (1.1%). The prevalence of nematode ova was higher in female birds (48.6%) than male (34.9%). A total of 30.5% of the samples had adult cestodes. They were significantly more numerous ($p<0.05$) in local chickens (40.1%) than guinea fowls (5.2%). *Raillietina* specie were significantly more prevalent ($p<0.05$) than *Hymenolepis* and *Choanotaenia*. Male birds were 2.42 times more likely to be infected than females. Prevalence of adult nematodes was 37.6%, comprising of *Ascaridia galli*, *Subulura brunpti* and *Heterakis gallinarum*. Guinea fowls were 13.82 times more likely to be infected than local chickens. It was concluded that guinea fowls were more likely to be infected with GI helminths than local chickens. Significantly more nematode *(Ascaridia galli*) ova and adult were found in female birds than male. While adult cestodes (*Raillietina)* were significantly more numerous in local chickens than guinea fowls with males twice more likely to be infected than females.

Keywords: Gastrointestinal Helminths; *Gallus gallus domesticus; Numida meleagris galeata*; Maiduguri

INTRODUCTION

Poultry are birds such as chickens, ducks, guinea fowls, geese and turkeys domesticated for their meat, eggs and feathers, and they contribute to food security, poverty reduction, and ecological utilization of natural resources (Guéye, 2003). The traditional free-range production system accounts for large proportion of poultry populations and play a significant role in pest control and socio-economic functions in religious and traditional rituals (Mtileni *et al*., 2012; Maxwell *et al*., 2016; Mlondo *et al*., 2022). Regrettably, free-range chickens have poor productivity, veterinary care, improper housing and low economic returns (Saha, 2003).

Up to a 100% prevalence of GI helminthosis in free-ranging birds have been documented (Permin and Hansen, 1998; Maxwell *et al*., 2016), which included both single or mixed infections by cestodes, nematodes and/or coccidia (Puttalakshmamma, 2008; Marizvikuru and Patrick, 2011). The prevalence and intensity of these helminthoses could be influenced by factors of age, sex, breed and climate change (Magwisha *et al*., 2002).

Gastrointestinal helminthes are of global concerns in poultry production due to their effects on the health, production and welfare of the birds (Shifaw *et al*., 2021; Makalo *et al*., 2022). As part of efforts to meet the protein needs of populace in sub-Saharan Africa, as well as complement income from the sales of free-range poultry flocks, there is a renewed effort to ensure the health of these birds by controlling GI parasites. In Maiduguri, reports on the prevalence of GI parasites on the two different classes of poultry (local chicken and guinea fowl) have been reasonably studied by several workers in the past (Gadzama and Strivastava, 1986; Ahmed and Sinha, 1993; Biu and Etukwudo, 2004; Biu *et al.*, 2012; Atsanda *et al*., 2015). Therefore, this study was designed to provide updates on GI helminth parasites of free-range chickens and guinea fowls slaughtered for human consumption in Maiduguri, by examining the intestinal content for parasitic ova by floatation and the morphological identification of adult

worms (nematodes and cestodes) recovered from the intestinal tract after staining and mounting. Additionally, our study also determines the influence of age, sex and avian type on the occurrence of these parasites within the study area.

MATERIALS AND METHODS

Study Design and Sample Collection

This study was carried out in Maiduguri, Nigeria. Purposive sampling technique was used and samples collected at slaughtered birds in Monday market, Baga road, and Custom/Abbaganaram live bird market. Samples were collected daily for five weeks between November 2021 and January, 2022. Fresh complete GIT of 58 slaughtered guinea fowls and 152 chickens were obtained. Samples were immediately transported on ice to the Department of Veterinary Parasitology and Entomology laboratory, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria.

Sample Processing

Each GIT was cut open with the aid of a sharp pair of scissors, and placed in a Petri dish containing normal saline, then drawn firmly several times between the fingers to slip off all of its contents. Each Petri dish was examined for parasites, and adult worms visible to the naked eyes were isolated and washed by shaking in normal saline. Thereafter, they were picked with forceps, preserved in 10% formalin, and later identified using the keys of Soulsby, (1982) and Kaufmann, (1996).

