International Journal of Innovative Agriculture & Biology Research 4(4):27-36, Oct.-Dec., 2016

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Survey on Prevalence of Gastrointestinal Nematodes and Associated Risk Factors in Domestic Turkeys (*Meleagris Gallopavo*) Slaughtered in Poultry Markets in Bukuru – Jos, Plateau State, Nigeria

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ABSTRACT
This study aimed to determine the gastrointestinal nematodes in randomly selected turkeys slaughtered in Bukuru – Jos metropolis, Nigeria. An overall prevalence of 68.25% (n = 273) of the 400 turkeys examined for gastrointestinal nematodes was recorded in this study. Seven (7) nematode species were recovered from different predilection sites of infected turkeys of which *Ascaridia* species (26.75%) found in the small intestine was most prevalent nematode followed by *Capillaria* species (20.50%) which were found in the Oesophagus and small intestine, *Cheilospirura spinosa* (0.75%) was the least prevalent nematode and was found in the Gizzard of infected turkeys. There was statistical significant difference (df = 1; OR= 0.5232; $P<0.0001$) between young and adult turkeys and there was also statistical significant difference between male and female turkeys (df= 1; OR= 0.6835; $P= 0.0307$) using Chi-square at 95% confidence interval. Out of the 273 infected turkeys, 190 (47.50%) were infested with single species of nematode while 83 (20.75%) were infested with two or more species of nematodes. Worm Infestation with single nematode was significantly higher ($P<0.0001$) compared to mixed infestation of nematodes in infected turkeys (df= 1; OR= 0.4368; $P< 0.0001$). It is therefore concluded that domesticated Turkeys in Bukuru – Jos are harbouring different species of gastrointestinal nematodes of poultry origin which they can spread and as well maintain continuous cross infections to other healthy free range poultry species if they are not treated.
Keyword: Prevalence, gastrointestinal nematode, turkeys, markets, Bukuru-Jos, Nigeria

INTRODUCTION
Poultry production in Africa and parts of Asia is still distinctively divided into commercialized and village poultry production systems, each with its peculiarities for the purpose of meat and egg production (Nnadi and George, 2010; Opara *et al*., 2014; RanjbarBahadory *et al*., 2014). Poultry production specifically includes chickens, ducks, guinea fowl, turkey and ostrich. As the world human population is growing, the demand for protein of animal origin as a vital component of nutrients is very important.

Poultry production is the most efficient and economic means of meeting this demand; due to the relative small capital required to start off, the ease of feed availability and the fast maturity of the birds (Udoh *et al.*, 2014). Compared to other livestock species, fewer social and religious taboos are related to the production, marketing and consumption of poultry products in most developing countries of Africa including Nigeria (Onuorah and Ayo, 2003; Nam *et al.*, 2010; Saleshe *et al*., 2014). Poultry population in Nigeria composed of 84% local/indigenous and 16% exotic breeds. Of this, 52.3 million chickens, 7.6 million guinea fowls, 3.6 million ducks, 0.4 million turkeys and 1.2 million other birds which makes up subsistence poultry farming in the country (Adene and Oguntade, 2006; FAO, 2008).

Turkeys are large poultry birds, fast gaining popularity among peasant farmers in Nigeria due to their quick turn over rate, higher feed conversion rate and minimum land requirements. Although, turkey production enterprises has not been fully exploited in developing countries despite its greater potential than the chicken (Perez-Lara *et al.,* 2013). Turkey thrives better under arid conditions, more atmospheric heat tolerant, ranges farther and has higher meat quality compared to chickens (Yakubu *et al.,* 2013). Male turkeys are bigger in size and tend to be more expensive than the female turkeys (Ngu *et al*., 2014). However, the carcass of turkeys contains a higher amount of protein than the carcass of chicken (Oso *et al.,* 2008). They also have higher quality meat with low fat content. The meats of turkey are in many instances demanded by high ranked, rich or health challenged individuals in Nigeria (Udoh *et al*., 2014). Although, till now in most parts of Nigeria there has been no known discriminatory attitude towards the production and consumption of turkeys (Nwagu, 2002), but then they are scarce to find because they are seldom raised, and mostly as free range turkeys (Adene and Oguntade, 2006; Ngu *et al*., 2014). Domestic turkeys are omnivores, feeding on ground dwelling arthropods, molluscs and amphibians, vegetables, nuts, seeds and leaves (RanjbarBahadory *et al.*, 2014). Unfortunately, the turkey production system is hindered by many problems among which are various infectious diseases, this range from viral to bacteria and parasitic (Hafez, 2011; Wakawa *et al.*, 2014; Opara *et al*., 2014; Akanbi *et al*., 2015; Biu *et al.*, 2016).