Examination and Identification of Helminths Ova

The saturated sodium chloride (NaCl) floatation method was used to examine for helminths ova. Each of the intestinal content was dissolved in a universal bottle containing 10mls of floatation medium, and the mixture filtered through a double layer sieve into a separate universal bottle, more medium was added until meniscus was formed. A cover slip was placed gently on the universal bottle and allowed to stand for 10 minutes. The cover slip was then carefully removed and placed on grease free glass slide and examined for helminths ova under ×10 and ×40 objectives of the Olympus light microscope. Ova were identified as described by Soulsby, (1982)

Processing and Identification of Adult Helminths

Borax carmine was prepared by weighing two (2) grams of carmine and dissolving in 50 mL of distilled water and then heated in a water bath for 60 minutes, then allowed to cool. Alcohol solution (25% methanol) was prepared following standard procedure by adding 2.5 mL of absolute methanol to 7.5 mL of distilled water and allowed to stand for one hour. Similarly, 50% alcohol solution was also prepared by adding 5 mL of absolute methanol to 5 mL of distilled water and allowed to stand for one hour. Finally, 75% alcohol solution was prepared by adding 7.5 mL of absolute methanol to 2.5 mL of distilled water and allowed to stand for one hour. Adult helminths were soaked in the prepared borax carmine solution for 48 hours. Ascending grades of 25%, 50%, 75%, 100% alcohol were used to destain the specimen for 2 hours, which were then cleared using clove oil for 30 minutes. Each of the cleared specimens was then removed and placed on a clean glass slide and a drop of DPX mountant was added to each slide and covered with a cover slip. The mounted slides were then allowed to air dry and then viewed under stereoscopic microscope. Adult cestodes and nematodes were identified using taxonomic keys (Singh and Srivastava, 1977; Sloss and Kemp, 1978).

Data Analysis

Data were expressed as frequencies and percentages. Strength of association between prevalence, sex and age was determined using Chi-square test with "p-values equal to or less than 0.05 regarded as significant using Graph pad Prism version 5.

Ethical statement

Oral consent was duly sorted from the personnel involved in slaughtering and approval was given before the specimens were collected for further investigations in the laboratory.

RESULTS

The prevalence of nematode ova in slaughtered local chickens and guinea fowls in Maiduguri is shown in Table 1. Out of 210 GIT examined a prevalence of 88 (41.9%) was recorded, which was higher in guinea fowls with 84.5% (49/58) than local chickens 25.7% (39/152) ($p<0.05$). Guinea fowls were 15.8 times more likely to be infected than local chickens (OR= 15.77; 95% CI: 7.09-35.06). Nematode ova identified were those of *Ascaridia galli* (84.1%; 74/88), *Subuluru brumpti* (21.6%; 19/88), *Heterakis gallinarum* (15.9%; 14/88) and *Strongyloides avium* 1.1% (1/88) ($p<0.05$). Sex-wise prevalence of nematode ova was higher in female birds 48.6% (52/107) than male 34.95% (36/103) ($p<0.05$), and based on slaughter-point, Custom/abbaganaram market had a higher prevalence of 81.1%; 43/53 than Monday market (31.4%; 33/105) and Baga road market (23.1%; 12/52) ($p<0.05$). Table 2 shows the prevalence of adult cestodes in slaughtered guinea fowls and local chickens in Maiduguri. Adult cestodes had an overall prevalence of 30.5%; 64/210 represented as *Raillietina* spp. (40.6%; 26/64), *Hymenolepis* spp. (37.5%; 24/64) and *Choanotaenia* spp. 21.9% (14/64) ($p<0.05$). Local chickens had a higher prevalence (40.1%; 61/152) than guinea fowls (5.2%; 3/58) ($p<0.05$). Sex-wise male birds had a higher prevalence (39.8%; 41/103) than female (21.5%; 23/107) ($p<0.05$). Male birds were 2.42 times (OR=2.42, 95% CI= 1.32-4.43) more likely to be infected with adult cestodes compared with the female. Based on slaughter-point Monday market had a higher prevalence (41.9%; 44/105) than Baga road market (36.5%; 19/52), and Custom/abbaganaram market (1.9%; 1/53) ($p<0.05$).