Gastrointestinal helminth infections have an important role causing hidden economic losses in the production of poultry meat and eggs. Also, they may have particularly deleterious or debilitating effects on infected birds, especially the young birds (squabs), causing retarding growth, interfering with healthy development, and making older birds prone to secondary infections (Adang *et al.,* 2008). Multiple helminthiases is common in poultry that are kept extensively, while heavy infestation is common in intensively managed stock in which they cause weight loss, emaciation, anemia, diarrhea and economic losses such as decreased egg production and also affect other normal activities of the birds resulting to death in severe infections (Hogue *et al.,* 2014). Despite the importance of turkey in meeting the demand for animal protein, there is paucity of information on the effects of gastrointestinal nematodes on the domestic turkeys in Nigeria. Therefore, the current study was aimed to determine the prevalence and some risk factors associated with gastrointestinal tract nematodes and predilection sites of the parasites in turkeys slaughtered in live poultry markets in Bukuru-Jos, Plateau State Nigeria.

MATERIALS AND METHODS

Study area and Study period

Bukuru is located on the Jos Plateau in Nigeria. It was previously considered a separate city from the city of Jos close by, but like every other form of urbanization, the city of Jos has merged with the town of Bukuru to form the Jos-Bukuru metropolis. It is the headquarters of the Jos South Local Government Area. Bukuru is a populated place in Plateau State, Nigeria with the region font code of Africa/Middle East. The altitude of the area is located at an elevation of 1,237 meters above sea level and its population amounts to 171,672. Its coordinates are 9°48'0" N and 8°52'0" E in DMS (Degrees Minutes Seconds) or 9.8 and 8.86667 (in decimal degrees). The climate of the area is tropical continental with an annual rain fall of about 1,284mm. The rainy season commence from April to October while the dry season is from November to March. Most of the turkeys produced in Plateau State are raised under the extensive or semi-

intensive production system. However, there is increasing demand of turkey meat by high ranked individuals in Bukuru – Jos, Plateau State. The study was conducted from April to October, 2015. With consent from the poultry sellers, poultry markets/dressing slabs were visited in the morning at alternate days during the study periods.

Sample Size Determination

The desired sample size for the study was calculated using the equation described by Thrusfield (2005), since the exact prevalence of gastrointestinal nematodes of turkeys in the study area was not known; so to maximize the sample size it was supposed that the expected prevalence was 50%, absolute precision was 5% and the confidence level was set to be 95% as shown below,

$$n = \frac{1.96^2 \times pq\ (1-\ p\ exp)}{l^2}$$

Where, n= the required sample size, p = expected prevalence, q = 1 – p; and l= absolute precession, that is the largest acceptable differences between the true and the estimated prevalence.

As a result, 400 study populations were selected.

Determination of sex and age

Determination of sexes and ages of turkeys was carried out according to the characteristic described by Maikasuwa *et al*. (2014). Male turkeys are larger than female turkeys. The adult turkeys (tom) has long and sharp spur or small spike-shaped bumps on the legs that is visible from a moderate distance., beard of modified feathers running down the chest and the head is featherless. The adult female turkeys (hen) have neither spur on the legs nor beard of whiskers but possess feathers on top of the head. Male turkeys also have longer legs than female turkeys. Caruncles are fleshy growths on top of the head and snoods are fleshy growths hanging over the bill of the bird. Both sexes have these growths, but the snood of an adult male is usually somewhat larger than that of a female turkey. The female turkeys generally have gray-blue flesh that might be visible beneath the small feathers on their heads. Male turkeys have more brightly colored feathers. Females, on the other hand, have a duller, drabber appearance. More specifically, males can have feathers that have an iridescent red, green, copper, bronze, or gold sheen. Females have brown or gray feathers that lack iridescence.

Collection of samples

The study population comprised domestic turkeys brought for slaughter and dressing in three (3) live poultry markets and dressing slabs in Bukuru – Jos metropolis. Each turkey to be sample was randomly selected and physically examined for sex and age group before slaughter. With consent from the turkey owners, complete gastrointestinal tracts from slaughtered turkeys during dressings were collected at alternate days. The gastrointestinal tracts were collected in clean faecal sample bottles containing 10% formalin and label appropriately. The samples were transported in ice to the Parasitology Unit, National Veterinary Research Institute Vom, Plateau State, Nigeria for examination and identification of the parasites.