Table 3 shows the prevalence of adult nematodes in slaughtered guinea fowls and local chickens in Maiduguri. An overall prevalence of 37.6%; 79/210 comprising of *Ascaridia galli* 62.0 % (49/79), *Subulura brunpti* 24.1% (19/79) and *Heterakis gallinarum* 13.9% (11/79) was recorded, and this was higher in guinea fowls 79.3% (46/58) than the local chickens 21.7% (33/152) ($p<0.05$). Guinea fowls were 13.82 times (OR=13.82; 95% CI 6.57-29.07) more likely to be infected with adult nematodes compared with local chickens. Sex-wise, females had a higher prevalence 42.1% (45/107) than male 33.0% (34/103) ($p>0.05$). Based on slaughter-point, Custom/ abbaganaram had a higher prevalence (77.4%; 41/53) than Monday market (25.7%; 27/105) and Baga road market (21.2%; 11/52) ($p<0.05$).

Table 1: Prevalence of Nematode ova in slaughtered guinea fowls and local chickens in Maiduguri

	No. Examined	No. (%) Infected	No. (%) Infected with Nematode Ova of:			
			Subuluru brumpti	*Ascaridia galli*	*Heterakis gallinarum*	*Strongyloides avium*
Species	210	88 (41.9)	19 (21.6)	74 (84.1)	14 (15.9)	1 (1.1)
Guinea fowl	58	49 (84.5)	13 (26.5)	43 (87.8)	5 (10.2)	0 (0)
Local Chicken	152	39 (25.7)	6 (15.4)	31 (79.5)	9 (23.1)	1 (2.6)
Sex						
Male	103	36(34.9)	12 (33.3)	30 (83.3)	4 (11.1)	0 (0)
Female	107	52 (48.6)	7 (13.5)	44 (84.6)	10 (19.2)	1 (1.9)
Slaughter point						
Baga Road Market	52	12 (23.1)	2 (16.7)	12 (100.0)	0 (0)	0 (0)
Monday Market	105	33 (31.4)	8 (24.2)	20 (60.6)	11 (33.3)	1 (0.3)
Custom/Abbaganaram Market	53	43 (81.1)	9 (20.9)	42 (97.7)	3 (6.9)	0 (0)

Table 2: Prevalence of adult Cestodes in slaughtered guinea fowls and local chickens in Maiduguri

	No. Examined	No. (%) Infected	No. (%) Infected with:		
			Raillietina spp.	*Hymenolepis* spp.	*Choanotaenia* spp.
Species	210	64 (30.5)	26 (40.6)	24 (37.5)	14 (21.9)
Guinea fowl	58	3 (5.2)	1 (33.3)	2 (66.7)	0 (0)
Local chicken	152	61 (40.1)	25 (40.9)	22 (36.1)	14 (22.9)
Sex					
Male	103	41 (39.8)	15 (36.6)	17 (41.5)	9 (21.9)
Female	107	23 (21.5)	11 (47.8)	7 (30.4)	5 (21.7)
Slaughter point					
Baga Road	52	19 (36.5)	8 (42.1)	6 (31.6)	5 (26.3)
Monday Market	105	44 (41.9)	17 (38.6)	18 (40.9)	9 (20.5)
Custom/Abbaganaram Market	53	1 (1.9)	1 (100.0)	0 (0)	0 (0)

Table 3: Prevalence of adult Nematodes in slaughtered guinea fowls and local chickens in Maiduguri

	No. Examined	No. (%) Infected	No. (%) Infected with:		
			Subulura brumpti	*Ascaridia galli*	*Heterakis gallinarum*
Species	210	79 (37.6)	19 (24.1)	49 (62.0)	11 (13.9)
Guinea fowl	58	46 (79.3)	13 (28.3)	31 (67.4)	2 (4.3)
Local chicken	152	33 (21.7)	6 (18.2)	18 (54.5)	9 (27.3)
Sex					
Male	103	34 (33.0)	11 (32.4)	18 (52.9)	5 (14.7)
Female	107	45 (42.1)	8 (17.8)	31 (68.9)	6 (13.3)
Slaughter point					
Baga Road Market	52	11 (21.2)	2 (18.2)	9 (81.8)	0 (0)
Monday Market	105	27 (25.7)	7 (25.9)	10 (37.0)	10 (37.0)
Custom/Abbaganaram Market	53	41 (77.4)	10 (24.4)	30 (73.2)	1 (2.4)

DISCUSSION

Both nematodes and cestodes have in this study been shown to afflict local chickens and guinea fowls, and are known worldwide as the major causes of helminthosis in domesticated free-range birds (Yoriyo *et al*., 2008; Biu *et al*., 2012; Nagwa *et al*., 2013; Atsanda *et al*., 2015). The prevalence rates of 41.9% for helminths ova with 30.5% for cestodes and 37.6% for nematodes in this study affirms the previous findings by Ahmed and Sinha, (1993); Biu and Etukwudo, (2004); Biu and Lillian, (2004); Yoriyo *et al.,* (2008); Biu *et al*., (2012) and Atsanda *et al*., (2015) in Maiduguri, and Fakae and Paul-Abiade, (2003); Luka and Ndams, (2007); Nnadi and George, (2010); Onyirioha, (2011); Offiong *et al*., (2013); Lawal *et al*., (2015[a and b]); Imam *et al*., (2017); Mera and Musa, (2017) and Jajere*et al*., (2018) in other parts of Nigeria. Both guinea fowls and local chickens were infected with similar species of helminths viz: *Raillietina*, *Choanotaenia*, *Hymenolepis*, *Ascaridia*, *Subulura*, *Heterakis* and *Strongyloides* species. This could be due to the fact that both avian types were raised under the same environment conditions of free-range management system hence were exposed to similar agents of infection (Attah *et al*., 2013).

In this study, generally there was no significant difference based on sex. This agrees with Biu *et al*., (1999) that host-parasite relationship does not vary much for indigenous breeds of fowls especially with sex, but nutritional status and the presence of intermediate hosts such as ants, houseflies, beetles, cockroaches and earthworms are the major determinants for infection.

The large chicken roundworm, *Ascaridia galli* was the most prevalent of all nematodes followed by *Subulura brumpti* and *H. gallinarum* in this study. Numerous surveys in Nigeria have reported *A. galli* as the most prevalent nematode of free-range domestic birds (Fakae and Paul-Abiade, 2003; Imam *et al*., 2017; Mera and Musa, 2017; Jajere *et al*., 2018; Yahaya *et al*., 2020). Similar observations were reported in many parts of the world such as Ethiopia (Abebe *et al*., 1997), India

(Puttalakshmamma *et al*., 2008), Germany (Kaufmann *et al*., 2011), Brazil (da Silva *et al*., 2016) and Lesotho (Makalo *et al*., 2022). *Ascaridia galli* is frequently associated with weight loss, low egg production and decreased feed conversion rates due to occlusion of the intestinal tract especially in heavy infections. *Railleitina* species of cestodes were most prevalent in this study. This agrees with Fakae *et al*. (1991) who opined that *Raillietina* is responsible for most cases of poultry helminthosis in rural free-range poultry in Nigeria.