Sample Processing and Helminthology

In the laboratory, the gastrointestinal tracts were separated into different regions: the oesophagus, crop, gizzard, proventriculus, small intestine, large intestine and caecum. These regions were separately cut open using a dissecting Myoris scissors and the contents gently washed through fine sieve to trap parasites. All visible adult Nematode recovered from the different regions were picked with thumb forceps, washed in physiological saline and identified using standard procedure. The adult worms were mounted on glass slides using polyvinyl alcohol and identified directly under the stereomicroscope using the key characteristics described by Soulsby, (1982) and Permin and Nansen, (1998). The floatation method according to Soulsby, (1982) was used in the examination of the faecal samples for the detection

of helminthes. The faecal preparations were examined under the light microscope at X10 and X40 magnification.

Data analysis

Data obtained were subjected to GraphPad InStat3® (2003) for windows. The prevalence of the nematodes among infected Turkeys was calculated using frequencies and percentages. Chi-square was employed to determine whether there is association between the sex and infestation as well as age and infestation and their predilection sites. The observed prevalence and 95% confidence intervals (CI) were evaluated and "*P"* values equals to or less than 0.05 was regarded significant.

$$\text{Prevalence} = \frac{\text{Number of hosts infected}}{\text{Number of hosts examined}} \times 100$$

$$\text{Worm count intensity (\%)} = \frac{\text{Number of a parasite species in all infected hosts}}{\text{Number of hosts infected by parasites}} \times 100$$

RESULTS

Complete gastrointestinal tract of 400 domestic turkeys comprising of 247 adults and 153 young turkeys were collected from three poultry dressing slabs within Bukuru – Jos metropolis and were examined for the presence of nematodes. Out of which 254 are males and 146 are female turkeys. Out of the total number of turkey examined, 273(68.25%) were found to habour different species of gastrointestinal nematodes. Seven (7) nematode species were recovered in the examined visceral of the infected turkeys at different predilection sites. *Ascaridia* species (26.75%) was the most prevalent nematode and was recovered from the small intestine of infected turkeys; *Capillaria* species (20.50%) were found in the Oesophagus and small intestine, *Subulura brumpti* (8.50%) was found in the large intestine, *Heterakis gallinarum* (5.25%) were found in the Caecum, *Dispharynx nasuta* (4.0%) was found in the Proventriculus, *Strongyloides* species (2.50%) was also found in the small intestine and Caecum while *Cheilospirura spinosa* (0.75%) was the least prevalent nematode and was found in the Gizzard of infected turkey (Table 1).

Young (37.0%) turkeys had a significantly higher nematode infection rate ($P<0.0001$) compared to the adult turkeys (31.25%) (df = 1; OR= 0.5232; $P<0.0001$). Moreover, the infected males (49.0%) also showed a significantly higher nematode infection rate ($P= 0.0307$) compared to the infected female (19.25%) turkeys (df= 1; OR= 0.6835; $P= 0.0307$) (Table 2).

Out of the 273 infected turkeys, 190 (47.50%) were infested with single species of nematode while 83 (20.75%) were infested with two or more species of nematodes. Worm Infestation with single nematode was significantly higher ($P<0.0001$) compared to mixed infestation of nematodes in infected turkeys (df= 1; OR= 0.4368; $P< 0.0001$) (Table 3).

Table 1: Prevalence of gastrointestinal Nematodes in turkeys in Bukuru – Jos, Nigeria (N = 400)

Nematode species encountered	Number (%) of turkeys infected (N = 400)	Worm count Intensity (%)	Worm recovery predilection sites
Ascaridia species	107 (26.75)	2863 (46.17)	Small intestine
Heterakis gallinarum	21(5.25)	1007 (16.24)	Caecum
Dispharynx nasuta	16(4.0)	301 (4.85)	Proventriculus
Subulura brumpti	34 (8.50)	695 (11.21)	Large intestine
Capillaria species	82(20.50)	1126 (18.16)	Oesophagus; Small intestine
Strongyloides species	10 (2.50)	118 (1.90)	Small intestine; Caecum
Cheilospirura spinosa	3 (0.75)	91 (1.47)	Gizzard
Total	**273 (68.25)**	**6201 (100)**	