Conclusion

This study has successfully documented the occurrence of gastrointestinal ova including *A. galli, S. brumpti, H. gallinarum* and *Strongyloides avium* with varying prevalence in free-range birds slaughtered in Maiduguri, Nigeria. Also, the prevalence of GI helminthes was higher in female birds and guinea fowls compared with male and local chicken respectively. Finally, three adult cestodes were identified namely *Raillietina* spp., *Hymenolepis* spp. and *Choanotaenia* spp. while *Subuluru brumpti*, *Ascaridia galli* and *H. gallinarum* were the adult nematodes identified.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contributions

EBK, TEO and AAB contributed to the design, analysis of data and drafting of the manuscript. EBK carried out field and laboratory work. CM and JL reviewed the manuscript. All authors read and approved the manuscript for publication.

REFERENCES

Abebe, W., Asfaw, T., Genete, B., Kassa, B. and Dorchies, P. H. (1997). Comparative studies of external parasites and gastro-intestinal helminths of chickens kept under different management systems in and around Addis Ababa (Ethiopia). *Revue de MedecineVeterinaire*, 148:497–500.

Ahmed, M. I. and Sinha, P. K. (1993). Prevalence of poultry helminthiasis in an arid-zone in Nigeria. *Indian Veterinary Journal*, 70: 703 - 704.

Atsanda, N. N., Jajere, S. M., Adamu, N. B., Lawal, J. R., Zango, M. K. and Chindo, M. B. (2015). Prevalence of helminth parasites of helmeted guinea fowl (*Numida meleagris galeata*) in Maiduguri, Northeastern Nigeria. *New York Science Journal*, 8(3): 93-97.

Attah, D. D., Danladi, Y. K., Abdullahi, K. and Ibrahim, S. (2013). A survey of gastrointestinal helminthes of chickens and guinea fowls slaughtered at Sokoto, Nigeria. *Equity Journal of Science and Technology*, 1(1): 1-5.

Biu, A. A. and Etukwudo, J. (2004). Cestodes of the guinea fowl (*Numida meleagridis galeata*) in Borno State, Nigeria. *Nigerian Journal of Experimental and Applied Biology*, 5: 21-28.

Biu, A. A., Rabo, J. S., Dawurung, J. S. and Lagu, A. A. (2012). Prevalence of nematodes of domesticated guinea fowl in Maiduguri, Nigeria. *New York Science Journal*, 5(3): 6-8.

Biu, A.A. and Lillian, O.D. (2004). Caecal nematodes of local chickens (*Gallus gallus domesticus*) slaughtered at Maiduguri central market. *Sokoto Journal of Veterinary Sc*ience, 6(1):21-23.

Biu, A.A., Yusufu, S.D. and Suleiman, B.A. (1999). The prevalence of intestinal helminthiasis among local breed of chicken (*Gallus gallus domesticus*) in Maiduguri, north-eastern Nigeria. *Journal of Life and Environmental Sc*ience, 1(1): 28-32.

da Silva, G. S., Romera, D. M., Fonseca, L. E. C. and Meireles, M. V. (2016). Helminthic parasites of chickens (*Gallus gallus domesticus*) in different regions of São Paulo State, Brazil. *Brazilian Journal of Poultry Science*, 18:163-168. doi.org/10. 1590/18069061-2015-0122

Fakae, B. B. and Paul-Abiade, C. U. (2003). Rainy season period prevalence of helminths in the domestic fowl (*Gallus gallusdomesticus*) in Nsukka, Eastern Nigeria. *Nigerian Veterinary Journal*, 24(1): 21-27.

Fakae, B. B., Umeorizu, J. M. and Orajaka, L. E. (1991). Gastrointestinal helminth infection of the domestic fowl (*Gallus gallus domesticus*) during the dry season in eastern Nigeria. *Revue de Zoologie Africaine*, 105(6): 503-508.

Gadzama, E. N., and Strivastava, G. C. (1986). Prevalence of Gastrointestinal Parasites of Market Chickens in Borno State. *Zaria Veterinarian*, *1*, 126-128.

Guèye, E. F. (2003). Gender issues in family poultry production systems in low-income food-deficit countries. *American Journal of Alternative Agriculture*, 18(4): 185-195.

Imam, T. S., Dambo, R., Said, M. A. and Suleiman, K. (2017). Detection of Gastro-Intestinal Helminthes in Local Chicken (*Gallus gallus domesticus*) Sold at Sharada Market, Kano Metropolis, Nigeria. *Journal of Dryland Agriculture*, 3(1): 19-27.

Jajere, S. M., Lawal, J. R., Atsanda, N. N., Hamisu, T. M. and Goni, M. D. (2018). Prevalence and burden of gastrointestinal helminthes among grey-breasted helmet guinea fowls (*Numida meleagris galeata*) encountered in Gombe State, Nigeria. *International Journal of Veterinary Science and Medicine*, 6(1): 73-79.doi.org/10.1016/j.ijvsm.2018.04.007.

Kaufmann, F., Daş, G., Sohnrey, B. and Gauly, M. (2011). Helminth infections in laying hens kept in organic free-range systems in Germany. *Livestock Science*, 141(2-3): 182-187.

Kaufmann, H. (1996). Parasitic Infections of Domestic Animals: *A Diagnostic Manual.Birkhäuser Verlag,* Basel; Pp. 353–354.

Lawal, J.R., Hambali, I.U., Jajere, S.M., Bello, A.M., Biu, A.A. and Musa, G. (2015[a]). Survey and prevalence of gastrointestinal nematodes in village chickens (*Gallus gallus domesticus*) slaughtered in Gombe metropolis poultry dressing slabs. *International Journal of Life Science and Research,* 3(4): 120-125.

Lawal, J.R., Hambali, I.U., Jajere, S.M., Bello, A.M., Biu, A.A. and Musa, G. (2015[b]). Survey and prevalence

of gastrointestinal cestodes in village chickens (*Gallus gallus domesticus*) slaughtered in Gombe metropolis poultry dressing slabs. *International Journal of Livestock Res*earch, 5(12): 21-27.

Luka, S. A. and Ndams, I. S. (2007). Gastrointestinal parasites of domestic chickens *Gallus gallus domesticus* Linnaeus 1758 in Samaru Zaria Nigeria. *Science World Journal*, 2 (1): 27–9.

Magwisha, H. B., Kassuku, A. A., Kyvsgaard, N. C. and Permin, A. (2002). A comparison of the prevalence and burdens of helminth infections in grower and adult free-range chickens. *Tropical Animal Health and Production*, 34: 205-214.

Makalo, M. J., Mtshali, K., Tsotetsi-Khambule, A. M., Mofokeng, L. S., Taioe, M. O., Onyiche, T. E. and Thekisoe, O. M. (2022). First report of gastrointestinal nematodes and coccidia parasites from free-range chickens in Mafeteng district, Lesotho. *Veterinary Parasitology: Regional Studies and Reports*, 36, 100798.

Marizvikuru, M. and Patrick, J. M. (2011). Point prevalence study of gastro-intestinal parasites in village chickens of Centane district, South Africa. *African Journal of Agricultural Research*, 6(9): 2033-2038.

Maxwell, O. N., Roseline, O. E., Daniel, O. O. and Cornelius, J. O. (2016). Haemoparasitism of Local and Exotic Chickens Reared in the Tropical Rainforest Zone of Owerri Nigeria. *Alexandria Journal for Veterinary Sciences*, 51(1):22-18.

Mera, U. M. and Musa, U. (2017). A survey of gastrointestinal helminthes of grey breasted helmet guinea fowls (*Numida meleagridis galeata* Pallas) in Sokoto,Nigeria. *Scientific Research Journal*, 5(2): 64-67.