Table 2: Risk factors associated with prevalence of Nematodes infection in Turkeys in Bukuru – Jos, Nigeria (N = 400)

Risk Factors	Information	No. examined	No. positive	Prevalence (%)	95% CI L – U	*P-value*	OR	df
Age	Young	153	148	37.0[a]	0.3829 – 0.7148	*P*<0.0001	0.5232	1
	Adult	247	125	31.25[b]				
Sex	Male	254	196	49.0[a]	0.4898 – 0.9537	*P*= 0.0307	0.6835	1
	Female	146	77	19.25[b]				

Key:
NB: Columns with different superscripts are statistically significant (*P*<0.0001)
N= Total number of turkeys examined; CI= 95% Confidence Interval

Table 3: Prevalence of single and mixed infectivity of nematodes in infected turkey in Bukuru – Jos, Nigeria

Worm infectivity	Number examined (N= 400)	Number of turkeys infected (%)	95% CI L – U	*P*-value	OR
Single	400	190 (47.50)			
Mixed	400	83 (20.75)	0.3259 – 0.5855	*P*< 0.0001	0.4368
Total	**400**	**273 (68.25)**			

Key:
N= Number of turkeys examined

DISCUSSION

This present study is the first report of gastrointestinal nematodes infestation in domesticated turkey presented for slaughter and dressing in poultry dressing slabs within Bukuru metropolis and it revealed high prevalent rate of 68.25%. This finding is consistent with those of Opara *et al*. (2014) who reported the prevalence of 60.0% nematode species in turkeys from Southeastern Nigeria and Biu *et al*. (2016)

who also reported 60% nematode species in Northeastern Nigeria. However, 31.10% prevalent rate of nematode reported by Udoh *et al*. (2014) from Kaduna State is lower than those of this study. Poor sanitary condition, lack of proper hygiene and maintenance of strict biosecurity measures are among the major contributing factors to the high prevalence recorded in this study. Most village poultry farmers do not take caution about keeping their poultry shelters and surroundings clean. This predisposes the birds to serious infection including gastrointestinal parasites (Yakubu, 2013).

The high prevalence recorded in this study could be associated with the fact that domestic turkeys are left to scavenge for forages, seeds, insects and wide range of diet as well as contaminated soil that predispose them to parasitic infections under the extensive management system. Since the nematodes do not require intermediate hosts as other gastrointestinal helminthes such as cestodes, turkeys could get direct infection when they ingest contaminated feeds from the surroundings. This work is consistent with previous findings of Yoriyo *et al.* (2008); Ohaeri and Okwum, (2013) and Udoh *et al.* (2014) which indicates that nematodes are always the most prevalent gastrointestinal helminths and they establish themselves in their hosts faster compared to other gastrointestinal parasites in turkeys (Opara *et al*., 2014). Nematodes are mostly soil transmitted, their eggs can remain viable for a long period of time which enables free range turkeys to constantly pick up and swallow viable eggs from faecal droppings that contaminate the environment as they feed and this could increase worm burden (Ohaeri and Okwum, 2013). The occurrence of nematodes in the gastrointestinal tract of domestic turkeys could be one of the physiopathological effects that lead to high economic losses in the industry through meat condemnation and morbidity (Frantovo, 2000; Naem and Eskandari, 2005). This present study clearly shows that the nematodes of turkeys are not different from those of free-range chickens (Yoriyo *et al.*, 2008; Alam *et al*., 2014; Lawal *et al*., 2015), guinea fowls (Atsanda *et al*., 2015) and ducks (Adejinmi and Oke, 2011; Adang *et al.*, 2014; Paul *et al*., 2015) reported in some part of Northern Nigeria and Oates *et al.* (2005) and RanjbarBahadory *et al.* (2014) have reported the existence of similar nematodes in wild and naïve turkeys elsewhere. This finding may be due to the common practice of rearing turkey and other local breeds of poultry as mixed flock in most rural settings of Northern Nigeria (Yakubu, 2013; Udoh *et al*., 2014; Akanbi *et al*., 2015). This practice allows them to share the same feeding and water sources as well as habitation which allow cross infection of various infectious disease including gastrointestinal helminths infestations (Adejinmi and Oke, 2011).

Amongst the nematode species recovered in the infected turkeys, *Ascaridia* species (26.75%) recovered from the small intestine was the most prevalent followed by *Capillaria* species (20.50%) which was found in the small intestine and oesopahgus of infected turkeys. This finding is consistent with those of Udoh *et al.* (2014) who reported 26.0% *Ascaridia* species in turkeys and Das *et al.* (2015) who have also reported the occurrence of these worms in turkey. However, the finding of this present study is lower than 60.0% *Ascaridia* species reported by Opara *et al.* (2014). This difference could be due to climatic conditions, incidence of the infective stages, seasonal variation and the period of sample collection.

The species specific prevalence of the parasites in this study revealed higher prevalence in young turkeys (37.0%) compared to adults (31.25%). This finding agrees with Biu and Monguno (2001); Biu *et al.* (2016) who have earlier observed that young turkeys are mostly affected by gastrointestinal parasites and they show severe clinical manifestation in heavy worm burden while adult may sustain worm infestation but serve as reservoir to maintain the continuous contamination of the environment and circulation of infection amongst poultry species on free range, which complicate adequate control measures.

Also, the result of this study revealed that gastrointestinal nematodes in male turkeys were significantly (P= 0.0307) higher than in female turkeys. This finding is consistent with those of Biu *et al.* (2016) who also reported significantly higher nematode infestation in male turkeys compared to the females in Maiduguri. This outcome could be due to the fact that female turkeys reduces their scavenging range during incubation period and rely more on feed supplement or remnants being served to them, thereby reducing the chances of acquiring infection. However, the male turkeys on the other hand can go far scavenging for food or courtship mates, thereby increasing the possibility of picking more parasitic eggs and getting infested (Adang *et al*., 2008).

Mixed infections with two or more species of gastrointestinal nematodes in infected turkey were common in this study but have lower prevalent rates compared to the single infection. The occurrence of *Ascaridia* species and *Capillaria* species in mixed infection was most encountered in this study. This may be attributed to the fact that domesticated turkeys brought to the poultry dressing slabs for slaughter are sourced from several areas of the state and have been reared under different management and husbandry systems. It has been reported that these two nematodes species are the most prevalent gastrointestinal nematodes of free range poultry species and been the cause of weight loss, diarrhea and economic losses in severe infections (Hogue *et al.*, 2014). Multiple or single worm infectivity might be attributed to the feeding preference of turkeys, favourable climatic conditions and rate of environmental contamination with viable worm eggs at a particular time which to a great extent can determine the establishment of mixed or single infection (Udoh *et al*., 2014).

Most of the nematodes recovered in this study were from the small intestine, these nematodes include *Ascaridia* species, *Capillaria* species and *Strongyloides* species. The small intestine continuously contain substrates such as optimum concentration of saline, glucose and other semi digested food which provide optimum environment for the biological maintenance and survival of the nematodes. Also, this predilection site generally favours absorption of nutrients through the body surface of the parasites (Adang *et al*., 2008). This might be attributed to the fairly developed digestive system of these nematodes that gives them greater chances of establishment of a host- parasite relationship. Moreover, nematodes such as *Subulura brumpti* and *Heterakis gallinarum* were restricted to the large intestine and caecum respectively. This finding supported those of Udoh *et al.* (2014) who also recovered same species of gastrointestinal nematodes from domesticated turkeys in Kaduna State. Few nematodes like *Cheilospirura spinosa* and *Dispharynx nasuta* were recovered from the Gizzard and proventriculus respectively despite low concentration of physiological substrates in these organs which may not support the existence of parasites as compared to the small intestine.

CONCLUSIONS

This current study revealed the presence of seven species of gastrointestinal nematodes with *Ascaridia* species and *Capillaria* species highly prevalent. These nematodes were recovered from different predilection sites in the infested turkeys which were sourced from different locations, brought for slaughter and dressed in Bukuru – Jos metropolis. It could therefore be concluded from this study that domesticated Turkeys in Bukuru – Jos are harbouring several gastrointestinal nematodes of poultry origin which they can spread and as well maintain continuous cross infections to other healthy free range poultry species if they are not treated. Thus, as precautionary measures it is necessary to regularly screen the faecal samples of turkeys to prevent contamination and spread of infection to healthy birds. It is also recommended that, small scale turkey farmers should be enlighten on the needs to routinely deworm their flocks using appropriate medication to reduce worm burden. Further research is suggested to assess the impact of these parasites on the health and production performance of turkeys including the cost effectiveness of control strategies.

ACKNOWLEDGEMENTS

The Authors wish to extend their hearty appreciations to the entire laboratory staff of the Veterinary Parasitology and Entomology Unit, National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria, for their technical assistance.

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