Mlondo, S., Tembe, D., Malatji, M. P., Khumalo, Z. T. and Mukaratirwa, S. (2022). Molecular identification of helminth parasites of the *Heterakidae* and *Ascarididae* families of free-ranging chickens from selected rural communities of KwaZulu-Natal province of South Africa. *Poultry Science*, 101979. doi.org/10.1016/j.psj.2022.101979

Mtileni, B. J., Muchadeyi, F. C., Maiwashe, A., Chimonyo, M. and Dzama, K. (2012). Conservation and utilisation of indigenous chicken genetic resources in Southern Africa. *World's Poultry Science Journal*, 68(4): 727-748.

Nagwa, E.A., Loubna, M.A., El- Madawy, R.S. and Toulan, E.AI. (2013). Studies on helminthes of poultry in Gharbia Governorate. *Benha Veterinary Medical Journal* 25(2): 139-144.

Nnadi, P. A. and George, S. O. (2010). A cross-sectional survey on parasites of chickens in selected villages in the subhumid zones of South-Eastern Nigeria. *Journal of Parasitology Research*, 1-6. doi.org/10.1155/2010/141824

Offiong, E.E.A., Obioku, O.E., Umoh, J.U., Essien, C.A. and Idiong, N.B. (2013). A survey of gastrointestinal helminthes of local chickens in Abak Local Government Area of Akwa Ibom State, Nigeria. *International Journal of Science: Basic and Applied Research,* 9(1):1-4.

Onyirioha, J.N.N. (2011). Gastrointestinal helminthes fauna of native domestic fowl (*Gallus gallusdomesticus*) in Owerri area of Imo State, Nigeria. *Researcher* 3(1): 124-126.

Permin, A. and Hansen, J.W. (1998). *Epidemiology, diagnosis and disease control of poultry parasites*. FAO, Rome, Italy.

Puttalakshmamma, G. C., Mamatha, P. R. and Rao, S. (2008). Prevalence of gastrointestinal parasites of poultry in and around Banglore. *Veterinary World*, 1(7): 201. Doi:10.5455/vetworld.2008.201-202.

Saha, D. (2003). Status of Rural Poultry Production in North Parganas District of West Bengal. Doctoral Dissertation (Ph.D), Indian Veterinary Research Institute, India (IVRI).

Shifaw, A., Feyera, T., Walkden-Brown, S.W., Sharpe, B., Elliott, T. and Ruhnke, I. (2021). Global and regional prevalence of helminth infection in chickens over time: a systematic review and meta-analysis. *Poultry Science*, 100,101082. doi.org/10.1016/j.psj.2021.101082

Singh, S.K.R. and Srivastava, H.D. (1977). Diagnosis and treatment of helminth infections. Division of Parasitology, Indian Vet. Res. Inst., Izatnagar, Uttar Pradesh, India.

Sloss, M.W. and Kemp, L.R. (1978). *Veterinary Clinical Parasitology*, 5th ed. Iowa State University Press, Ames, Iowa, Pp. 45-55.

Soulsby, E.J.L. (1982). *Helminths, Arthropods and Protozoa of Domesticated Animals*. 7th ed. Bailliere Tindall, London. pp. 809.

Udoh, N. A., Luka, S. A. and Audu, P. A. (2014). Prevalence of gastrointestinal parasites of domestic turkey (Meleagris gallopavo Linnaeus 1758) slaughtered in Kaduna metropolis, Kaduna State, Nigeria. *Journal of Natural Sciences Research*, 4(7): 105-109.

Yahaya, A., Othman, S. A. and Muhammad, A. L. I. (2022). Gastrointestinal Helminths of Helmeted Guinea Fowls (*Numida meleagris*) Slaughtered at Garin Dau Market, Warawa Local Government Area, Kano State, Nigeria. *Biosciences Journal of Fudma*, 2(1): 85-93.

Yoriyo, K. P., Adang, K. I., Adamu, S. U. and Panda, S. M. (2008). Prevalence of gastrointestinal helminthes of free-range chickens and guinea fowls in Bauchi and its Environs. *Bulletin of Pure and Applied Science A*,27: 1-6